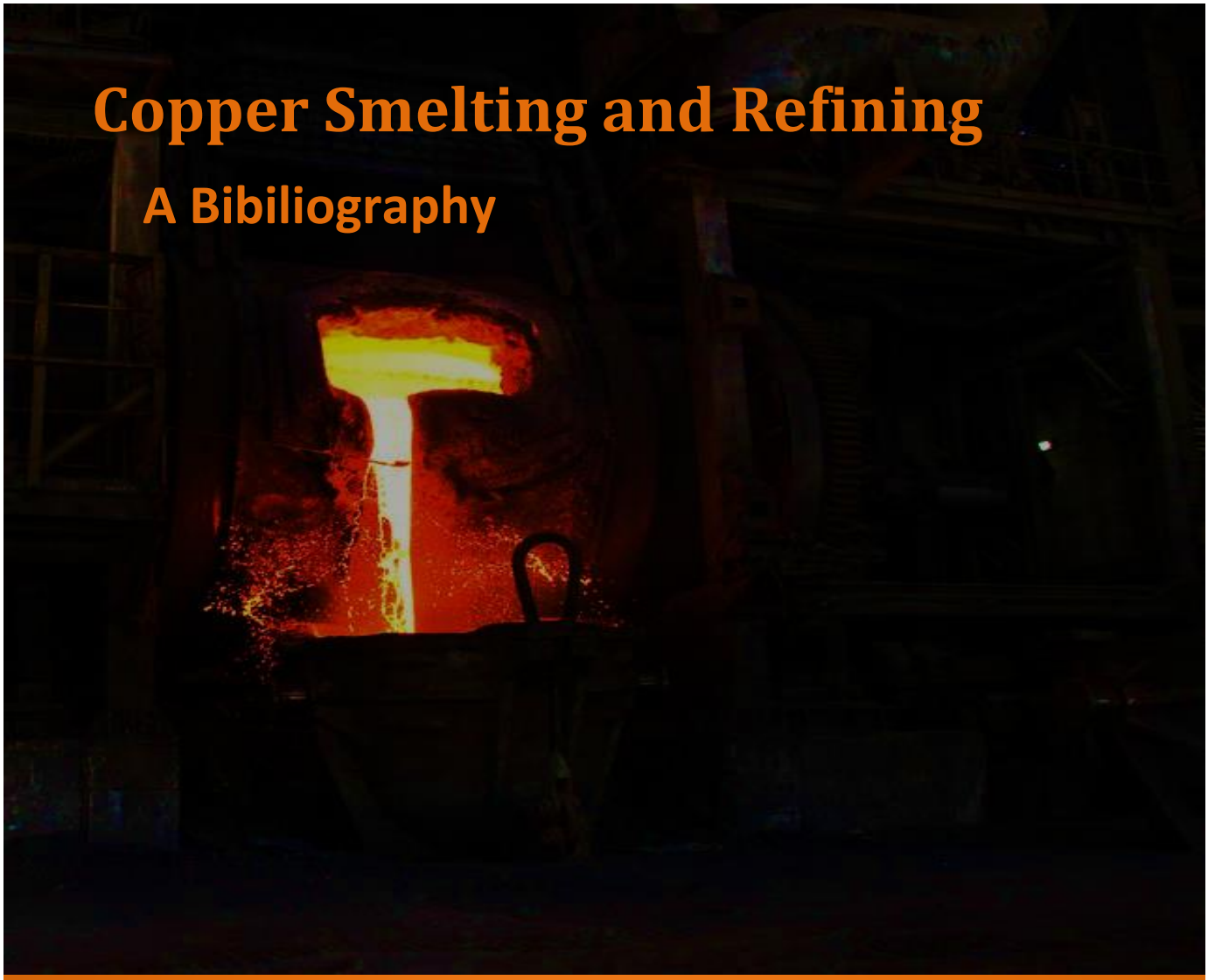
Copper Smelting and Refining

A Bibiliography



This bibliography has been compiled to provide process engineers with a comprehensive reference list covering credible sources in the field of copper smelting and electrorefining. Several topics will be discussed, including the two main processes and subprocesses' basic principles and technical aspects. The main focus is on smelting and refining. In addition to NICICO's determination to construct slag flotation and dust recovery plants, dust recovery and slag flotation are sub-processes.

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Preface

The demand for copper is increasing due to the growing electrification market, which is expected to double by 2035. Environmental, social, and governance (ESG) expectations are also increasing.

Since the mid-20th century, research has increased rapidly in the fields of copper smelting and refining and its various subfields. Finding appropriate and relevant literature on specified problems/topics would be best. There are thousands of relevant articles available. The question here is, how do you locate appropriate and relevant literature on specified problems/topics? The answer to this question is crucial. Keeping track of the thousands of research papers published worldwide is difficult, if not impossible.

This bibliography has been compiled to provide process engineers with a comprehensive reference list covering credible sources in the field of copper smelting and electrorefining. Several topics will be discussed, including the two main processes and subprocesses' basic principles and technical aspects. The main focus is on smelting and refining. In addition to NICICO's determination to construct slag flotation and dust recovery plants, dust recovery and slag flotation are sub-processes.

Generally, the order of chapters and their subchapters is derived from the sixth edition of the extractive metallurgy of copper. However, there are several differences regarding the book's intended goals.

The first chapter of this book presents the books, thesis, and articles one finds in the context of the pyrometallurgical processing of copper concentrates. It describes the fundamental thermodynamic aspects of pyrometallurgical copper processing. This chapter discusses flash smelting, electric slag cleaning furnace, copper matte conversion, anode fire refining, casting, analysis, sampling, and continuous refractories for copper smelting. Furthermore, it discusses energy and environmental, social, and governance (ESG) issues, as these frameworks are crucial to sustainable communities. Three subchapters in this paper provide insight into the process. These include bath smelting, the alternative to Pierce-Smith converters, and continuous copper production. Towards the end of this chapter, a list of sources about pyrometallurgical industrial processes is provided.

As a result of a comprehensive literature review of electrolytic refining principles, chapter 2 focuses on electrolytic refining of copper anodes. The chemistry of electrorefining, anodic dissolution, and impurities is discussed after a discussion of slime and electrolyte published papers. Optimizing the operation covered in the transport

phenomena subchapter of this chapter requires an understanding of the movement of ions, impurity particles, momentum, and energy associated with electrolytes in copper electrorefining cells. As well as anode casting's physicochemical quality, this chapter discusses cell and busbar design and its effects on operational efficiency. In addition, copper cathode purity, physical quality, anode casting, and physicochemical quality are discussed. As part of the second part of this article, primary sources will be discussed regarding the reduction of energy consumption and maximization of current efficiency, as well as interelectrode short circuits and other contributing factors. Two chapters examine value addition by treating bleed stream and anode slime. The final section discusses the latest developments and emerging trends in copper electrorefining.

Three sub-chapters in the third chapter discuss copper recovery from flow dust. The first section focuses on the chemical and mineralogical characterization of flow dust, the second on copper extraction, and the third on arsenic removal from flow dust.

Pyro vs. hydrometallurgical process, hydrometallurgical treatment, slag flotation, and copper slag as replacement material are the four topics covered in Chapter 4.

The materials of these 4 chapters are not adequate for a comprehensive understanding of the hydrometallurgical process of copper production. Hopefully, I will be able to complete this bibliography with other chapters focused on leaching, solvent extraction, and electrowinning.

Seyyed Mohammad Jvad Khorasani

2023 August 12

Contents

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Chapter 1

1 Pyrometallurgical processing of copper concentrates

1.1 Fundamental thermodynamic aspects associated with pyrometallurgical copper processing

01. Shishin, Denis, Ata Fallah Mehrjardi, Maksym Shevchenko, Taufiq Hidayat, and Evgueni Jak. "**Experimental study, thermodynamic calculations and industrial implications of slag/matte/metal equilibria in the Cu–Pb–Fe–O–S–Si system**." Journal of Materials Research and Technology 19 (2022): 899-912.

02. Tan, Pengfu, and Chuanfu Zhang. "**Thermodynamic analysis of copper smelting process**." processing of metals and advanced materials: modeling, design and properties (1998): 109-120.

03. Sridhar, R., J. M. Toguri, and S. Simeonov. "**Thermodynamic considerations in copper pyrometallurgy**." *JOM* 49, no. 4 (1997): 48.

04. Hills, A. W. D. "**Multiphase reaction systems in pyrometallurgy**." In Process Engineering of Pyrometallurgy: Proceedings of a Joint Meeting of the Institution of Mining and Metallurgy and the Institution of Chemical Engineers, p. 81. Institution of Mining and Metallurgy, 1974.

05. Shamsuddin, Mohammad. "**Sulfide Smelting**." In Physical Chemistry of Metallurgical Processes, Second Edition, pp. 69-106. Cham: Springer International Publishing, 2021.

06. Johto1, Hannu, and Pekka Taskinen. "**Stabilities of Phases in the Cu_2S-FeS-PbS System**." In International Smelting Technology Symposium: Incorporating the 6th Advances in Sulfide Smelting Symposium, pp. 205-211. Hoboken, NJ, USA: John Wiley & Sons, Inc., 2012.

07. Tan, Pengfu. "**Applications of Thermo-Chemical and Thermo-Physical Models in the Copper and Lead Pyrometallurgical Industries**." In AIP Conference Proceedings. American Institute of Physics, Ste. 1 NO 1 Melville NY 11747-4502 United States, 2012.

08. Shishin, Denis, Peter C. Hayes, and Evgueni Jak. "**Development and applications of thermodynamic database in copper smelting**." In Proceedings of the Copper 2019 Conference, vol. 2. 2019.

09. Prostakova, Viktoria, Denis Shishin, and Evgueni Jak. "**Thermodynamic optimization of the Cu–As–S system**." Calphad 72 (2021): 102247.

10. Pérez-Fontes, S. E., M. Pérez-Tello, Lizbeth Ofelia Prieto-López, Francisco Brown, and Felipe Castillón-Barraza. "**Thermoanalytical study on the oxidation of sulfide minerals at high temperatures**." Mining, Metallurgy & Exploration 24 (2007): 275-283.

11. Vázquez, M., I. Moreno-Ventas, I. Raposo, A. Palma, and M. J. Díaz. "**Kinetic evolution of chalcopyrite thermal degradation under oxidative environment**." Mining, Metallurgy & Exploration 37, no. 3 (2020): 923-932.

12. Vázquez, Marta, Ignacio Moreno-Ventas, Irene Raposo, A. Palma, and M. J. Díaz. "**Kinetic of pyrite thermal degradation under oxidative environment**." Journal of Thermal Analysis and Calorimetry 141 (2020): 1157-1163.

13. Dong, Haidong, Shiwei Zhou, Yonggang Wei, Bo Li, and Hua Wang. "**Phase transformation and multiphase reaction properties of complex copper ore system under melting conditions**." Canadian Metallurgical Quarterly (2023): 1-13.

14. Rose, Thomas, Erica Hanning, and Sabine Klein. "**Smelting experiments with chalcopyrite ore based on evidence from the Eastern Alps**." Metalla 25, no. 2 (2020): 77-100.

15. Saxén, Henrik, Marco A. Ramírez-Argáez, Alberto N. Conejo, and Abhishek Dutta. "**Special Issue on "Process Modeling in Pyrometallurgical Engineering"**." Processes 9, no. 2 (2021): 252.

16. Flores, Gerardo Alvear, Carlos Risopatron, and Joe Pease. "**Processing of complex materials in the copper industry: challenges and opportunities ahead**." Jom 72, no. 10 (2020): 3447-3461.

17. Brimacombe, J. Keith, and Enrique O. Hoefele. "**Non-ferrous metal treatment**." U.S. Patent Application 06/447,805, filed August 26, 1986.

18. Chaubal, P. C., and H. Y. Sohn. "**Intrinsic kinetics of the oxidation of chalcopyrite particles under isothermal and nonisothermal conditions**." Metallurgical Transactions B 17 (1986): 51-60.

19. Schuhmann, R. "**A survey of the thermodynamics of copper smelting**." JOM 2 (1950): 873-884.

20. Johansen, Ernst-B., Terkel Rosenqvist, and Per Terje Torgersen. "**On the thermodynamics of continuous copper smelting**." JOM 22, no. 9 (1970): 39-47.

21. Jaervi, J., Tapio Ahokainen, and Ari Jokilaakso. "**Developments in kinetic modelling of chalcocite particle oxidation**." (1997).

22. Semrau, Konrad T. "**Sulfur oxides control and metallurgical technology**." JOM 23 (1971): 41-47.

23. Alvear Flores, G. R. F., M. Löbbus, B. Springub, A. Fallah-Mehrjardi, and A. Tappe. "**Sulfide Smelting: Thirty-Five Years of Continuous Efforts to Find New Value Adding Solutions**." In Extraction 2018: Proceedings of the First Global Conference on Extractive Metallurgy, pp. 39-56. Springer International Publishing, 2018.

24. Nakamura, T., and J. M. Toguri. "**Interfacial phenomena in copper smelting processes**." Copper 91(Cobre 91) (1991).

25. Pound, G. M., G. Derge, and G. Osuch. "**Electrical conduction in molten Cu-Fe sulphide mattes**." JOM 7 (1955): 481-484.

26. Vadasz, P., K. Tomasek, and M. Havlik. "**Physical properties of FeO-Fe_2O_3-SiO_2-CaO melt systems**." Archives of Metallurgy 46, no. 3 (2001): 279-291.

27. Yazawa, Akira. "**Thermodynamic evaluations of extractive metallurgical processes**." Science reports of the Research Institutes, Tohoku University. Ser. A, Physics, chemistry and metallurgy 29 (1980): 149-149.

28. Chen, chunlin, ling zhang, and sharif jahanshahi. "**Thermodynamic modeling of arsenic in copper smelting processes**." metallurgical and materials transactions b 41, no. 6 (2010): 1175-1185.

29. Shishin, denis, taufiq hidayat, jiang chen, peter c. Hayes, and evgueni jak. "**Integrated experimental study and thermodynamic modelling of the distribution of arsenic between phases in the Cu-Fe-OS-Si system**." the journal of chemical thermodynamics 135 (2019): 175-182.

30. Itagaki, kimio, and akira yazawa. "**Thermodynamic evaluation of distribution behaviour of arsenic in copper smelting**." transactions of the japan institute of metals 23, no. 12 (1982): 759-767.

31. Jak, evgueni. "**Integrated experimental and thermodynamic modelling research methodology for metallurgical slags with examples in the copper production field**." in proceedings of ix international conference on molten slags, fluxes and salts, p. 77. Chinese society for metals beijing, china, 2012.

32. Jak, e., b. Zhao, and p. Hayes. "**Phase equilibria in the system Feo–Fe_2O_3–Al_2O_3–CaO–SiO_2 with applications to non-ferrous smelting slags**." mineral processing and extractive metallurgy 117, no. 3 (2008): 147-152.

33. Kucharski, m., w. Ip, and j. M. Toguri. "**The surface tension and density of Cu_2S, FeS, Ni_3S_2 and their mixtures**." canadian metallurgical quarterly 33, no. 3 (1994): 197-203.

34. Li, h., and w. J. Rankin. "**Thermodynamics and phase relations of the Fe-OS-Si_2 (sat) system at 1200° c and the effect of copper**." metallurgical and materials transactions b 25 (1994): 79-89.

35. Sundström, a. W., j. J. Eksteen, and g. A. Georgalli. "**A review of the physical properties of base metal mattes**." journal of the southern african institute of mining and metallurgy 108, no. 8 (2008): 431-448.

36. Ramachandra, v. "**Primary copper production–a survey of operating world copper smelter, copper pyrometallurgy of copper book, copper 2003**." met. Soc (2003).

37. Shishin, denis, evgueni jak, and sergei a. Decterov. "**Thermodynamic assessment of slag–matte–metal equilibria in the Cu-Fe-OS-Si system**." journal of phase equilibria and diffusion 39 (2018): 456-475.

38. Shishin, denis, taufiq hidayat, ata fallah-mehrjardi, peter c. Hayes, sergei a. Decterov, and evgueni jak. "**Integrated experimental and thermodynamic modeling study of the effects of Al_2 O_3, CaO, and MgO on slag–matte equilibria in the Cu-Fe-OS-Si-(Al, Ca, Mg) system**." journal of phase equilibria and diffusion 40 (2019): 445-461.

39. Xia, longgong, zhihong liu, and pekka antero taskinen. "**Equilibrium study of the Cu–O–SiO_2 system at various oxygen partial pressures**." the journal of chemical thermodynamics 98 (2016): 126-134.

40. Taskinen, pekka. "**Industrial use of thermodynamic simulations in pyrometallurgy**." in aip conference proceedings, vol. 1805, no. 1, p. 020001. Aip publishing llc, 2017.

41. Fagerlund, K. O., and H. Jalkanen. "**Some aspects on matte settling in copper smelting**." In Fourth International Conference Copper 99-Cobre, vol. 99, pp. 539-551. 1999.

42. Rumbu, Roger. **Non-Ferrous Extractive Metallurgy-Industrial Practices**. Lulu. com, 2015.

43. Avarmaa, katri, lassi klemettinen, pekka taskinen, daniel lindberg, jouni pihlasalo, hannu johto, and ari jokilaakso. "**Utilization of scrap metals as reductants for improved Ni and Cu recoveries in copper smelting**." journal of sustainable metallurgy (2022): 1-17.

44. Roselló, a., j. Martínez, and f. Carrillo. "**A kinetic comparison between laboratory and industrial scales in the copper blowing process**." journal of metallurgy 2009 (2009).

1.1.1 The Yazawa diagram and pyrometallurgical copper processing

45. Takeda, Yoichi, Gabriel Riveros, Yong-Jin Park, and Akira Yazawa. "**Equilibria between liquid copper and soda slag.**" Transactions of the Japan institute of metals 27, no. 8 (1986): 608-615.

46. Yazawa, Akira. "**Extractive Metallurgy of Non-Ferrous Metals**." JIM, Sendai, Japan (1980): 276.

47. Yazawa, Akira. "**Thermodynamic evaluations of extractive metallurgical processes**." (1979): 307-321.

48. Yazawa, Akira, Shigeatsu Nakazawa, and Youichi Takeda. "**Distribution behavior of various elements in copper smelting systems**." Advances in Sulfide Smelting, 1 (1983): 99-117.

49. Yazawa, Akira, and Takeshi Azakami. "**Thermodynamics of removing impurities during copper smelting.**" Canadian Metallurgical Quarterly 8, no. 3 (1969): 257-261.

1.1.2 Smelting: the first processing step

1.1.2.1 Matte

50. in_liang, W. A. N. G., Lu Hong, and Z. E. N. G. Qing_yun. "**Application of GA_BP to the Matte Grade Model Based on Neural Network**." 有色金属科学与工程 17, no. 3 (2003): 39-42.

51. Nagamori, M., W. J. Errington, P. J. Mackey, and D. Poggi. "**Thermodynamic simulation model of the isasmelt process for copper matte**." Metallurgical and Materials Transactions B 25 (1994): 839-853.

52. Johnson, Elizabeth Ann. **Minor-element interactions in copper matte smelting**. Vol. 8874. United States Department of the Interior, Bureau of Mines, 1984.

53. Nagamori, M. "**Thermodynamic behaviour of arsenic and antimony in copper matte smelting-a novel mathematical synthesis**." Canadian metallurgical quarterly 40, no. 4 (2001): 499-522.

54. Matousek, J. W. "**The Thermodynamic properties of Copper mattes**." JOM 61, no. 10 (2009): 61.

55. Kaiura, G. H., and J. M. Toguri. "**Natural convective mass transfer rates between solid magnetite and molten mattes**." Metallurgical Transactions B 10 (1979): 595-606.

56. Sohn, H. S., Y. Fukunaka, T. Oishi, H. Y. Sohn, and Z. Asaki. "**Kinetics of As, Sb, Bi and Pb volatilization from industrial copper matte during Ar+ O 2 bubbling**." Metallurgical and materials transactions B 35 (2004): 651-661.

57. Tan, P., and C. Zhang. "**Effect of matte grade upon distribution behaviors of accessory elements in fayalite-slag-making and ferrite-slag-making processes for copper smelting**." Huagong Yejin(Engineering Chemistry and Metallurgy)(China) 19, no. 2 (1998): 166-169.

58. Ip, S. W., and J. M. Toguri. "**Entrainment behavior of copper and copper matte in copper smelting operations**." Metallurgical and Materials Transactions B 23 (1992): 303-311.

59. Cheng, Xiangfeng, Zhixiang Cui, Leonel Contreras, Mao Chen, Anh Nguyen, and Baojun Zhao. "**Matte entrainment by SO_2 bubbles in copper smelting Slag**." Jom 71 (2019): 1897-1903.

60. Elliott, J. F., and M. Mounier. "**Surface and interfacial tensions in copper matte-slag systems, 1200 C**." Canadian Metallurgical Quarterly 21, no. 4 (1982): 415-428.

61. Fagerlund, Kim O., and Heikki Jalkanen. "**Microscale simulation of settler processes in copper matte smelting**." Metallurgical and Materials Transactions B 31 (2000): 439-451.

62. Asaki, Z., S. Ando, and Y. Kondo. "**Oxidation of molten copper matte**." Metallurgical Transactions B 19 (1988): 47-52.

1.1.2.2 Slag phase: FeO-Fe_2O_3-SiO_2 system

63. Nagamori, M., P. J. Mackey, and P. Tarassoff. "**Copper solubility in $FeO–Fe_2O_3–SiO_2–Al_2O_3$ slag and distribution equilibria of Pb, Bi, Sb and As between slag and metallic copper**." Metallurgical Transactions B 6 (1975): 295-301.

64. Mohamadi Nasab, Saeed, Behnam Shafiei Bafti, Mohamad Reza Yarahmadi, Mohammad Mahmoudi Maymand, and Javad Kamalabadi Khorasani. "**Mineralogical Properties of the Copper Slags from the SarCheshmeh Smelter Plant, Iran, in View of Value Recovery**." Minerals 12, no. 9 (2022): 1153.

65. Eguchi, Motonori, and Akira Yazawa. "**Equilibrium relations between copper, white metal and silica-saturated slag under controlled SO2 pressure**." Transactions of the Japan Institute of Metals 18, no. 4 (1977): 353-360.

66. Yazawa, Akira, Yoichi Takeda, and Yoshio Waseda. "**Thermodynamic properties and structure of ferrite slags and their process implications**." Canadian Metallurgical Quarterly 20, no. 2 (1981): 129-134.

67. Dańczak, Anna, Lassi Klemettinen, Hugh O'Brien, Pekka Taskinen, Daniel Lindberg, and Ari Jokilaakso. "**Slag chemistry and behavior of nickel and tin in black copper smelting with alumina and magnesia-containing slags**." Journal of Sustainable Metallurgy 7 (2021): 1-14.

68. Tan, Pengfu. "**Process Modeling and Reduction of Copper Loss in Smelting Slag**." Minerals, Metals and Materials Society/AIME, 420 Commonwealth Dr., P. O. Box 430 Warrendale PA 15086 United States.[np]. Feb (2011).

69. Tan, Pengfu. "**Modeling and Control of Copper Loss in Smelting Slag: Part I and Part II**." Minerals, Metals and Materials Society/AIME, 420 Commonwealth Dr., P. O. Box 430 Warrendale PA 15086 United States.[np]. Feb (2011).

70. Yusupkhodjayev, Anvar Abdullaevich, Shokhrukh Toshpulatovich Khojiev, and Javokhir Sobitjonovich Mamirkulov. "**The analysis of physicochemical properties of metallurgical molten slags**." In УПРАВЛЕНИЕ СОЦИАЛЬНО-ЭКОНОМИЧЕСКИМИ СИСТЕМАМИ: ТЕОРИЯ, МЕТОДОЛОГИЯ, ПРАКТИКА, pp. 12-15. 2017.

71. Hidayat, Taufiq, Jiang Chen, Peter C. Hayes, and Evgueni Jak. "**Distributions of As, Pb, Sn and Zn as minor elements between iron silicate slag and copper in equilibrium with tridymite in the Cu–Fe–O–Si system**." International Journal of Materials Research 112, no. 3 (2021): 178-188.

72. Zhao, Hongliang, Yadong Xiao, Fengqin Liu, and Hong Yong Sohn. "**Computational fluid dynamics simulation of gas–matte–slag three-phase flow in an ISASMELT furnace**." Metallurgical and Materials Transactions B 52, no. 6 (2021): 3767-3776.

73. Dosmukhamedov, N. K., and E. E. Zholdasbay. "**Distribution of non-ferrous metals, arsenic and antimony during plumbous slags sulfidizing impoverishment by copper-zinc concentrate**." Non-Ferrous Metals 2 (2016): 12-18.

74. Isaksson, Jenny, Tommy Vikström, Andreas Lennartsson, and Caisa Samuelsson. "**Influence of process parameters on copper content in reduced iron silicate slag in a settling furnace**." Metals 11, no. 6 (2021): 992.

75. Zhang, Sihai, Nengwu Zhu, Weiqing Shen, Xiaorong Wei, Fei Li, Weiwen Ma, Fulin Mao, and Pingxiao Wu. "**Relationship between mineralogical phase and bound heavy metals in copper smelting slags**." Resources, Conservation and Recycling 178 (2022): 106098.

76. Jalkanen, Heikki, Jouni Vehviläinen, and Jaakko Poijärvi. "**Copper in solidified copper smelter slags**." Scandinavian Journal of Metallurgy 32, no. 2 (2003): 65-70.

77. Takeda, Yoichi. "**Copper solubility in matte smelting slag**." In Molten Slags, Fluxes and Salts' 97 Conference, pp. 5-8. 1997.

78. Gorai, Bipra, and R. K. Jana. "**Characteristics and utilisation of copper slag—a review**." Resources, conservation and recycling 39, no. 4 (2003): 299-313.

79. Sineva, Svetlana, Maksym Shevchenko, Denis Shishin, Taufiq Hidayat, Jiang Chen, Peter C. Hayes, and Evgueni Jak. "**Phase equilibria and minor element distributions in complex copper/slag/matte systems**." Jom 72 (2020): 3401-3409.

80. Tavera, Francisco J., and Egberto Bedolla. "**Distribution of Cu, S, O and minor elements between silica-saturated slag, matte and copper-experimental measurements**." International Journal of Mineral Processing 29, no. 3-4 (1990): 289-309.

81. Takeda, Yoichi. "**Copper solubility in SiO2-CaO-FeOx slag equilibrated with matte**." High Temperature Materials and Processes 20, no. 3-4 (2001): 279-284.

82. Chun, Tiejun, Chao Ning, Hongming Long, Jiaxin Li, and Jialong Yang. "**Mineralogical characterization of copper slag from tongling nonferrous metals group China**." Jom 68 (2016): 2332-2340.

83. Imris, I., M. Sanchez, and G. Achurra. "**Copper losses to slags obtained from the El Teniente process**." Mineral Processing and Extractive Metallurgy 114, no. 3 (2005): 135-140.

84. Rusen, Aydin, Ahmet Geveci, Yavuz Ali Topkaya, and Bora Derin. "**Effects of some additives on copper losses to matte smelting slag**." Jom 68 (2016): 2323-2331.

85. Nagamori, M. "**Metal loss to slag: Part I. Sulfidic and oxidic dissolution of copper in fayalite slag from low grade matte**." Metallurgical and Materials Transactions B 5 (1974): 531-538.

86. Cheng, Xiangfeng, Zhixiang Cui, Leonel Contreras, Mao Chen, Anh Nguyen, and Baojun Zhao. "**Introduction of matte droplets in copper smelting slag**." In 8th International symposium on high-temperature metallurgical processing, pp. 385-394. Springer International Publishing, 2017.

87. Yusupkhodjayev, Anvar Abdullaevich, and Shokhrukh Toshpulatovich Khojiyev. "**Methods of decreasing of Copper loss with Slag in Smelting Processes**." Web of Scholar 2 (2017): 5-8.

88. Ye, Zhong-lin, Hai-pei Zhang, Quan-kun Chen, Yun-feng Zhu, Shi-wei Zhou, Bo Li, and Zhe Shi. "**Effect of Slag Properties on Copper Loss in Copper Slag**." Transactions of the Indian Institute of Metals 75, no. 8 (2022): 1957-1965.

89. Zhang, Huaiwei, Li Fu, Jianbo Qi, and Weidong Xuan. "**Physicochemical properties of the molten iron-rich slags related to the copper recovery**." Metallurgical and Materials Transactions B 50 (2019): 1852-1861.

90. Toshpo'latovich, Khojiev Shokhrukh. "**Pyrometallurgical processing of copper slags into the metallurgical ladle**." (2019): 8094-8099.

91. Khojiev, Shokhrukh Toshpo'latovich, Xurshida Tolibova, and Farangis Abdikarimova. "**Solubility of copper and cobalt in iron-silicate slags**." In СОВРЕМЕННЫЕ ТЕХНОЛОГИИ: АКТУАЛЬНЫЕ ВОПРОСЫ, ДОСТИЖЕНИЯ И ИННОВАЦИИ, pp. 65-67. 2019.

92. Acuna, M. A. "**Copper losses and slag treatment in chilean smelters**." Metallurgy and Foundry Engineering 26, no. 1 (2000): 9-19.

93. Henao, Héctor, Erik Kohnenkamp, Lisa Rojas, and Alex Moyano. "**Experimental Determination of the Effect of CaO and Al_2O_3 in Slag Systems Related to the Conversion Process of High Copper Matte Grade**." Minerals 9, no. 11 (2019): 716.

94. Vartiainen, Asmo. "**Viscosity of iron-silicate slags at copper smelting conditions**." Sulfide Smelting'98: Current and Future Practices (1998): 363-371.

95. Mihailova, I., and D. Mehandjiev. "**Characterization of fayalite from copper slags**." J. Univ. Chem. Technol. Metall 45, no. 3 (2010): 317-326.

96. Liao, Yalong, Qingfeng Liu, Bowen Su, and Guangxiong Ji. "**Value-added utilization of silicon and iron in copper smelting slag**." Separation Science and Technology 57, no. 16 (2022): 2662-2674.

97. Wang, Zhongbing, Zongwen Zhao, Lifeng Zhang, Fansong Liu, Bing Peng, Liyuan Chai, Dachun Liu et al. "**Formation mechanism of zinc-doped fayalite (Fe2-xZnxSiO4) slag during copper smelting**." Journal of hazardous materials 364 (2019): 488-498.

98. Choi, N., and W. D. Cho. "**Distribution behavior of cobalt, selenium, and tellurium between nickel-copper-iron matte and silica-saturated iron silicate slag**." Metallurgical and Materials transactions B 28 (1997): 429-438.

99. Tan, P., and C. Zhang. "**Effect of smelting temperature on distribution behavior of accessory elements in Fayalite-slag-making and ferrite-slag-making processes**." Nonferrous Metals(China)(China) 50, no. 2 (1998): 58-62.

100. Guo, Zhengqi, Deqing Zhu, Jian Pan, Feng Zhang, and Congcong Yang. "**Industrial tests to modify molten copper slag for improvement of copper recovery**." Jom 70 (2018): 533-538.

101. VOISIN, Leandro, Julio OSSANDÓN, and Camila PIZARRO. "**Effects of clay minerals on viscosity and copper entrainment losses in smelting slags**." In 5th international Slag Valorisation symposium, SVS 2017, Leuven, Belgium, April 3er-5th. 2017.

102. Wang, Baoren, Hongying Yang, Zhenan Jin, Zhijian Liu, and Mingjun Zou. "**Effect of Fe/SiO_2 Ratio and Fe_2O_3 on the Viscosity and Slag Structure of Copper-Smelting Slags**." Metals 12, no. 1 (2022): 24.

103. Wang, Baoren, Hongying Yang, Zhenan Jin, Qianfei Zhao, and Yan Fu. "**Effect of Fe/SiO_2 ratio and cooling regime on As stability in copper smelting slag**." Journal of Non-Crystalline Solids 606 (2023): 122190.

104. Shi, Yu, Yonggang Wei, Shiwei Zhou, Bo Li, Yindong Yang, and Hua Wang. "**Effect of B_2O_3 content on the viscosity of copper slag**." Journal of Alloys and Compounds 822 (2020): 153478.

105. Zhang, Haipei, Bo Li, Yonggang Wei, Hua Wang, and Yindong Yang. "**Effect of MgO on physicochemical property and phase transformation in copper slag**." Journal of Materials Research and Technology 18 (2022): 4604-4616.

106. Zhang, Xin-yi, Xiao-ming Li, and Xiang-dong Xing. "**Effect of B_2O_3 content on viscosity and structure of SiO_2– MgO– FeO-based slag**." Transactions of Nonferrous Metals Society of China 32, no. 7 (2022): 2403-2413.

107. Shi, Huayue. "**Characterization and modification of the secondary copper smelting slag for smooth operation and slag valorization**." (2017).

108. Chen, Min, Katri Avarmaa, Pekka Taskinen, Radoslaw Michallik, and Ari Jokilaakso. "**An experimental study on the phase equilibria of FeOx-saturated iron silicate slags and metallic copper alloys at 1200–1300° C**." Calphad 77 (2022): 102418.

109. Rozendaal, Abraham, and Richard Horn. "**Textural, mineralogical and chemical characteristics of copper reverb furnace smelter slag of the Okiep Copper District, South Africa**." Minerals Engineering 52 (2013): 184-190.

1.1.2.3 Calcium ferrite and olivine slags systems

110. Takeda, Yoichi, Shoji Ishiwata, and Akira Yazawa. "**Distribution equilibria of minor elements between liquid copper and calcium ferrite slag**." Transactions of the Japan institute of metals 24, no. 7 (1983): 518-528.

111. KONGOLI, Florian, and Akira YAZAWA. "**Phase relations of "ferrous calcium silicate slag" with special reference to copper smelting and sintering of iron ore**." In Fundamentals of Metallurgical Processing: Proceedings of James M. Toguri Symposium, p. 365. Canadian Institute of Mining, Metallurgy and Petroleum, 2000.

112. Takeda, Yoichi, Shigeatsu Nakazawa, and Akira Yazawa. "**Thermodynamics of Calcium Ferrite Slags at 1200 and 1300°**." Canadian Metallurgical Quarterly 19, no. 3 (1980): 297-305.

113. Kongoli, Florian, and Akira Yazawa. "**Liquidus surface of FeO-Fe_2O_3-SiO_2-CaO slag containing Al_2O_3, MgO, and Cu_2O at intermediate oxygen partial pressures**." Metallurgical and Materials Transactions B 32 (2001): 583-592.

114. Kashima, Masaru, Motonori Eguchi, and Akira Yazawa. "**Distribution of impurities between crude copper, white metal and silica-saturated slag**." Transactions of the Japan Institute of Metals 19, no. 3 (1978): 152-158.

115. Takeda, Yoichi, Akira Yazawa, Po Po Chit, and Hayao Ujiie. "**Equilibria between Liquid Tin and FeOx–CaO–SiO_2 Slag**." Materials transactions, JIM 31, no. 9 (1990): 793-801.

116. Yazawa, Akira, and Yoichi Takeda. "**Equilibrium relations between liquid copper and calcium ferrite slag**." Transactions of the Japan institute of Metals 23, no. 6 (1982): 328-333.

117. Devia, M. I., and M. A. Sanchez. "**Comparative analysis of slag systems Cu–Fe–O–SiO_2 and Cu–Fe–O–CaO between 1100 and 1300° C**." Mineral Processing and Extractive Metallurgy 120, no. 3 (2011): 177-190.

118. Tian, Miao, Xingbang Wan, Min Chen, Pekka Taskinen, Mia Tiljander, and Ari Jokilaakso. "**Phase equilibria of FeOx-SiO_2-Al_2O_3 slag system at 1200° C and pO2 of 10–8.6 atm**." Calphad 79 (2022): 102502.

119. Chen, Min, Katri Avarmaa, Pekka Taskinen, Radoslaw Michallik, and Ari Jokilaakso. "**Investigation on the Matte/Slag/Spinel/Gas Equilibria in the Cu-Fe-OS-SiO_2-(CaO, Al_2O_3) system at 1250° C and p SO_2 of 0.25 atm**." Mineral Processing and Extractive Metallurgy Review (2022): 1-12.

120. Chen, Min, Katri Avarmaa, Lassi Klemettinen, Junjie Shi, Pekka Taskinen, Daniel Lindberg, and Ari Jokilaakso. "**Equilibrium of Copper Matte and Silica-Saturated Iron Silicate Slags at 1300° C and P SO_2 of 0.5 atm**." Metallurgical and Materials Transactions B 51, no. 5 (2020): 2107-2118

121. Khorasanipour, Mehdi, and Esmat Esmaeilzadeh. "**Environmental characterization of Sarcheshmeh Cu-smelting slag, Kerman, Iran: Application of geochemistry, mineralogy and single extraction methods**." Journal of Geochemical Exploration 166 (2016): 1-17.

122. Anisimov, I. S., A. M. Sagitova, I. A. Agapov, and N. V. Rylov. "**Mineralogical characterization of copper in smelter slags**." Proceedings of the XXIX International Mineral Processing Council, IMPC, Moscow, Russia (2018): 17-20.

123. Biernat, S., A. W. Bydałek, W. Wołczyński, and M. Holtzer. "**Method and Apparatus for Assessing the Properties of Slags**." Archives of Foundry Engineering 17 (2017).

124. Cardona, N., P. Coursol, P. J. Mackey, and R. Parra. "**Physical chemistry of copper smelting slags and copper losses at the Paipote smelterPart 1–Thermodynamic modelling**." Canadian Metallurgical Quarterly 50, no. 4 (2011): 318-329.

125. Cardona, N., P. Coursol, J. Vargas, and R. Parra. "**The physical chemistry of copper smelting slags and copper losses at the paipote SmelterPart 2–characterisation of industrial slags**." Canadian Metallurgical Quarterly 50, no. 4 (2011): 330-340.

126. Coursol, Pascal, Nubia Cardona Valencia, Phillip Mackey, Stacy Bell, and Boyd Davis. "**Minimization of copper losses in copper smelting slag during electric furnace treatment**." Jom 64 (2012): 1305-1313.

127. Wang, Zengwu, Jintao Gao, Xi Lan, Guoliang Feng, and Zhancheng Guo. "**A new method for continuous recovery of fine copper droplets from copper matte smelting slag via super-gravity**." Resources, Conservation and Recycling 182 (2022): 106316.

128. Lan, Xi, Jintao Gao, Zili Huang, and Zhancheng Guo. "**Rapid separation of copper phase and iron-rich phase from copper slag at low temperature in a super-gravity field**." Metallurgical and Materials Transactions B 49 (2018): 1165-1173.

129. Van den Bulck, Amy, Stuart Turner, Muxing Guo, Annelies Malfliet, and Bart Blanpain. "**The Distribution of Sn Between CaO–CuO x–FeO y–SiO_2 Slag and Copper Metal at 1300° C**." In Extraction 2018: Proceedings of the First Global Conference on Extractive Metallurgy, pp. 1083-1092. Springer International Publishing, 2018.

130. Oleksiak, B., J. Lipart, A. Karbownik, and R. Burdzik. "**Effects of a reducer type on copper flash smelting slag decopperisation**." Metalurgija 54, no. 1 (2015): 116-118.

131. Sokolovskaya, L. V., S. A. Kvyatkovskiy, S. M. Kozhakhmetov, A. S. Semenova, and R. S. Seisembayev. "**Effect of Reducing Agent on Structure and Thermal Properties of Autogenous Copper Sulfide Concentrate Smelting Slags**." Metallurgist 65 (2021): 529-537.

132. Khojiev, Sh T., A. A. Yusupkhodjaev, D. Y. Aribjonova, G. B. Beknazarova, and D. N. Abdullaev. "**Depletion of Slag from Almalyk Copper Plant with Aluminum Containing Waste**." methods 30 (2019): 33.

133. Zhang, Haipei, Bo Li, Yonggang Wei, and Hua Wang. "**Recovery of matte from copper slag by using rubber seed oil as green reductant**." Journal of Materials Research and Technology 20 (2022): 1580-1592.

134. Zhang, Haipei, Bo Li, Alexander McLean, Yonggang Wei, Hua Wang, and Zhonglin Ye. "**Investigation of Reducing Copper Slag Using Waste Motor Oil to Recover Matte**." Metallurgical and Materials Transactions B 54, no. 1 (2023): 178-191.

135. Zhang, Baojing, Tingan Zhang, Zhihe Dou, and Dongliang Zhang. "**Effect of Vortex Stirring on the Dilution of Copper Slag**." Journal of Wuhan University of Technology-Mater. Sci. Ed. 37, no. 4 (2022): 699-706.

136. Takeda, Yoichi. "**Oxygen potential measurement of iron silicate slag-copper-matte system**." In Proceedings international conference on molten slags, fluxes salts, iron and steel society Warrendale, PA, pp. 735-743. 1997.

137. Roghani, Ghasem, Jonkion C. Font, Mitsuhisa Hino, and Kimio Itagaki. "**Distribution of minor elements between calcium ferrite slag and copper matte at 1523 K under high partial pressure of SO_2**." Materials transactions, JIM 37, no. 10 (1996): 1574-1579.

1.1.3 The copper converting process

138. Johnson, R. E., N. J. Themelis, and G. A. Eltringham. "**A world-wide survey of copper converting practice**." JOM 31, no. 6 (1979): 28-36.

1.1.3.1 Reactions involved in batch converting

139. Bustos, Alejandro Alberto. "**Injection phenomena and heat transfer in copper converters**." PhD diss., University of British Columbia, 1984.

140. Matousek, J. W. "**The oxidation mechanism in copper smelting and converting**." *JOM* 50, no. 4 (1998): 64-65.

1.1.3.2 Reactions involved in continuous converting

141. Kabwe, Joseph. "**Mathematical modelling of the base metal matte converter**." Master's thesis, University of Cape Town, 2012.

142. Mackey, P. J., and R. Campos. "**Modern continuous smelting and converting by bath smelting technology**." Canadian Metallurgical Quarterly 40, no. 3 (2001): 355-376.

1.2 Flash smelting

1.2.1 General consideration

143. Davenport, William George, and E. H. Partelpoeg. **Flash smelting: analysis, control and optimization**. Elsevier, 2015.

144. Varnas, S. R., and J. S. Truelove. "**Simulating radiative transfer in flash smelting furnaces**." Applied mathematical modelling 19, no. 8 (1995): 456-464.

145. Bryk, Petri, John Ryselin, Jorma Honkasalo, and Rolf Malmstrom. "**Flash smelting copper concentrates**." JOM 10 (1958): 395-400.

146. Partelpoeg, E. H. "**Control and optimization of flash smelting**." (1980).

147. GAO, Dong-bo, Xiao-qi PENG, Yan-po SONG, Zhen-yu ZHU, and D. A. I. Yang. "**Mathematical modelling and numerical optimization of particle heating process in copper flash furnace**." Transactions of Nonferrous Metals Society of China 31, no. 5 (2021): 1506-1517.

148. Asaki, Zenjiro. "**Kinetic studies of copper flash smelting furnace and improvements of its operation in the smelters in Japan**." Mineral Processing and Extractive Metullargy Review 11, no. 3 (1992): 163-185.

149. Arias, Luis, Sergio Torres, Carlos Toro, Eduardo Balladares, Roberto Parra, Claudia Loeza, Camilo Villagrán, and Pablo Coelho. "**Flash smelting copper concentrates spectral emission measurements**." Sensors 18, no. 7 (2018): 2009.

150. Serbula, Snezana M., Jelena S. Milosavljevic, Jelena V. Kalinovic, Tanja S. Kalinovic, Ana A. Radojevic, Tatjana Lj Apostolovski Trujic, and Visa M. Tasic. "**Arsenic and SO2 hotspot in South-Eastern Europe: An overview of the air quality after the implementation of the flash smelting technology for copper production**." Science of the Total Environment 777 (2021): 145981.

151. Arias, Luis, Sergio Torres, Carlos Toro, Eduardo Balladares, Roberto Parra, Claudia Loeza, Camilo Villagrán, and Pablo Coelho. "**Flash smelting copper concentrates spectral emission measurements**." Sensors 18, no. 7 (2018): 2009.

152. Manoochehri, Ali, Mahmoud Khodadadi, Roohallah Abbasi, Hossin Mahmoudi, Peyman Jamali, and Ahmad Karami. "**Monitoring of various minerals of flash furnace charge and their impacts on furnace operation**." In IOP Conference Series: Materials Science and Engineering, vol. 409, no. 1, p. 012014. IOP Publishing, 2018.

153. Wang, Jin-liang, Ya-zhou Chen, Wen-hai Zhang, and Chuan-fu Zhang. "**Furnace structure analysis for copper flash continuous smelting based on numerical simulation**." Transactions of Nonferrous Metals Society of China 23, no. 12 (2013): 3799-3807.

154. Jylhä, Jani. "**CFD-DEM simulation of two-phase flows in the flash smelting settler**." (2018).

155. Bacedoni, María, Ignacio Moreno-Ventas, and Guillermo Ríos. "**Copper flash smelting process balance modeling**." Metals 10, no. 9 (2020): 1229.

156. Marín, Milton, Carlos Toro, Luis Arias, and Eduardo Balladares. "**Estimation of spectral emissivity and S/Cu ratio from emissions of copper concentrates at the flash smelting process**." IEEE Access 7 (2019): 103346-103353.

157. Liao, Jinfa, Chunfa Liao, and Baojun Zhao. "**Comparison of Copper Smelting Slags Between Flash Smelting Furnace and Bottom-Blowing Furnace**." In 12th International Symposium on High-Temperature Metallurgical Processing, pp. 249-259. Cham: Springer International Publishing, 2022.

158. Sanchez-Corrales, V. M., J. A. Valera-Gonzalez, M. Perez-Tello, and P. Flores-Perez. "**Mass balance calculations in copper flash smelting by means of genetic algorithms**." Jom 56 (2004): 29-32.

159. Wan, Xingbang. "**Experimental investigation on time-dependent recycling behaviour of WPCBs in copper flash smelting conditions**." (2021).

160. Jun, Z. H. O. U., C. H. E. N. Zhuo, Z. H. O. U. Ping, Jian-ping YU, and An-ming LIU. "**Numerical simulation of flow characteristics in settler of flash furnace**." Transactions of Nonferrous Metals Society of China 22, no. 6 (2012): 1517-1525.

161. Khan, Nadir Ali, and Ari Jokilaakso. "**Flash Smelting Settler Design Modifications to Reduce Copper Losses Using Numerical Methods**." Processes 10, no. 4 (2022): 784.

162. Solghar, Alireza Arab, and Morteza Abdolzadeh. "**Thermochemical simulation of flash smelting furnace**." Proceedings of the Institution of Mechanical Engineers, Part E: Journal of Process Mechanical Engineering 229, no. 1 (2015): 11-24.

163. Rajabi, N., and M. Moghiman. "**Numerical Simulation of Co-Firing of Biomass-Sulfide Concentrate and Pollutants Formation in the Flash Furnace Copper Smelting**." Modares Mechanical Engineering 19, no. 12 (2019): 2927-2934.

164. Jokilaakso, ari, and pekka taskinen. "**Towards a comprehensive model of the flash smelting furnace**." in com hosting copper, p. 593961. The metallurgical society of cim, 2019.

165. Wan, Xingbang, Ari Jokilaakso, Ise Iduoze, Hürman Eriç, and Petri Latostenmaa. "**Experimental research on the behaviour of WEEE scrap in flash smelting settler with copper con-centrate and synthetic slag**." In Proceedings of EMC, p. 1. 2019.

166. Taskinen, Pekka, Xingbang Wan, Dmitry Sukhomlinov, M. Lindgren, Radoslaw Michallik, and Ari Jokilaakso. "**Arsenic Condensation and Reaction Mechanisms in Flash Smelting Off-Gas Line Conditions**." Available at SSRN 4292707.

167. Vaarno, Jussi, Juha Jarvi, Tapio Ahokainen, Toni Laurila, and Pekka Taskinen. "**Development of a mathematical model of flash smelting and converting processes**." In Third Internatianal Conference on CFD in the Minerals and Process Industries, Melbourne, pp. 147-154. 2003.

168. Taskinen, Pekka, and Ari Jokilaakso. "**Reaction sequences in flash smelting and converting furnaces: An in-depth view**." Metallurgical and Materials Transactions B 52, no. 5 (2021): 3524-3542.

169. Ahokainen, Tapio, Ari Jokilaakso, Pekka Taskinen, and Markku Kytö. "**A new advanced CFD model for flash smelting and converting processes**." In TMS Fall Extraction and Processing Meeting: Sohn International Symposium, pp. 529-543. 2006.

170. Vartiainen, Asmo Y., Pekka A. Taskinen, and Ari T. Jokilaakso. "**Thermochemical description of antimony and arsenic in the suspension stage of the Outokumpu flash smelting furnace**." In HH Kellogg International Symposium on Quantitative Description of Metal Extraction Processes, pp. 45-67. 1991.

171. Jokilaakso, Ari. "**Experimental investigation of Flash Smelting reaction kinetics**." In International Process Metallurgy Symposium in honour of Professor Pekka Taskinen: Metallurgy as a tool for challenges in circular economy, pp. 157-172. Aalto University, 2017.

172. Tan, Pengfu, Chuanfu Zhang, and R. C. Tong. "**Effects of temperature on distribution behaviors of minor elements in copper flash smelting-computer simulation**." Transactions of the Nonferrous Metals Society of China(China) 6, no. 4 (1996): 38-41.

173. Hagni, Richard D., Christopher B. Vierrether, and H. Y. Sohn. "**Process mineralogy of suspended particles from a simulated commercial flash smelter**." Metallurgical Transactions B 19 (1988): 719-729.

174. Czernecki, J., Z. Smieszek, J. Botor, S. Sobierajski, and Z. Miczkowski. "**The choice and control of parameters of the direct smelting of copper concentrates in a flash furnace**." Process Control and Automation in Extractive Metallurgy (1989): 183-195.

175. Fernández-Caliani, J. C., I. Moreno-Ventas, M. Bacedoni, and G. Ríos. "**Mineral chemistry and phase equilibrium constraints on the origin of accretions formed during copper flash smelting**." Minerals & Metallurgical Processing 34 (2017): 36-43.

176. Zhang, Huibin, Yanan Wang, Yuzheng He, Shenghang Xu, Bin Hu, Huazhen Cao, Jun Zhou, and Guoqu Zheng. "**Efficient and safe disposition of arsenic by incorporation in smelting slag through copper flash smelting process**." Minerals Engineering 160 (2021): 106661.

177. Davies, h., c. Diaz, and r. Stratton-crawley. "**Direct production of copper by oxygen flash smelting with a calcareous flux**." copper 87: pyrometallurgy of copper 4 (1988): 331.

178. Stevens, Glenn, Tatsuya Motomura, Tomoya Kawasaki, Misha Mazhar, and Gary Walters. "**Redesign and Rebuild of the Pan Pacific Copper Flash Smelting Furnace**." In Extraction 2018: Proceedings of the First Global Conference on Extractive Metallurgy, pp. 89-101. Springer International Publishing, 2018.

179. White, Matthew, Ross Haywood, Wesley Taylor, Shu Chen, John Ranasinghe, and Robert West. "**Improved copper flash smelting at olympic dam**." In AUSIMM MetPlant conference, Perth, Australia. 2015.

180. Siwiec, G., B. Oleksiak, I. Vaskova, and R. Burdzik. "**A study on reduction of copper slag from the flash furnace with the use of anthracite dust**." Metalurgija 53, no. 3 (2014): 343-345.

181. Wang, Jinliang, Yanxin Wu, Liwei Liang, and Chuanfu Zhang. "**Viscosity Determination of the Freeze Slag in Reaction Shaft of Flash Smelting Furnace**." In 3rd International Symposium on High-Temperature Metallurgical Processing, pp. 189-195. Hoboken, NJ, USA: John Wiley & Sons, Inc., 2012.

182. Yu, S. Y., J. L. Wang, and X. B. Peng. "**Prediction model of craft parameters based on neural network during the process of copper flash smelting**." J. Cent. South Univ.(Science and Technology) 38, no. 3 (2007): 523-527.

183. Dong, yuncheng, junfeng yao, fei long, kunhong liu, and chenhan lin. "**research on data-driven energy efficiency optimization for copper flash smelting process**."

184. Zhou, Ping, Ying-jin Yao, Yuan-fang Ai, An-ming Liu, Ze-lin Xu, and Jian-cai Xie. "**Grey correlation analysis of factors influencing maldistribution in feeding device of copper flash smelting**." Journal of Central South University 19, no. 7 (2012): 1938-1945.

185. Xie, Yong-fang, Jian-hua Liu, De-gang Xu, Wei-hua Gui, and Chun-hua Yang. "**Optimal control strategy of working condition transition for copper flash smelting process**." Control Engineering Practice 46 (2016): 66-76.

186. Mäkinen, Juho K., and Gustav A. Jåfs. "**Production of matte, white metal, and blister copper by flash furnace**." JOM 34, no. 6 (1982): 54-59.

187. Kemori, Nobumasa, Yukio Shibata, and Mutsuo Tomono. "**Measurements of oxygen pressure in a copper flash smelting furnace by an EMF method**." Metallurgical Transactions B 17 (1986): 111-117.

188. Kemori, N., Y. Shibata, and K. Fukushima. "**Thermodynamic consideration for oxygen pressure in a copper flash smelting furnace at Toyo smelter**." JOM 37, no. 5 (1985): 24-29.

189. Jokilaakso, Ari, Tapio Ahokainen, Osmo Teppo, Yongxiang Yang, and Kaj Lilius. "**Experimental and computational-fluid-dynamics simulation of the Outokumpu flash smelting process**." Mineral Processing and Extractive Metallurgy Review 15, no. 1-4 (1995): 217-234.

190. Ahokainen, T., E. Peuraniemi, and Ari Jokilaakso. "**Experimental and computer simulation of gas-solid reactions in the flash smelting process**." (1998).

191. Hanniala, Pekka, and I. Kojo. "**Utilization of Outokumpu Flash Technology to Meet Environmental Requirements**." In Proceedings of COPPER, vol. 95, pp. 305-318. 1995.

192. White, Matthew, Ross Haywood, D. John Ranasinghe, and Shu Chen. "**The development and application of a CFD model of copper flash smelting**." In Proceedings of the Eleventh International Conference on CFD in the Minerals and Process Industries, Melbourne, Australia, pp. 7-9. 2015.

193. Kemori, N., W. T. Denholm, and H. Kurokawa. "**Reaction mechanism in a copper flash smelting furnace**." Metallurgical and Materials Transactions B 20 (1989): 327-336.

194. Kojo, Ilkka V., and Hannes Storch. "**Copper production with Outokumpu flash smelting: An update**." In Sohn international symposium, vol. 8, pp. 225-238. Warrendale (PA: TMS, 2006.

195. Yazawa, Akira, and Kazuteru Tozawa. "**Oxygen Smelting of Copper Concentrate With Exhaust SO2 Gas Recycling**." JOM 34, no. 3 (1982): 39-44.

196. Alyaser, abdelmonem hussein, and j. K. Brimacombe. "**Oxidation kinetics of molten copper sulfide**." metallurgical and materials transactions b 26 (1995): 25-40.

197. Cocquerel, mat, and sr holmes. "**Use of flash and bath smelting technologies for the modernization and expansion of copper smelting facilities**." copper 87: pyrometallurgy of copper 4 (1988): 37.

198. Kolenda, Z. S., and J. Szmyd. "**The Coordinated Material and Energy Balances of the Flash Smelting Process**." Arch. Hutn. 30, no. 1 (1985): 3-20.

1.2.2 Impact of Concentrate

199. Lamoureux, Alexandre, Adam Blackmore, and Maciej Jastrzebski. "**Impact of Concentrate Feed Temporal Fluctuations on a Copper Flash Smelting Process**." In 5th International Symposium on High-Temperature Metallurgical Processing, pp. 417-426. Hoboken, NJ, USA: John Wiley & Sons, Inc., 2014.

200. Mather, Paul. "**An Exergetic Comparison of Copper Extraction from Chalcopyrite Concentrates by Pyrometallurgy and Hydrometallurgy**." PhD diss., Purdue University Graduate School, 2020.

201. Stokreef, Arthur. "**Measuring the Effect of Concentrate Mineralogy on Flash Furnace Smelting Using Drop Tower Testing and a Novel Optical Probe**." PhD diss., Queen's University (Canada), 2019.

202. Pérez-Tello, Manuel, Víctor R. Parra-Sánchez, Víctor M. Sánchez-Corrales, Agustín Gómez-Álvarez, Francisco Brown-Bojórquez, Roberto A. Parra-Figueroa, Eduardo R. Balladares-Varela, and Eugenia A. Araneda-Hernández. "**Evolution of size and chemical composition of copper concentrate particles oxidized under simulated flash smelting conditions**." Metallurgical and Materials Transactions B 49 (2018): 627-643.

203. Parra-Sánchez, V. R., M. Pérez-Tello, V. M. Sánchez-Corrales, R. Parra-Figueroa, and E. Balladares-Varela. "**Evolution of size distribution of copper concentrate particles oxidized under suspension-smelting conditions**." In Copper international conference. 2013.

204. Metsärinta, Maija-Leena, Pekka Taskinen, Jens Nyberg, and Esko Ohvo. "**Industrial scale roasting of impure concentrates at Boliden Kokkola**." In International Symposium on Lead & Zinc Processing (October 17-19, 2005, Kyoto, Japan), pp. 343-357. MMIJ, 2005.

205. Samadov, alisher usmonovich, shokhrukh toshpulatovich khojiev, firuzakhon saybirovna buzurkhanova, and ziyodullo nayimovich ruziev. "**perspective method of smelting low-sulfur copper concentrates**." in научные достижения и открытия современной молодёжи, pp. 38-41. 2018.

206. Taylor, Patrick R., and Teuku AR Putra. "**Pyrometallurgical processing technologies for treating high arsenic copper concentrates**." In Celebrating the Megascale: Proceedings of the Extraction and Processing Division Symposium on Pyrometallurgy in Honor of David GC Robertson, pp. 197-211. Springer International Publishing, 2016.

207. Chambers, Brandon Tadashi. **An investigation into the sulphation roasting of enargite concentrates**. Queen's University (Canada), 2012.

208. Stefanova, V., and Y. Trifonov. "**Phase composition of spinel melts obtained during flash smelting of the mineral chalcopyrite**." Russian Journal of Non-Ferrous Metals 49, no. 3 (2008): 148-155.

209. Jokilaakso, Ari Tapani, Risto Olavi Suominen, Pekka Antero Taskinen, and Kaj Rainer Lilius. "**Antimony in flash smelting simulation experiments. Part 1: The behaviour of a high-antimony concentrate (tetrahedrite)**." Scandinavian Journal of Metallurgy 18, no. 2 (1989): 50-60.

210. Rajabi, N., Maryam Ghodrat, and Mohammad Moghiman. "**Numerical simulation of the effect of sulfide concentrate particle size on pollutant emission from flash smelting furnace**." International Journal of Environmental Science and Technology (2021): 1-12.

211. Stokreef, arthur. "**Measuring the effect of concentrate mineralogy on flash furnace smelting using drop tower testing and a novel optical probe**." phd diss., queen's university (canada), 2019.

1.2.3 Concentrate combustion

212. Jorgensen, F. R. A., and P. T. L. Koh. "**Combustion in flash smelting furnaces**." JOM 53, no. 5 (2001): 16-20.

213. Sohn, H. Y., and P. C. Chaubal. "**The ignition and combustion of chalcopyrite concentrate particles under suspension-smelting conditions**." Metallurgical Transactions B 24 (1993): 975-985.

214. Hahn, Yoon Bong. **Mathematical modeling of chalcopyrite concentrate combustion in an axisymmetric flash-furnace shaft**. The University of Utah, 1988.

215. Sohn, H. Y. "**Experimental and mathematical investigation of the flash combustion of copper sulfide particles in a turbulent gas jet**." NATO ASI Series E Applied Sciences-Advanced Study Institute 282 (1995): 171-200.

216. Sasaki, Yukihito, Yoshiaki Mori, Yasumasa Hattori, and Akihiro Tanabe. "**Prediction of combustion phenomena in flash smelting furnace for production enhancement using a mathematical model**." In Sohn International Symposium; Advanced Processing of Metals and Materials Volume 8: International Symposium on Sulfide Smelting 2006, vol. 8, pp. 545-559. 2006.

217. SASAKI, Yukihito, Yoshiaki MORI, and Yasumasa HATTORI. "**Numerical Study of Combustion Phenomena of Concentrate Particles in Flash Smelting Furnace**." Journal of MMIJ 125, no. 1 (2009): 31-37.

218. Natsui, Shungo, Iori Nishimura, Akihisa Ito, and Hiroshi Nogami. "**Tracking combustion behavior of copper monosulfide, ferrous sulfide, and chalcopyrite tablets by high-speed microscopic videography**." Chemical Engineering Science 267 (2023): 118355.

219. Zhou, Jun, Jieming Zhou, Zhuo Chen, and Yongning Mao. "**Influence analysis of air flow momentum on concentrate dispersion and combustion in copper flash smelting furnace by cfd simulation**." JOM 66 (2014): 1629-1637.

220. Reyes, Gonzalo, Walter Diaz, Carlos Toro, Eduardo Balladares, Sergio Torres, Roberto Parra, and Alejandro Vásquez. "**Copper oxide spectral emission detection in chalcopyrite and copper concentrate combustion**." Processes 9, no. 2 (2021): 188.

221. Zahedi, Rahim, Aidin Shaghaghi, Mohammad Taghi Tahooneh, and Abolfazl Ahmadi. "**Numerical simulation of combustion of sulfide-biomass concentrate ingredients and contaminants in copper furnace smelting**." Future Energy 2, no. 1 (2023): 1-8.

222. Zaim, Ehsan Hassan, and Seyed Hossein Mansouri. "**A new mathematical model for copper concentrate combustion in flash smelting furnaces**." Proceedings of the Institution of Mechanical Engineers, Part E: Journal of Process Mechanical Engineering 231, no. 2 (2017): 119-130.

223. Solnordal, christopher b., frank ra jorgensen, and robin russell. "**The effect of particle size and composition on the performance of the composite particle model in**

predicting combustion behaviour in a flash furnace reaction shaft." in seventh int. Conf. On cfd in the minerals and processing industries, pp. 1-6. 2009.

224. Díaz, Walter, Carlos Toro, Eduardo Balladares, Victor Parra, Pablo Coelho, Gonzalo Reyes, and Roberto Parra. "**Spectral characterization of copper and iron sulfide combustion: A multivariate data analysis approach for mineral identification on the blend**." Metals 9, no. 9 (2019): 1017.

225. Caffery, G. A., A. A. Shook, J. R. Grace, I. V. Samarasekera, and T. R. Meadowcroft. "**Comparisons between sulfide flash smelting and coal combustion--with implications for the flash smelting of high-grade concentrate**." Metallurgical and Materials Transactions 31, no. 5 (2000): 1005.

226. Łabaj, Jerzy, Leszek Blacha, Albert Smalcerz, Jakub Wieczorek, Maria Fröhlichová, Pavol Vadasz, Robert Findorak, and Marian Niesler. "**Utilization of waste coal flotation concentrate for copper matte smelting**." Engineering Science and Technology, an International Journal 24, no. 4 (2021): 996-1004.

227. Caffery, Grant A. "**Analysis of transport phenomena in a combusting sulfide particle cloud: with implications to the flash smelting of high-grade copper concentrates**." PhD diss., University of British Columbia, 2002.

228. Stefanova, V., K. Genevski, and B. Stefanov. "**Mechanism of oxidation of pyrite, chalcopyrite and bornite during flash smelting**." Canadian metallurgical quarterly 43, no. 1 (2004): 78-88.

229. Ahokainen, Tapio, and Ari Jokilaakso. "**Modelling of chalcopyrite oxidation reactions in the Outokumpu flash smelting process**." (1996).

1.2.4 Reactions during matte smelting

230. Park, Moon-Gyung, Yoichi Takeda, and Akira Yazawa. "**Equilibrium relations between liquid copper, matte and calcium ferrite slag at 1523 K**." Transactions of the Japan institute of metals 25, no. 10 (1984): 710-715.

231. Đorđević, predrag, nataša mitevska, ivan mihajlović, đorđe nikolić, dragan manasijević, and živan živković. "**The effect of copper content in the matte on the distribution coefficients between the slag and the matte for certain elements in the sulphide copper concentrate smelting process**." journal of mining and metallurgy section b-metallurgy 48, no. 1 (2012): 143-151.

232. Liu, y-x., y-g. Wei, s-w. Zhou, b. Li, and h. Wang. "**Matte-slag separation behavior as a function of iron phase reduction in copper slag**." journal of mining and metallurgy, section b: metallurgy 00 (2023): 3-3.

233. Klaffenbach, Eric, Gerardo RF Alvear Flores, Muxing Guo, and Bart Blanpain. "**Thermodynamic Consideration of Copper Matte Smelting Conditions with Respect to Minor Element Removal and Slag Valorization Options**." In Extraction 2018: Proceedings of the First Global Conference on Extractive Metallurgy, pp. 491-504. Springer International Publishing, 2018.

234. Goto, Yuko, Shungo Natsui, and Hiroshi Nogami. "**Development of a Dynamic Model of Collision and Coalescence for Molten Matte Droplets in Copper Smelting Reaction Shaft Considering Interfacial Deformation**." In New Directions in Mineral Processing, Extractive Metallurgy, Recycling and Waste Minimization: An EPD Symposium in Honor of Patrick R. Taylor, pp. 87-94. Cham: Springer Nature Switzerland, 2023.

235. Tavera, Francisco J., and William G. Davenport. "**Equilibrations of copper matte and fayalite slag under controlled partial pressures of SO_2**." Metallurgical Transactions B 10 (1979): 237-241.

236. Guntoro, Pratama Istiadi, Ari Jokilaakso, Niko Hellsten, and Pekka Taskinen. "**Copper Matte–Slag reaction sequences and separatIon processes in matte smelting**." Journal of Mining and Metallurgy, Section B: Metallurgy 54, no. 3 (2018): 301-301.

237. Wan, Xingbang, Leiting Shen, Ari Jokilaakso, Hürman Eriç, and Pekka Taskinen. "**Experimental approach to matte–slag reactions in the flash smelting process**." Mineral Processing and Extractive Metallurgy Review 42, no. 4 (2021): 231-241.

238. Navarra, A., F. Valenzuela, R. Cruz, C. Arrancibia, R. Yañez, and C. Acuña. "**Incorporation of matte-slag thermochemistry into sulphide smelter discrete event simulation**." Canadian Metallurgical Quarterly 57, no. 1 (2018): 70-79.

239. Deng, Peng, Yong Gang Li, and Jia Xin Li. "**Prediction of Matte grade in Copper Flash Smelting Process based on LSTM and Mechanism Model**." In 2022 41st Chinese Control Conference (CCC), pp. 2613-2620. IEEE, 2022.

240. Zeng, Fan Rong, and Ping Zhang. "**Prediction for matte grade in the process of copper flash smelting based on QPSO-LSSVM**." In Advanced Materials Research, vol. 722, pp. 535-540. Trans Tech Publications Ltd, 2013.

1.2.5 Matte and slag

1.2.5.1 Matte

241. Kameda, M. I. T. S. U. O., and A. K. I. R. A. Yazawa. "**The oxygen content of copper mattes**." Physical Chemistry of Process Metallurgy, part 2 (1961): 963-988.

242. Shimpo, ryokichi, sakichi goto, osamu ogawa, and iwazo asakura. "**A study on the equilibrium between copper matte and slag**." canadian metallurgical quarterly 25, no. 2 (1986): 113-121.

243. Sundström, a. W., j. J. Eksteen, and g. A. Georgalli. "**A review of the physical properties of base metal mattes**." journal of the southern african institute of mining and metallurgy 108, no. 8 (2008): 431-448.

244. Grimsey, eric. "**Non-ferrous melt chemistry: the role of slags and mattes**." in mervyn willis symposium and smelting and refining course, pp. 7-1. University of melbourne, 1982.

1.2.5.2 Slag

245. Kowalczyk, J., W. Mroz, A. Warczok, and T. A. Utigard. "**Viscosity of copper slags from chalcocite concentrate smelting**." Metallurgical and Materials Transactions B 26 (1995): 1217-1223.

246. Zivkovic, Zivan, Predrag Djordjevic, and Natasa Mitevska. "**Contribution to the Examination of the Mechanisms of Copper Loss with the Slag in the Process of Sulfide Concentrates Smelting**." Mining, Metallurgy & Exploration 37 (2020): 267-275.

247. Ospanov, Ye A., S. A. Kvyatkovskiy, S. M. Kozhakhmetov, L. V. Sokolovskaya, A. S. Semenova, M. Dyussebekova, and A. A. Shakhalov. "**Slag heterogeneity of autogenous copper concentrates smelting**." Canadian Metallurgical Quarterly (2022): 1-8.

248. Zhou, Shiwei, Yonggang Wei, Bo Li, and Hua Wang. "**Effect of iron phase evolution on copper separation from slag via coal-based reduction**." Metallurgical and Materials Transactions B 49 (2018): 3086-3096.

249. Zhai, Qilin, Runqing Liu, Changtao Wang, Xiaofei Wen, Jie Li, Zhenhui Xie, and Wei Sun. "**Mineralogical characteristics of copper smelting slag affecting the synchronous flotation enrichment of copper and arsenic**." Journal of Environmental Chemical Engineering 10, no. 6 (2022): 108871.

250. Sanchez, m., f. Parada, r. Parra, f. Marquez, r. Jara, j. C. Carrasco, and j. Palacios. "**Management of copper pyrometallurgical slags: giving additional value to copper**

mining industry." in vii int. Conference on molten slags, fluxes & salts, cape town, south africa, pp. 543-550. 2004.

251. An, Xun, Nan Li, and Eric Grimsey. "**Recovery of copper and cobalt from industrial slag by top-submerged injection of gaseous reductants**." In TMS Annual Meeting, pp. 717-732. 1998.

252. Taskinen, Pekka, Markku Kaskiala, Pilvi Hietanen, Kaisa Miettinen, and Antti Forsström. "**Microstructure and formation kinetics of a freeze lining in an industrial copper FSF slag**." Mineral Processing and Extractive Metallurgy 120, no. 3 (2011): 147-155.

1.2.5.2.1 Calcium ferrite and olivine slags

253. YAZAWA, Akira. "**Ferrous calcium silicate slag to be used for copper smelting and converting**." Proceedings of Copper 99 6 (1999): 587-599.

254. Acuña, César, and Akira Yazawa. "**Behaviours of Arsenic, Antimony and Lead in Phase Equilibria among Copper, Matte and Calcium or Barium Ferrite Slag**." Transactions of the Japan institute of metals 28, no. 6 (1987): 498-506.

255. Ku, Jiangang, Lin Zhang, Weng Fu, Shubin Wang, Wanzhong Yin, and Huihuang Chen. "**Mechanistic study on calcium ion diffusion into fayalite: a step toward sustainable management of copper slag**." Journal of Hazardous Materials 410 (2021): 124630.

256. Hamuyuni, Joseph, Lassi Klemettinen, and Pekka Taskinen. "**Experimental phase equilibrium data of the system Cu–O–CaO–Al_2O_3 at copper saturation**." Calphad 55 (2016): 199-207.

257. .Hamuyuni, Joseph, Niko Hellstén, Guven Akdogan, and Pekka Taskinen. "**The liquidus in Cu–O–CaO system at metallic copper saturation up to 1698 K**." Journal of the American Ceramic Society 98, no. 1 (2015): 320-323.

258. Shi, Junjie, Min Chen, Xingbang Wan, Pekka Taskinen, and Ari Jokilaakso. "**Phase equilibrium study of the CaO-SiO_2-MgO-Al_2O_3-TiO_2 system at 1300 C and 1400 C in air**." JOM 72 (2020): 3204-3212.

259. Shishin, Denis, Taufiq Hidayat, and Evgueni Jak. "**Thermodynamic assessment of the CaO–Cu_2O–FeO–Fe_2O_3 system**." Calphad 68 (2020): 101715.

260. Fahey, N. P., D. R. Swinbourne, Shiqin Yan, and J. M. Osborne. "**The solubility of Cr_2O_3 in calcium ferrite slags at 1573 K**." Metallurgical and materials transactions B 35 (2004): 197-202.

261. Tsukihashi, f., and h. Kimura. "**Phase diagram for the CaO-SiO_2-FeOx system at low oxygen partial pressure**." in proc.: seetharaman s, sichen d, editors. Proc. 6th

international conference on molten slags, fluxes, and salts, stockholm, sweden-helsinki, finland. 2000.

262. Kim, hang goo. "**Thermodynamic modeling of minorelement behaviour in in-bath copper smelting and converting with calcium ferrite slag**." tranasactions of the institution of mining & metallurgy, section c-mineral processing & extractive metallurgy 105 (1996): c151-c163.

263. Chen, chunlin, and sharif jahanshahi. "**Thermodynamics of arsenic in FeO_x-CaO-SiO_2 slags**." metallurgical and materials transactions b 41, no. 6 (2010): 1166-1174.

1.2.5.3 Phase equilibrium and mutual interactions

264. Roghani, Ghasem, Mitsuhisa Hino, and Kimio Itagaki. "**Phase equilibrium and minor elements distribution between SiO_2–CaO–FeO_x–MgO slag and copper matte at 1573 K under high partial pressures of SO_2.**" Materials transactions, JIM 38, no. 8 (1997): 707-713.

265. Acuña, César, and Akira Yazawa. "**Mutual dissolution between matte and ferrite slags**." Transactions of the Japan institute of metals 27, no. 11 (1986): 881-889.

266. Djordjevic, Predrag, Natasa Mitevska, Ivan Mihajlovic, Djordje Nikolic, and Zivan Zivkovic. "**Effect of the slag basicity on the coefficient of distribution between copper matte and the slag for certain metals**." Mineral Processing and Extractive Metallurgy Review 35, no. 3 (2014): 202-207.

267. Guntoro, Pratama. "**Experimental investigation of matte-slag interactions in copper flash smelting**." (2017).

268. Chen, Min, Katri Avarmaa, Lassi Klemettinen, Junjie Shi, Pekka Taskinen, and Ari Jokilaakso. "**Experimental Study on the Phase Equilibrium of Copper Matte and Silica-Saturated FeO x-SiO_2-Based Slags in Pyrometallurgical WEEE Processing**." Metallurgical and Materials Transactions B 51, no. 4 (2020): 1552-1563.

269. Khan, Nadir Ali, and Ari Jokilaakso. "**Dynamic modelling of molten slag-matte interactions in an industrial flash smelting furnace settler**." In Extraction 2018: Proceedings of the First Global Conference on Extractive Metallurgy, pp. 993-1005. Springer International Publishing, 2018.

1.2.5.4 Fluxing strategy

270. Chen, Min, Katri Avarmaa, Pekka Taskinen, Lassi Klemettinen, Radoslaw Michallik, Hugh O'Brien, and Ari Jokilaakso. "**Novel fluxing strategy of copper matte smelting and trace metals in E-Waste recycling**." Minerals Engineering 191 (2023): 107969.

271. Selivanov, E. N., A. M. Klyushnikov, and R. I. Gulyaeva. "**Use of quartz-containing materials as fluxes in copper smelting production**." Metallurgist 61 (2017): 155-161.

272. Dyussebekova, Maral, Bagdaulet Kenzhaliyev, Sergey Kvyatkovskiy, Sultanbek Kozhakhmetov, Anastasiya Semenova, and Bulat Sukurov. "**Study of the Effect of Fluxing Ability of Flux Ores on Minimizing of Copper Losses with Slags during Copper Concentrate Smelting**." Metals 12, no. 8 (2022): 1240.

273. Tanaka, atsushi, hiroyuki fukuyama, and chikabumi yamauchi. "**Application of Na_2CO_3 flux to the removal of impurity elements from molten copper**." shigen-to-sozai 115, no. 2 (1999): 89-96.

274. Fujisawa, toshiharu, and chikabumi yamauchi. "**Application of nazcog flux to the removal of impurity elements from molten copper**."

1.2.5.5 Oxygen enrichment

275. Anjala, y., j. Asteljoki, and p. Hanniala. "**The role of oxygen in the outokumpu flash smelting process**." in proceedings of the metallurgical society of the canadian institute of mining and metallurgy, pp. 87-105. Pergamon, 1987.

276. Taskinen, P., K. Seppälä, J. Laulumaa, and J. Poijärvi. "**Oxygen pressure in the Outokumpu flash smelting furnace—Part 1: Copper flash smelting settler**." Mineral Processing and Extractive Metallurgy 110, no. 2 (2001): 94-100.

277. Taskinen, P., K. Seppälä, J. Laulumaa, and J. Poijärvi. "**Oxygen pressure in the Outokumpu flash smelting furnace—Part 2: the DON process**." Mineral Processing and Extractive Metallurgy 110, no. 2 (2001): 101-108.

278.

1.2.5.6 Copper losses in the silicate slag

279. Savic, Marija V., Predrag B. Djordjevic, Ivan N. Mihajlovic, and Zivan D. Zivkovic. "**Statistical modeling of copper losses in the silicate slag of the sulfide concentrates smelting process**." Polish Journal of Chemical Technology 17, no. 3 (2015): 62-69.

280. Yusupkhodjayev, Anvar Abdullaevich, Shokhrukh Toshpulatovich Khojiev, and Javlon Usarov. "**Reasons of copper loss with slag**." In УПРАВЛЕНИЕ СОЦИАЛЬНО-ЭКОНОМИЧЕСКИМИ СИСТЕМАМИ: ТЕОРИЯ, МЕТОДОЛОГИЯ, ПРАКТИКА, pp. 22-23.

281. Bellemans, Inge, Evelien De Wilde, Nele Moelans, and Kim Verbeken. "**Metal losses in pyrometallurgical operations-A review**." Advances in Colloid and Interface Science 255 (2018): 47-63.

282. Sridhar, R., J. M. Toguri, and S. Simeonov. "**Copper losses and thermodynamic considerations in copper smelting**." Metallurgical and Materials transactions B 28 (1997): 191-200.

283. Yannopoulos, J. C. "**Control of copper losses in reverberatory slags—a literature review**." Canadian Metallurgical Quarterly 10, no. 4 (1971): 291-307.

1.2.6 Flash Smelting: Transport phenomena

284. Schmidt, Amélia, Victor Montenegro, and Gregor D. Wehinger. "**Transient CFD Modeling of Matte Settling Behavior and Coalescence in an Industrial Copper Flash Smelting Furnace Settler**." Metallurgical and Materials Transactions B 52 (2021): 405-413.

285. Xia, J. L., Tapio Ahokainen, Timo Kankaanpää, J. Järvi, and P. Taskinen. "**Flow and heat transfer performance of slag and matte in the settler of a copper flash smelting furnace**." steel research international 78, no. 2 (2007): 155-159.

286. Jylhä, Jani-Petteri, Nadir Ali Khan, and Ari Jokilaakso. "**Computational approaches for studying slag–matte interactions in the flash smelting furnace (FSF) settler**." Processes 8, no. 4 (2020): 485.

287. Anderson, Alexandra, Vineet Kumar, Vivek M. Rao, and Joseph Grogan. "**A Review of Computational Capabilities and Requirements in High-Resolution Simulation of Nonferrous Pyrometallurgical Furnaces**." JOM 74, no. 4 (2022): 1543-1567.

288. Björklund, P., T. Ranki, and E. Miettinen. "**Recent experiences from implementing dynamic process control and monitoring in the flash smelting process**." In Proc. Copper 2013 Int. Symp, vol. 3, pp. 153-163. 2013.

289. Li, bingzhi, anders brink, and mikko hupa. "**CFD analysis of an uptake shaft with slagging walls–the slag model**."

290. Navarra, a., h. Marambio, f. Oyarzún, r. Parra, and f. Mucciardi. "**System dynamics and discrete event simulation of copper smelters**." minerals & metallurgical processing 34 (2017): 96-106.

291. Hahn, Y. B., and H. Y. Sohn. "**Mathematical modeling of sulfide flash smelting process: Part I. Model development and verification with laboratory and pilot plant measurements for chalcopyrite concentrate smelting**." Metallurgical Transactions B 21 (1990): 945-958.

292. Hahn, Y. B., and H. Y. Sohn. "**Mathematical modeling of sulfide flash smelting process: Part II. Quantitative analysis of radiative heat transfer**." Metallurgical Transactions B 21 (1990): 959-966.

293. Seo, K. W., and H. Y. Sohn. "**Mathematical modeling of sulfide flash smelting process: Part III. Volatilization of minor elements**." Metallurgical and Materials Transactions B 22 (1991): 791-799.

294. Gray, nb, and jm floyd. "**Some heat and mass transfer challenges in smelting and refining of metals**." in third australasian conference on heat and mass transfer, university of melbourne, 13-15 may 1985, p. 193. Brookfield publishing company, 1985.

295. Sohn, Hong Yong. "**Principles and applications of mathematical and physical modelling of metallurgical processes**." *Mineral Processing and Extractive Metallurgy* 129, no. 2 (2020): 117-144.

1.2.7 Outotec flash furnace Construction details

1.2.7.1 Cooling jackets

296. Chen, Zhuo, Chi Mei, Hong-rong Chen, and Jiao Mo. "**Simulation of moving boundary of the reaction shaft in a flash smelting furnace**." Journal of Central South University of Technology 8 (2001): 213-218.

297. Fagerlund, K., M. Lindgren, and M. Jåfs. "**Modern flash smelting cooling systems**." In Proc. Copper 2010 Int. Conf., Clausthal-Zellerfeld, Germany, GDMBH, June, pp. 699-711. 2010.

298. Leggett, A. R. "**Investigation of a Novel Cooling Element Design**." In Proc. 6th AusIMM Ext. Met. Conf., pp. 77-77. Melbourne, Australia: AusIMM, 1994.

1.2.7.2 Concentrate burner

299. Inami, T., K. Baba, H. Kurokawa, K. Nagai, and Y. Kondo. "**Modification of concentrate burner for a copper flash smelting furnace**." Copper 91(Cobre 91) (1991).

300. Koh, P. T. L., F. R. A. Jorgensen, and B. J. Elliot. "**Solids falling in flash furnace burner concentrate chutes**." International Journal of Mineral Processing 3, no. 83 (2007): 81-88.

301. Koh, P. T. L., F. R. A. Jorgensen, and B. J. Elliot. "**Analysis of solids flow in flash furnace burner concentrate chutes**." (2006).

302. Guevara, F., R. Fuentes, and A. Valencia. "**Numerical and Experimental Modelling of the Concentrate Burner in a Flash Smelting Furnace**." Copper 99- Cobre 99 (1999): 377-387.

303. Šutalo, I. D., F. R. A. Jorgensen, and N. B. Gray. "**Experimental and mathematical investigation of the fluid flow inside and below a 1/4 scale air model of a flash smelting burner**." Metallurgical and Materials Transactions B 29 (1998): 993-1006.

304. Li, Xinfeng, Chi Mei, and Tianyuan Xiao. "**Numerical modeling of Jinlong CJD burner copper flash smelting furnace**." International Journal of Minerals, Metallurgy and Materials 9, no. 6 (2002): 417-421.

305. Jorgensen, F. R. A., B. J. Elliot, P. T. L. Koh, and T. V. Nguyen. "**Modelling the burners and reaction shaft of a flash smelting furnace**." (1994).

306. Solnordal, Christopher, Frank Jorgensen, and Andrew Campbell. "**Validation of the Olympic Dam flash furnace burner and reaction shaft model- comparison of model with plant measurements**." In Sohn International Symposium; Advanced Processing of Metals and Materials Volume 8: International Symposium on Sulfide Smelting 2006, vol. 8, pp. 687-701. 2006.

307. 陈红荣, 梅炽, 谢锴, 李欣锋, 周俊, 王晓华, and 葛则令. "**Operation optimization of concentrate burner in copper flash smelting furnace**." 中国有色金属学会会刊: 英文版 14, no. 3 (2004): 631-636.

308. AI, Yuan. "**Cold Model Experiment for Particles Distribution of CJD Burner**." Journal of Northeastern University (Natural Science) 35, no. 4 (2014): 543.

309. Jastrzebski, M., A. Lamoureux, T. Gonzales, and R. Veenstra. "**In pursuit of improved flash-smelting burner performance**." In Proceeding international copper conference copper, vol. 3, pp. 413-427. 2013.

1.2.7.3 Supplementary hydrocarbon fuel burners

310. Kojo, ilkka v., and hannes storch. "**Copper production with outokumpu flash smelting: an update**." in sohn international symposium, vol. 8, pp. 225-238. Warrendale pa: tms, 2006.

1.2.7.4 Matte and slag tapping

311. Madariaga, Rodrigo, Luis Arevalo, Thomas Gabardi, and Phillip Mackey. "**MIRS Robotic tapping and plugging of non-ferrous smelting furnaces**." In Furnace Tapping 2022, pp. 15-31. Cham: Springer International Publishing, 2022.

312. Gregurek, Dean, Christine Wenzl, Günter Unterreiter, Goran Vukovic, and Hans Ulrich Marschall. "**Improving Tapping Experience—and Why to Choose a Comprehensive Approach**." JOM 74, no. 11 (2022): 3999-4008.

313. Reynolds, Quinn G., and Markus W. Erwee. "**Multiphase fluid flow modelling of furnace tap-holes**." In Proceedings of the 12th International Conference on CFD in Oil & Gas, Metallurgical and Process Industries, pp. 521-530. 2017.

314. Nolet, I., L. Rodd, S. Straub, J. Du Toit, T. Futterer, and W. Taylor. "**PGM, Nickel, and copper tapping: an updated industry survey**." In Furnace Tapping 2022, pp. 201-231. Cham: Springer International Publishing, 2022.

315. Madariaga, Rodrigo, Luis Arevalo, Thomas Gabardi, and Phillip Mackey. "**Advances in Robotic Tapping and Plugging of Non-Ferrous Smelting Furnaces: The MIRS Robotic Tapping Machine**." JOM 74, no. 11 (2022): 4009-4014.

316. Nolet, i., t. Futterer, w. Taylor, j. Ward, s. Straub, and l. Rodd. "**PGM, nickel, and copper tapping: an updated survey and industry trends**." jom 74, no. 11 (2022): 3947-3961.

317. Steven Wright, Frank Jorgensen, and Andrew Campbell. "**Thermodynamics of tapping molten copper**." In Advanced Processing of Metals and Materials: Proceedings of the International Symposium, August 27-31, 2006, San Diego, California, USA, vol. 1, p. 321. Minerals, Metals and Materials Society, 2006.

1.2.7.5 Concentrate blending system

318. Imanbekova, Ulzhan, Oleksandra Hotra, and Shamil Koshimbayev. "**Optimal control of copper concentrate blending and melting based on intelligent systems**." Przegląd Elektrotechniczny 92, no. 8 (2016): 125-128.

319. Byszyński, Leszek, Leszek Garycki, Z. Gostynski, Tomasz Stodulski, and Jerzy Urbanowski. "**Present and future modernization of metallurgical production lines of the Glogow copper smelter**." In Proceedings of copper, vol. 2, pp. 631-647. 2010.

320. Williams, NR & Holtzhausen, S. "**The impact of ore characterization and blending on metallurgical plant performance**." Journal of the Southern African Institute of Mining and Metallurgy 101, no. 8 (2001): 437-446.

321. Jovanović, Ivan M., and Predrag S. Stanimirović. "**A blending problem in copper production**." Environmental Modeling & Assessment 17, no. 5 (2012): 495-503.

322. Cheng, Pengfei, Pablo Garcia-Herreros, Mangalam Lalpuria, and Ignacio E. Grossmann. "**Optimal scheduling of copper concentrate operations under uncertainty**." Computers & Chemical Engineering 140 (2020): 106919.

1.2.7.6 Solids feed dryer

323. Talja, J., S. Chen, H. Mansikkaviita, and I. Kylmäkorpi. "**Recent Improvements in the Kumera Steam Dryer**." SAIMM Pyro (2011).

324. Chen, S. L., and H. Mansikkaviita. "**The beneficial effects of feeding dry copper concentrate to smelting furnaces and development of the dryers**." Southern African Pyrometallurgy (2006): 265-272.

325. Vega, Rolando E., Pablo Zúñiga, Jules Thibault, Ramón Blasco, and Pedro I. Álvarez. "**Indirect drying of copper concentrate in a rotating-coil dryer**." Journal of Fluid Flow, Heat and Mass Transfer (JFFHMT) 3, no. 1 (2016): 62-72.

326. Berg, Carl-Gustav, Shaolong Chen, and Hannu Mansikkaviita. "**Application of Kumera Steam Dryers in Mineral Processing**." Drying, Roasting, and Calcining of Minerals (2016): 81-88.

327. Chen, S. L., and H. Mansikkaviita. "**The beneficial effects of feeding dry copper concentrate to smelting furnaces and development of the dryers**." Southern African Pyrometallurgy (2006): 265-272.

328. Mujumdar, arun s. "**drying in mineral processing**." handbook of industrial drying 2 (1995): 921-929.

1.2.7.7 Bin and feed system

329. Korpi, Mikko, Hannu Toivonen, and Björn Saxén. "**Modelling and identification of the feed preparation process of a copper flash smelter**." In Computer Aided Chemical Engineering, vol. 14, pp. 731-736. Elsevier, 2003.

330. Legg, A. C., L. Ntsipe, M. Bogopa, and G. Dzinomwa. "**Modernization of the BCL smelter**." Journal of the Southern African Institute of Mining and Metallurgy 109, no. 11 (2009): 671-676.

1.2.7.8 Oxygen plant

331. Saddington, Robert, Walter Curlook, and Paul Queneau. "**Tonnage oxygen for nickel and copper smelting at copper cliff**." JOM 18, no. 4 (1966): 440-452.

332. Queneau, Paul E., and Samuel W. Marcuson. "**Oxygen pyrometallurgy at copper cliff—A half century of progress**." Jom 48 (1996): 14-21.

333. Suenaga, C., T. Fujii, Y. Suzuki, and M. Hoshi. "**High-performing flash smelting furnace at Saganoseki Smelter and Refinery**." In Second International Conference on Processing Materials for Properties, pp. 879-884. 2000.

334. Smith, T. J. A., I. Posener, and C. J. Williams. "**Oxygen Smelting and the Olympic Dam Project**." In Proceedings of the Metallurgical Society of the Canadian Institute of Mining and Metallurgy, pp. 49-59. Pergamon, 1987.

1.2.7.9 Blast heater

335. Yu, Hai, Lian Yong Wang, and Tao Du. "**Waste Heat Recovery and Reuse of Flue Gas in Copper Pyrometallurgy**." Applied Mechanics and Materials 71 (2011): 2239-2242.

1.2.7.10 Dust recovery and recycle system

336. Montenegro, Victor, Hiroyuki Sano, and Toshiharu Fujisawa. "**Recirculation of high arsenic content copper smelting dust to smelting and converting processes**." Minerals Engineering 49 (2013): 184-189.

1.2.7.11 Flash furnace operation

337. Taskinen, Pekka, Ari Jokilaakso, Daniel Lindberg, and Jiliang Xia. "**Modelling copper smelting–the flash smelting plant, process and equipment**." Mineral Processing and Extractive Metallurgy 129, no. 2 (2020): 207-220.

1.2.7.12 Startup and shut down

338. Kang, Y. C., and SoS Park. "**Making improvements in smelting capacity at Onsan copper smelter**." JOM 49, no. 10 (1997): 44-46.

1.2.7.13 Steady-state operation

339. Liu, Jian-hua, Wei-hua Gui, Yong-fang Xie, and Chun-hua Yang. "**Dynamic modeling of copper flash smelting process at a smelter in china**." Applied Mathematical Modelling 38, no. 7-8 (2014): 2206-2213.

1.2.7.14 Control

340. Björklund, Peter, Mikko Korpi, David Grimsey, and Miikka Marjakoski. "**Continuous improvement of process advisor optimizing furnace model**." In Ni-Co 2021: The 5th International Symposium on Nickel and Cobalt, pp. 259-270. Springer International Publishing, 2021.

341. Antonioni, T. N., C. M. Diaz, H. C. Garven, and C. Landolt. "**Control of the Inco oxygen flash smelting process**." Copper Smelting--an Update (1982): 17-31.

1.2.7.15 Concentrate throughput rate and matte grade controls

342. GUI, Wei-hua, Ling-yun WANG, Chun-hua YANG, Yong-fang XIE, and Xiao-bo PENG. "**Intelligent prediction model of matte grade in copper flash smelting process**." Transactions of Nonferrous Metals Society of China 17, no. 5 (2007): 1075-1081.

1.2.7.16 Slag composition control

343. Xie, Sui, Xinhua Yuan, Fupeng Liu, and Baojun Zhao. "**Control of Copper Content in Flash Smelting Slag and the Recovery of Valuable Metals from Slag—A Thermodynamic Consideration**." Metals 13, no. 1 (2023): 153.

1.2.7.17 Temperature control

344. Koskinen, T., and H. Torvela. "**Energy balance and operation equations of a copper flash smelting furnance based on the superposition principle**." Minerals engineering 2, no. 4 (1989): 489-500.

1.2.7.18 Reaction shaft and hearth

345. Ahokainen, T., and Ari Jokilaakso. "**Numerical simulation of the outokumpu flash smelting furnace reaction shaft**." Canadian metallurgical quarterly 37, no. 3-4 (1998): 275-283.

346. Higgins, D. R., N. B. Gray, and M. R. Davidson. "**Simulating particle agglomeration in the flash smelting reaction shaft**." Minerals Engineering 22, no. 14 (2009): 1251-1265.

347. olnordal, Christopher B., Frank RA Jorgensen, Peter TL Koh, and Arthur Hunt. "**CFD modelling of the flow and reactions in the Olympic Dam flash furnace smelter reaction shaft**." Applied Mathematical Modelling 30, no. 11 (2006): 1310-1325.

348. Higgins, D. R., N. B. Gray, and M. R. Davidson. "**Simulating particle agglomeration in the flash smelting reaction shaft**." Minerals Engineering 22, no. 14 (2009): 1251-1265.

349. Higgins, David, Neil Gray, and Malcolm Davidson. "**Simulating agglomeration of molten particles in the flash smelting reaction shaft**." In Seventh International Conference on CFD in the Minerals and Process Industries CSIRO, Melbourne. 2009.

350. Nirmal Kumar, S., Bhavin Desai, Vilas Tathavadkar, Yogesh Patel, Jayesh Patel, Anil Singh, Kaushik Vakil, and Sokkuraj Kanakanand. "**CFD modelling of copper flash smelting furnace–reaction shaft**." Mineral Processing and Extractive Metallurgy (2022): 1-13.

351. Afrouzeh, Mohsen, Maryam Ehteshamzadeh, Saeed Jafari, and Mehdi Borhannejad. "**Study the effect of different operation parameters on the reaction shaft performance of a copper flash smelting furnace: Mass and energy balance analysis**." Proceedings of the Institution of Mechanical Engineers, Part E: Journal of Process Mechanical Engineering (2022): 09544089221099890.

352. Jun, Zhou, and Chen Zhuo. "**Smelting mechanism in the reaction shaft of a commercial copper flash furnace**." In Extraction 2018: Proceedings of the First Global Conference on Extractive Metallurgy, pp. 533-546. Springer International Publishing, 2018.

1.2.8 Heat recovery boiler

353. Thakre, S., T. Kumaresan, and B. Basu. "**Design Modification Using CFD to Improve the Performance of the Waste Heat Boiler**." World of Metallurgy-ERZMETALL 64, no. 5 (2011).

354. Stefanova, V., D. Shentov, I. Mihailova, and P. Iliev. "**Investigation of the phase composition of accretions formed into WHB under flash smelting of copper concentrate**." Russian Journal of Non-Ferrous Metals 53 (2012): 26-32.

355. Schmidt, Amélia, Victor Montenegro, Markus Reuter, Michael Stelter, and Andreas Richter. "**Development of a Three-dimensional CFD Model for the Estimation of Accretion Formation in an Industrial-Scale Copper Waste Heat Boiler**."

356. Ranki-Kilpinen, Tiina. **Sulphation of cuprous and cupric oxide dusts and heterogeneous copper matte particles in simulated flash smelting heat recovery boiler conditions**. Helsinki University of Technology, 2004.

357. Schmidt, Amélia, Victor Montenegro, Markus Reuter, Alexandros Charitos, Michael Stelter, and Andreas Richter. "**CFD Study on the Physical Behavior of Flue Dust in an Industrial-Scale Copper Waste Heat Boiler**." Metallurgical and Materials Transactions B (2022): 1-11.

358. Schmidt, Amélia, Victor Montenegro, Markus Reuter, Alexandros Charitos, Michael Stelter, and Andreas Richter. "**Transient CFD Calculation of Accretion Formation in a Copper Waste Heat Boiler**." Metallurgical and Materials Transactions B 53, no. 6 (2022): 3765-3774.

359. Thakre, s., t. Kumaresan, b. Basu, m. Patel, t. Mukhopadhyay, r. Chugh, b. Gauri, k. Khandelwal, y. Mathur, and h. I. N. D. A. L. C. O. Birla copper. "**Using computational fluid dynamics to optimize a waste heat boiler design**." (2008).

360. Zhang, Dongjie, and Ting Ma. "**Study on slagging in a waste-heat recovery boiler associated with a bottom-blown metal smelting furnace**." Energy 241 (2022): 122852.

361. Yang, Yongxiang, Ari Jokilaakso, Pekka Taskinen, and Markku Kytö. "**Using computational fluid dynamics to modify a waste-heat boiler design**." JOM 51 (1999): 36-40.

362. Viitala, Hanna. "**Corrosion mechanisms of the heat recovery boiler of copper flash smelting**." (2020).

363. Yang, Yongxiang. "**Computer simulation of gas flow and heat transfer in waste-heat boilers of the Outokompu copper flash smelting process**." Acta Polytechnica Scandinavica. Chemical Technology Series 38 (1996).

364. Viitala, Hanna, and Pekka Taskinen. "**Hot Corrosion Mechanism of Steels Exposed to Heavy Metal Chlorides and Sulphates in SO_2 Environment**." Oxidation of Metals 86 (2016): 239-262.

365. Schmidt, Amélia, Victor Montenegro, Markus Reuter, Alexandros Charitos, Michael Stelter, and Andreas Richter. "**CFD Study on the Physical Behavior of Flue Dust in an Industrial-Scale Copper Waste Heat Boiler**." Metallurgical and Materials Transactions B (2022): 1-11.

366. Schmidt, Amélia, Victor Montenegro, Markus Reuter, Alexandros Charitos, Michael Stelter, and Andreas Richter. "**Transient CFD Calculation of Accretion Formation in a Copper Waste Heat Boiler**." Metallurgical and Materials Transactions B 53, no. 6 (2022): 3765-3774.

367. Ebara, R., F. Tanaka, and M. Kawasaki. "**Sulfuric acid dew point corrosion in waste heat boiler tube for copper smelting furnace**." Engineering failure analysis 33 (2013): 29-36.

368. Fang, Hao, Jianjun Xia, and Yi Jiang. "**Key issues and solutions in a district heating system using low-grade industrial waste heat**." Energy 86 (2015): 589-602.

369. Lehmusto, Juho, Daniel Stenlund, Mari Lindgren, and Patrik Yrjas. "**Deposit Build-up and Corrosion in a Copper Flash Smelting Heat Recovery Boiler**." Oxidation of Metals 87 (2017): 199-214.

370. Lehmusto, Juho, Tor Laurén, and Mari Lindgren. "**Catalytic Role of Process Dust in SO 2-to-SO 3 Conversion in Flash Smelting Heat Recovery Boilers**." JOM 71 (2019): 3305-3313.

371. Peuraniemi, E. J., A. Saarikoski, and T. Ranki-Kilpinen. "**Behaviour of Cu_2O Particles in Copper Smelting Heat Recovery Boiler Conditions**." In EPD Congress, pp. 421-430. 2001.

372. Bezuidenhout, J. J., Y. Yang, and J. J. Eksteen. "**Computational fluid dynamic modelling of a waste-heat boiler associated with flash smelting of base metal sulphides**." Journal of the Southern African Institute of Mining and Metallurgy 108, no. 3 (2008): 179-188.

373. Brink, Anders, Bingzhi Li, and Mikko Hupa. "**CFD investigation of deposition in a heat recovery boiler: Part I–a dual-layer particle conversion model**." Progress in Computational Fluid Dynamics, an International Journal 9, no. 8 (2009): 447-452.

374. Li, Bingzhi, Anders Brink, and Mikko Hupa. "**CFD investigation of deposition in a heat recovery boiler: Part II–deposit growth modelling**." Progress in Computational Fluid Dynamics, an International Journal 9, no. 8 (2009): 453-459.

375. Yang, Yongxiang, and An Jokilaakso. "**A CFD study on the dust behaviour in a metallurgical waste-heat boiler**." In Colloquium on Process Simulation, p. 275. 1997.

376. Ranki, Tiina. "**Sulphation reactions of oxidic dust particles in waste heat boiler environment. Literature review**." (1999).

377. Kruskopf, Ari. "**Tool for calculating the heat transfer of the flash smelting process in a heat recovery boiler's convection section**." Master's thesis, 2006.

378. Afrouzeh, mohsen, maryam ehteshamzadeh, saeid jafari, and mehdi borhannejad. "**chemical and mineralogical characterization and thermodynamic investigation of sulphatizing process of flash smelting furnace flue dust and accretions formed in whb transition**." journal of chemical technology and metallurgy 56, no. 5 (2021): 1058-1065.

379. Iliev, Peter, Vladislava Stefanova, Dimiter Shentov, and Biserka Lucheva. "**Thermodynamic Analysis Of The Sulphatization Processes Taking Place In A Dust-Gas Flow From Flash Smelting Furnace**." Journal of Chemical Technology and Metallurgy 51, no. 3 (2016): 335-340.

1.2.9 Dust formation in flash smelting and characteristics

1.2.9.1 Dust formation in flash smelting

380. Yli-Penttilä, J. T., E. J. Peuraniemi, Ari Jokilaakso, and K. M. Riihilahti. "**Dust formation in flash oxidation of copper matte particles**." Mining, Metallurgy & Exploration 15 (1998): 41-47.

381. Markova, Ts, Bi Boyanov, S. Pironkov, and N. Shopov. "**Investigation of dusts from waste-heat boiler and electrostatic precipitators after flash smelting furnace for copper concentrates**." Journal of Mining and Metallurgy B: Metallurgy 36, no. 3-4 (2000): 195-208.

382. Battle, t. P., m. L. Free, b. R. Davis, c. L. Harris, h. Henein, p. N. Anyalebechi, a. C. Powell, g. K. Krumdick, and c. K. Belt. "**Decomposition kinetics of flash smelting flue dust sulphates**."

383. Chen, Yujie, Zongwen Zhao, Pekka Taskinen, Yanjie Liang, Hongchuan Ouyang, Bing Peng, Ari Jokilaakso et al. "**Characterization of copper smelting flue dusts from a bottom-blowing bath smelting furnace and a flash smelting furnace**." Metallurgical and Materials Transactions B 51 (2020): 2596-2608.

384. Zhou, Huihui, Guijian Liu, Liqun Zhang, and Chuncai Zhou. "**Formation mechanism of arsenic-containing dust in the flue gas cleaning process of flash copper pyrometallurgy: A quantitative identification of arsenic speciation**." Chemical Engineering Journal 423 (2021): 130193.

1.2.9.2 Dust characteristics

385. Nurminen, Elli, Laura Stykki, and Kim Fagerlund. "**Thermal conductivity of copper flash smelting flue dust**." In EPD Congress 2005 Edited by ME Schlesinger TMS, San Francisco, 2005, pp. 429-436. 2005.

386. Orac, Dusan, Martina Laubertova, Jana Piroskova, Dusan Klein, Radovan Bures, and Jakub Klimko. "**Characterization of dusts from secondary copper production**." Journal of Mining and Metallurgy, Section B: Metallurgy 56, no. 2 (2020): 221-228.

387. Miettinen, Elli, Pekka Taskinen, and Ari Kruskopf. "**Thermal Conductivity and Characterisation of Copper Flash Smelting Flue Dust**." In TMS Annual Meeting 2009, pp. 501-508. TMS, 2009.

388. Balladares, Eduardo, Ursula Kelm, Sonia Helle, Roberto Parra, and Eugenia Araneda. "**Chemical-mineralogical characterization of copper smelting flue dust**." Dyna 81, no. 186 (2014): 11-18.

389. Miettinen, Elli. **Thermal conductivity and characteristics of copper flash smelting flue dust accretions**. Teknillinen korkeakoulu, 2008.

390. Samuelsson, Caisa, and Göran Carlsson. "**Characterization of copper smelter dusts**." CIM bulletin 94, no. 1051 (2001): 111-115.

1.2.10 Dust recirculation to smelting process

391. Dutton, A., A. E. M. Warner, and M. J. Humphris. "**Improved dust handling at Inco's Copper Cliff smelter**." In Process gas handling and cleaning. 1989.

392. Yang, Zhihui, Ken Li, Weizhi Zeng, Bo Li, and Shan Liu. "**Design and analysis of a novel furnace throat for removing dust particles in flue gas emitted from copper smelting furnace by a computational method**." Environmental Science and Pollution Research 26 (2019): 27180-

393. Montenegro, Victor, Hiroyuki Sano, and Toshiharu Fujisawa. "**Recirculation of Chilean copper smelting dust with high arsenic content to the smelting process**." Materials transactions 49, no. 9 (2008): 2112-2118.

394. Gibson, d., and w. Schmitz. "**Electrostatic precipitator enhancement through gas and dust flow optimisation**." clean air journal 10, no. 6 (2000): 13-18.

1.2.11 Minor element

395. Yazawa, Akira. "**Distribution of various elements between copper, matte and slag**." Erzmetall 33 (1980): 377-382.

396. Lynch, D. C., S. Akagi, and W. G. Davenport. "**Thermochemical nature of minor elements in copper smelting mattes**." Metallurgical Transactions B 22, no. 5 (1991): 677-688.

397. Lynch, D. C., and T. Zhong. "**Volatilization and activity coefficient of Sb in Cu-Fe mattes and white metal**." Canadian metallurgical quarterly 44, no. 3 (2005): 409-420.

398. Zhong, T., and D. C. Lynch. "**Henrian activity coefficient of Bi in Cu-Fe mattes and white metal**." Canadian metallurgical quarterly 39, no. 1 (2000): 23-36.

399. Zhong, Tom, and David C. Lynch. "**Henrian activity coefficient of Pb in Cu-Fe mattes and white metal**." Metallurgical and Materials Transactions B 29 (1998): 429-436.

400. Zhong, Tom, and David C. Lynch. "**Henrian activity coefficient of As in Cu-Fe mattes and white metal**." Metallurgical and Materials Transactions B 32 (2001): 437-447.

401. Sukhomlinov, Dmitry, Lassi Klemettinen, Hugh O'Brien, Pekka Taskinen, and Ari Jokilaakso. "**Behavior of Ga, In, Sn, and Te in copper matte smelting**." Metallurgical and Materials Transactions B 50, no. 6 (2019): 2723-2732.

402. Shishin, Denis, Viktoria Prostakova, and Evgueni Jak. "**Review and thermodynamic analysis of As (arsenic) in copper smelting liquid mattes, metals, slags, speiss and solid phases**." (2022): 506-521.

403. Kho, T. S., D. R. Swinbourne, and Theo Lehner. "**Cobalt distribution during copper matte smelting**." Metallurgical and materials transactions B 37 (2006): 209-214.

404. Aromaa, Riina. "**Rare earth elements distribution kinetics in copper matte-slag system**." (2019).

405. Avarmaa, Katri, Hugh O'Brien, Hannu Johto, and Pekka Taskinen. "**Equilibrium distribution of precious metals between slag and copper matte at 1250–1350 C**." Journal of Sustainable Metallurgy 1 (2015): 216-228.

406. Avarmaa, Katri, Hannu Johto, and Pekka Taskinen. "**Distribution of precious metals (Ag, Au, Pd, Pt, and Rh) between copper matte and iron silicate slag**." Metallurgical and Materials Transactions B 47 (2016): 244-255.

407. Chen, Min, Katri Avarmaa, Lassi Klemettinen, Hugh O'Brien, Junjie Shi, Pekka Taskinen, Daniel Lindberg, and Ari Jokilaakso. "**Precious Metal Distributions between**

Copper Matte and Slag at High P SO_2 in WEEE Reprocessing." Metallurgical and Materials Transactions B 52, no. 2 (2021): 871-882.

408. Sohn, H., Yasuhiro Fukunaka, Toshio Oishi, and Zenjiro Asaki. "**Volatilization behaviour of minor elements during non-isothermal oxidation of copper concentrate particles falling in One-dimensional laminar gas flow**." In Sohn international symposium, vol. 1, pp. 301-320. Warrendale, PA: TMS, 2006.

409. Holland, Keiran, Dmitry Sukhomlinov, Lassi Klemettinen, Petri Latostenmaa, Hugh O'Brien, Ari Jokilaakso, and Pekka Taskinen. "**Distribution of Co, Fe, Ni, and precious metals between blister copper and white metal**." Mineral Processing and Extractive Metallurgy 130, no. 4 (2021): 313-323.

410. Chen, Min. "**Phase equilibria and precious or high-tech metal distributions in copper smelting systems**." (2022).

411. Kenzhaliyev, B. K. "**Innovative technologies providing enhancement of non-ferrous, precious, rare and rare earth metals extraction**." Kompleksnoe Ispol'zovanie Mineral'nogo syr'â 310, no. 3 (2019): 64-75.

412. Henao, Hector M., Katsunori Yamaguchi, and Shigeru Ueda. "**Distribution of precious metals (Au, Pt, Pd, Rh and Ru) between copper matte and iron-silicate slag at 1573 K**." In 2006 TMS Fall Extraction and Processing Division: Sohn International Symposium, pp. 723-729. 2006.

413. Kucha, Henryk, and K. Cichowska. "**Precious metals in copper smelting products**." Physicochemical Problems of Mineral Processing Journal 15 (2001): 91-101.

414. Chen, Min. "**Phase equilibria and precious or high-tech metal distributions in copper smelting systems**." (2022).

415. Avarmaa, Katri, Lassi Klemettinen, Hugh O'Brien, and Pekka Taskinen. "**Urban mining of precious metals via oxidizing copper smelting**." Minerals Engineering 133 (2019): 95-102.

416. Avarmaa, Katri, Hugh O'Brien, Lassi Klemettinen, and Pekka Taskinen. "**Precious metal recoveries in secondary copper smelting with high-alumina slags**." Journal of material cycles and waste management 22, no. 3 (2020): 642-655.

417. Sukhomlinov, Dmitry, Lassi Klemettinen, Katri Avarmaa, Hugh O'Brien, Pekka Taskinen, and Ari Jokilaakso. "**Distribution of Ni, Co, precious, and platinum group metals in copper making process**." Metallurgical and Materials Transactions B 50 (2019): 1752-1765.

418. Wan, Xingbang, Lotta Kleemola, Lassi Klemettinen, Hugh O'Brien, Pekka Taskinen, and Ari Jokilaakso. "**On the kinetic behavior of recycling precious metals (Au, Ag, Pt, and**

Pd) through copper smelting process." Journal of Sustainable Metallurgy 7, no. 3 (2021): 920-931.

419. Klemettinen, Lassi, Riina Aromaa, Anna Dańczak, Hugh O'Brien, Pekka Taskinen, and Ari Jokilaakso. "**Distribution kinetics of rare earth elements in copper smelting**." Sustainability 12, no. 1 (2019): 208.

420. Avarmaa, Katri, Simon Yliaho, and Pekka Taskinen. "**Recoveries of rare elements Ga, Ge, In and Sn from waste electric and electronic equipment through secondary copper smelting**." Waste Management 71 (2018): 400-410.

421. Shen, Leiting, Fiseha Tesfaye, Xiaobin Li, Daniel Lindberg, and Pekka Taskinen. "**Review of rhenium extraction and recycling technologies from primary and secondary resources**." Minerals Engineering 161 (2021): 106719.

422. Chen, Min, Katri Avarmaa, Pekka Taskinen, Lassi Klemettinen, Radoslaw Michallik, Hugh O'Brien, and Ari Jokilaakso. "**Handling trace elements in WEEE recycling through copper smelting-an experimental and thermodynamic study**." Minerals Engineering 173 (2021): 107189.

423. Klemettinen, Lassi, Katri Avarmaa, Dmitry Sukhomlinov, Hugh O'Brien, Pekka Taskinen, and Ari Jokilaakso. "**Recycling of tellurium via copper smelting processes**." SN Applied Sciences 2 (2020): 1-9.

424. Sukhomlinov, Dmitry, Katri Avarmaa, Olli Virtanen, Pekka Taskinen, and Ari Jokilaakso. "**Slag–copper equilibria of selected trace elements in black copper smelting. Part I. Properties of the slag and chromium solubility**." Mineral Processing and Extractive Metallurgy Review (2019).

425. Sukhomlinov, Dmitry, Katri Avarmaa, Olli Virtanen, Pekka Taskinen, and Ari Jokilaakso. "**Slag-copper equilibria of selected trace elements in black-copper smelting. Part II. Trace element distributions**." Mineral Processing and Extractive Metallurgy Review 41, no. 3 (2020): 171-177.

426. Avarmaa, Katri, Hugh O'Brien, and Pekka Taskinen. "**Equilibria of gold and silver between molten copper and FeO x-SiO 2-Al 2 O 3 slag in WEEE smelting at 1300° C.**" In Advances in Molten Slags, Fluxes, and Salts: Proceedings of the 10th International Conference on Molten Slags, Fluxes and Salts 2016, pp. 193-202. Springer International Publishing, 2016.

427. Klemettinen, Lassi, Katri Avarmaa, and Pekka Taskinen. "**Trace element distributions in black copper smelting**." World of Metallurgy-Erzmetall 70, no. 5 (2017): 257-264.

428. Aspiala, Markus, Fiseha Tesfaye, and Pekka Taskinen. "**Experimental thermodynamic study on the Ag-Sb system at elevated temperatures**." In EPD Congress 2015, pp. 305-312. Springer International Publishing, 2016.

429. Vereecken, Jean, H. Y. Sohn, Hang Goo Kim, and K. W. Seo. "**Minor-element behaviour in copper-making**." EMC'91: Non-Ferrous Metallurgy—Present and Future (1991): 205-217.

430. Klaffenbach, Eric, Sina Mostaghel, Muxing Guo, and Bart Blanpain. "**Thermodynamic analysis of copper smelting, considering the impact of minor elements behavior on slag application options and Cu recovery**." Journal of Sustainable Metallurgy 7, no. 2 (2021): 664-683.

431. Larouche, Pascal. "**Minor elements in copper smelting and electrorefining**." (2001).

432. Klemettinen, Lassi, Katri Avarmaa, Hugh O'brien, Pekka Taskinen, and Ari Jokilaakso. "**Behavior of tin and antimony in secondary copper smelting process**." Minerals 9, no. 1 (2019): 39.

433. Itagaki, K., and A. Yazawa. "**Thermodynamic Properties of Arsenic and Antimony in Copper Smelting Systems**." Complex Sulfides--Processing of Ores, Concentrates and By-Products (1985): 705-722.

434. Wang, Qinmeng, Xueyi Guo, Qinghua Tian, Mao Chen, and Baojun Zhao. "**Reaction mechanism and distribution behavior of arsenic in the bottom blown copper smelting process**." Metals 7, no. 8 (2017): 302.

435. Itagaki, Kimio, and Akira Yazawa. "**Thermodynamic evaluation of distribution behaviour of arsenic in copper smelting**." Transactions of the Japan institute of metals 23, no. 12 (1982): 759-767.

436. Wan, Xingbang, Dmitry Sukhomlinov, Pekka Taskinen, Mari Lindgren, and Ari Jokilaakso. "**Condensation of arsenic in FSF atmospheres in typical WHB and ESP conditions**." In Copper International Conference, pp. 366-379. The Chilean Institute of Mining Engineers,(IIMCH), 2022.

437. Weisenberg, I. J., P. S. Bakshi, and A. E. Vervaert. "**Arsenic distribution and control in copper smelters**." JOM 31 (1979): 38-44.

438. Jolilaakso, Ari, Risto Suominen, Pekka Taskinen, and Kaj Lilius. "**Behaviour of antimony-bearing minerals in simulated suspension smelting conditions**."

439. Zhang, hui-bin, ya-nan wang, yin-bin zhu, r. E. N. Peng, h. U. Bin, sheng-hang xu, hua-zhen cao, z. H. O. U. Jun, and guo-qu zheng. "**Determination of occurrence and**

leaching toxicity of arsenic in copper flash smelting slags." transactions of nonferrous metals society of china 33, no. 1 (2023): 293-303.

440. Teppo, Osmo, Jaana Niemelä, and Pekka Taskinen. "**An assessment of the thermodynamic properties and phase diagram of the system Bi-Cu**." Thermochimica acta 173 (1990): 137-150.

441. Tesfaye, Fiseha, and Pekka Taskinen. "**Phase equilibria and thermodynamics of the system Zn-As-Cu-Pb-S at temperatures below 1173 K**." (2011).

442. Pengfu, Tan, and Zhang Chuanfu. "**Modeling of accessory element distribution in copper smelting process**." Scandinavian journal of metallurgy 26, no. 3 (1997): 115-122.

443. Moats, Michael, Lana Alagha, and Kwame Awuah-Offei. "**Towards resilient and sustainable supply of critical elements from the copper supply chain: A review**." Journal of cleaner production 307 (2021): 127207.

444. Zhang, Yi, Yijun Ji, He Xu, Yiting Yang, and Lili Tian. "**Life cycle assessment of valuable metal extraction from copper pyrometallurgical solid waste**." Resources, Conservation and Recycling 191 (2023): 106875.

445. Pengfu, Tan, and Zhang Chuanfu. "**Computer model of copper smelting process and distribution behaviors of accessory elements**." Journal of Central South University of Technology(China) 4, no. 1 (1997): 36-41.

446. Arac, Sabri, and Gordon H. Geiger. "**Thermodynamic behavior of bismuth in copper pyrometallurgy: Molten matte, white metal and blister copper phases**." Metallurgical Transactions B 12 (1981): 569-578.

447. Ajima, S., M. Hayashi, N. Hasegawa, and M. Nozaki. "**The distribution of minor elements at Naoshima**." Cu-products and minor elements in nonferrous smelting (1995): 13-26.

448. Sorokin, M. L., A. G. Nikolaev, and A. A. Komkov. "**Co-Products and Minor Elements in Non-Ferrous Smelting**." (1995): 109-29.

449. Shi, yifeng, and zhonglin ye. "**An overview of research on Au & Ag recovery in copper smelter**." in 4th international symposium on high temperature metallurgical processing, march, pp. 3-7. 2013.

1.3 Electric slag cleaning furnace

450. Moreno, A., G. Sánchez, A. Warczok, and G. Riveros. "**Development of slag cleaning process and operation of electric furnace in Las Ventanas Smelter**." Copper 2003–Cobre 2003 4 (1998): 1-17.

451. Warzok, A., Jonkion Font, Victor Montenegro, Carlos Caballero, and Alex Moyano. "**Mechanism of buildup formation in an electric furnace for copper slag cleaning**." In MOLTEN 2009 conference. Gecamin Ltd., Santiago (Chile), Ch IMM, Santiago, pp. 1211-1219. 2009.

452. Zhang, Haipei, Bo Li, Yonggang Wei, Hua Wang, Yindong Yang, and Alexander Mclean. "**Reduction of magnetite from copper smelting slag in the presence of a graphite rod**." Metallurgical and Materials Transactions B 51 (2020): 2663-2672.

453. Xiao, Wenbing, Shiwen Yao, Shiwei Zhou, Yonggang Wei, Bo Li, and Hua Wang. "**Evolution of the structure and viscosity of copper slag during metallization-reduction**." Journal of Alloys and Compounds 903 (2022): 163751.

454. Weber, Peter, Dirk Behrmann, Thomas Breuer, and Rüdiger Margraf. "**Installation of a Brown Field Slag Reduction Furnace: State of the Art Off-Gas Treatment with Dry Gas Cleaning for SO_2 Capture**." In PbZn 2020: 9th International Symposium on Lead and Zinc Processing, pp. 187-199. Springer International Publishing, 2020.

455. Holland, Keiran, R. Hürman Eriç, Pekka Taskinen, and Ari Jokilaakso. "**Upgrading copper slag cleaning tailings for re-use**." Minerals Engineering 133 (2019): 35-42.

456. Tian, Hongyu, Zhengqi Guo, Jian Pan, Deqing Zhu, Congcong Yang, Yuxiao Xue, Siwei Li, and Dingzheng Wang. "**Comprehensive review on metallurgical recycling and cleaning of copper slag**." Resources, Conservation and Recycling 168 (2021): 105366.

457. Wei, Yonggang, Tifu Zhang, Bo Li, and Shiwei Zhou. "**Copper Smelting Slag Cleaning in an Electric Furnace by Using Waste Cooking Oil**." Metallurgical and Materials Transactions B 51 (2020): 2756-2768.

458. Kcuharski, M. "**Effect of thermodynamic and physical properties of flash smelting slags on copper losses during slag cleaning in an electric furnace**." Arch. Metall. 32, no. 2 (1987): 307-323.

459. Zhang, Haipei, Bo Li, Yonggang Wei, and Hua Wang. "**The settling behavior of matte particles in copper slag and the new technology of copper slag cleaning**." Journal of Materials Research and Technology 15 (2021): 6216-6230.

460. Sineva, Svetlana, Denis Shishin, Maksym Shevchenko, Peter C. Hayes, and Evgueni Jak. "**Experimental study and thermodynamic modeling of distribution of elements**

among slag, matte and metal in the Cu-Fe-OS-Si-(Zn)-(Al, Ca, Mg) system for copper slag cleaning applications." Journal of Materials Research and Technology (2023).

461. Demetrio, Sergio, SA Jorge Ahumada, Miguel Ángel Durán, Ernest Mast, Ullises Rojas, José Sanhueza, Pedro Reyes, and Edmundo Morales. "**Slag cleaning: the Chilean copper smelter experience**." JOM 52, no. 8 (2000): 20-25.

462. Łabaj, Jerzy, Leszek Blacha, Maciej Jodkowski, Albert Smalcerz, Mária Fröhlichová, and Robert Findorak. "**The use of waste, fine-grained carbonaceous material in the process of copper slag reduction**." Journal of Cleaner Production 288 (2021): 125640.

463. Chikashi, H. M. "**Influence of slag composition on reduction control and operations of the slag-cleaning furnace at KCM, Zambia**." Southern African Pyrometallurgy 2011 (2011): 185-198.

464. Siwiec, G., B. Oleksiak, I. Vaskova, and R. Burdzik. "**A study on reduction of copper slag from the flash furnace with the use of anthracite dust**." Metalurgija 53, no. 3 (2014): 343-345.

465. Vuković, Goran, Anton Ishmurzin, Juergen Schmidl, Bojan Zivanović, and Bernhard Handle. "**Alternatives of Copper (I) Oxide Reduction in a Copper Slag Cleaning Furnace**." In Advances in Pyrometallurgy: Developing Low Carbon Pathways, pp. 137-150. Cham: Springer Nature Switzerland, 2023.

466. Kennedy, Mark William, and Proval Partners SA. "**Slag furnaces—some issues for optimal design and operation**." In Proceedings of conference of metallurgist, Ralph Lloyd Harris memorial symposium. Montreal, QC, pp. 411-426. 2013.

467. Acuna, C. M., and M. Sherrington. "**Slag cleaning processes: A growing concern**." In Materials Science Forum, vol. 475, pp. 2745-2752. Trans Tech Publications Ltd, 2005.

468. Cui, Zhi-xiang, Zhi Wang, Rui-min Bian, Chuan-bing Wei, and Bao-jun Zhao. "**Application study on technology of reducing copper content in discarded slag**." In Extraction 2018: Proceedings of the First Global Conference on Extractive Metallurgy, pp. 481-490. Springer International Publishing, 2018.

469. Furuta, M., S. Tanaka, M. Hamamoto, and H. Inada. "**Analysis of copper loss in slag in Tamano type flash smelting furnace**." In Sohn International Symposium; Advanced Processing of Metals and Materials Volume 8: International Symposium on Sulfide Smelting 2006, vol. 8, pp. 123-133. 2006.

470. Imris, I., S. Rebolledo, M. Sanchez, G. Castro, G. Achurra, and F. Hernandez. "**The copper losses in the slags from the El Teniente process**." Canadian Metallurgical Quarterly 39, no. 3 (2000): 281-290.

471. Ip, S. W., and J. M. Toguri. "**Entrainment of matte in smelting and converting operations**." In JM Toguri Symp. Fundamentals of Metallurgical Processing, Pickles G., Utigard T., and Vahed A., Editors, pp. 291-302. 2000.

472. Jalkanen, H., J. Poijärvi, and H. Pajari. "**Slags of suspension smelting of chalcopyrite ores and copper matte converting**." In Proc. Symp. sponsored by the Extraction and Processing Division (EPD) of TMS. Held during the 2002 TMS Annual Meeting in Seattle, Washigton, February 17-21, 2002, pp. 363-376. 2002.

473. Kennedy, Mark William. "**Electric slag furnace dimensioning**." In International Smelting Technology Symposium: Incorporating the 6th Advances in Sulfide Smelting Symposium, pp. 279-290. Hoboken, NJ, USA: John Wiley & Sons, Inc., 2012.

474. König, Roland, Axel Weyer, Rolf Degel, Jürgen Schmidl, Harald Kadereit, and Andreas Specht. "**Highly efficient slag cleaning—latest results from pilot-scale tests**." REWAS 2013: Enabling Materials Resource Sustainability (2016): 2-12.

475. Kunze, J., R. Degel, and A. Warczok. "**Current status and new trends in copper slag cleaning**." In 5th International Conference Copper, pp. 459-473. 2003.

476. MACKAY, RS, DC CORDERO, JS ESTEBAN, and GRF ALVEAR. "**Continuous improvement of the Teniente slag cleaning process**." In Proceedings of the Sixth International Conference on Molten Slags, Fluxes and Salts, Stockholm. 2000.

477. MARISCAL, L., and E. HERRERA. "**Isasmelt slag chemistry and copper losses in the rotary holding furnaces slag at Ilo smelter**." (2009): 1241-1250.

478. Li, Tianguo, Yue Liu, Shan Zhang, and Ming Jiang. "**Physicochemical, mineralogical liberation characteristics, and direct recovery of copper and iron from copper electric furnace slag**." Polish Journal of Environmental Studies 30, no. 3 (2021): 2621-2630.

479. Cornejo, Karen, Mao Chen, and Baojun Zhao. "**Control of Copper Loss in Flash Smelting Slag**." In Materials Engineering—From Ideas to Practice: An EPD Symposium in Honor of Jiann-Yang Hwang, pp. 71-79. Springer International Publishing, 2021.

480. Qu, Guorui, Yonggang Wei, Bo Li, Hua Wang, Yindong Yang, and Alexander McLean. "**Distribution of copper and iron components with hydrogen reduction of copper slag**." Journal of Alloys and Compounds 824 (2020): 153910.

481. Roghani, G., Y. Takeda, and K. Itagaki. "**Phase equilibrium and minor element distribution between FeOx-SiO_2-MgO-based slag and Cu2S-FeS matte at 1573 K under high partial pressures of SO_2**." Metallurgical and Materials Transactions B 31, no. 4 (2000): 705-712.

482. Sallee, J. E., and V. Ushakov. "**Electric settling furnace operations at the Cyprus Miami Mining Corporation copper smelter**." Copper 99- Cobre 99 (1999): 629-644.

483. Elliot, barry john. "**The effect oe slag composition on copper losses to silica-saturated iron silicate slags**." (1977).

484. Xia, J. L., and Tapio Ahokainen. "**Numerical modelling of slag flows in an electric furnace**." Scandinavian journal of metallurgy 33, no. 4 (2004): 220-228.

485. Zhou, Shiwei, Linchuan Wang, Yonggang Wei, Bo Li, and Hua Wang. "**Matte separated behavior from slag during the cleaning process by using waste cooking oil as carbon neutral reductant**." Journal of Mining and Metallurgy, Section B: Metallurgy 57, no. 3 (2021): 379-388.

486. Yang, H., J. Wolters, Philipp Pischke, H. Soltner, S. Eckert, G. Natour, and J. Fröhlich. "**Modelling and simulation of a copper slag cleaning process improved by electromagnetic stirring**." In IOP Conference Series: Materials Science and Engineering, vol. 228, no. 1, p. 012007. IOP Publishing, 2017.

487. Warczok, A., G. Riveros, R. Degel, J. Kunze, and H. Oterdoom. "**Slag cleaning in circular and rectangular electric furnaces**." Cu2007 111 (2007): 403-416.

488. Taskinen, p. "**numerical modeling of copper droplet settling behavior in the settler of a flash smelting furnace**."

489. Gonzalez, c., r. Parra, a. Klenovcanova, i. Imris, and m. Sanchez. "**Reduction of chilean copper slags: a case of waste management project**." scandinavian journal of metallurgy 34, no. 2 (2005): 143-149.

490. Henao, Hector M., Claudio Pizarro, Jonkion Font, Alex Moyano, Peter C. Hayes, and Evgueni Jak. "**Phase Equilibria of "Cu_2O"-"FeO"-CaO-MgO-Al_2O_3 Slags at PO_2 of 10-8.5 atm in Equilibrium with Metallic Copper for a Copper Slag Cleaning Production**." Metallurgical and Materials Transactions B 41 (2010): 1186-1193.

491. Bergh, L. G., J. B. Yianatos, and P. B. Chacana. "**Intelligent sensor for coal powder rate injection in a slag cleaning furnace**." Minerals engineering 13, no. 7 (2000): 777-781.

492. Li, Bo, Yonggang Wei, Hua Wang, and Yindong Yang. "**Reduction of magnetite from copper smelting slag using petro-diesel and biodiesel**." ISIJ International 58, no. 6 (2018): 1168-1174.

493. Wang, Zhi, Ruimin Bian, Chuanbing Wei, Baojun Zhao, Haibin Wang, and Wenzhao Cui. "**Application Study on Technology of Reducing Copper Content in Discarded Slag**." In 2018-Sustainable Industrial Processing Summit, vol. 7, pp. 67-76. Flogen Star Outreach, 2018.

494. Henao, Hector, Peter Hayes, Evgueni Jak, C. Pizarro, Jonkion Font, and Alex Moyano. "**Phase equilibria of fayalite-based slags for the slag cleaning process in copper**

production." In 8th international conference on molten slags, Santiago. University of Concepcion, Chile, pp. 93-100. 2009.

495. Langberg, David, Michael Somerville, and Tony Briffa. "**Kinetics and mechanism of copper slag cleaning by injection of natural gas**." In Sohn International Symposium; Advanced Processing of Metals and Materials Volume 8: International Symposium on Sulfide Smelting 2006, vol. 8, p. 755. 2006.

496. Reddy, R. G., V. L. Prabhu, and D. Mantha. "**Kinetics of reduction of copper oxide from liquid slag using carbon**." High Temperature Materials and Processes 22, no. 1 (2003): 25-34.

497. Tang, Chao-bo, Yun Li, Yong-ming Chen, Sheng-hai Yang, Long-gang Ye, and Hao-tian Xue. "**Distribution behaviours of cu, Co and Fe during Cu smelter slag cleaning process**." In 6th International Symposium on High-Temperature Metallurgical Processing, pp. 429-436. Springer International Publishing, 2016.

498. Isaksson, Jenny. "**Slag Cleaning of a Reduced Iron Silicate Slag by Settling: Influence of Process Parameters and Slag Modification on Copper Content**." PhD diss., Luleå University of Technology, 2021.

499. Hidayat, Taufiq, Peter C. Hayes, and Evgueni Jak. "**Characterisation of the Effect of Al_2O_3 on the Liquidus Temperatures of Copper Cleaning Furnace Slags Using Experimental and Modelling Approach**." Materials transactions 60, no. 7 (2019): 1377-1383.

500. Czernecki, Jozef, Zbigniew Smieszek, Zdzislaw Miczkowski, Norbert Kubacz, Jerzy Dobrzanski, Janusz Staszak, and Leszek Byszynski. "**The slag cleaning technologies for one-stage flash smelting of KGHM Polska Miedz concentrates**." In Sohn International Symposium; Advanced Processing of Metals and Materials Volume 8: International Symposium on Sulfide Smelting 2006, vol. 8, pp. 181-197. 2006.

501. Banda, Wezi. "**High temperature phase equilibria in the Fe-Co-Cu-Si system pertinent to slag cleaning**." PhD diss., Stellenbosch: University of Stellenbosch, 2006.

502. Isaksson, Jenny, Tommy Vikström, Andreas Lennartsson, Anton Andersson, and Caisa Samuelsson. "**Settling of copper phases in lime modified iron silicate slag**." Metals 11, no. 7 (2021): 1098.

503. Ye, Zhonglin, Guangping Dai, Ba Zhang, Shiwei Zhou, Bo Li, Yonggang Wei, and Hua Wang. "**Apparent Viscosity Evolution of Copper Converter Slag during a Reduction Process**." Mining, Metallurgy & Exploration (2022): 1-10.

504. Palacios, J., and M. Sánchez. "**Wastes as resources: update on recovery of valuable metals from copper slags**." Mineral Processing and Extractive Metallurgy 120, no. 4 (2011): 218-223.

505. Isaksson, Jenny, Tommy Vikström, Anton Andersson, Andreas Lennartsson, and Caisa Samuelsson. "**Industrial Slag Cleaning of Reduced Iron Silicate Slag-Effect of Process Parameters and Slag Modification**." In Copper 2022 International Conference, Santiago, Chile, pp. 22-40. 2022.

506. Saari, Visa, Petri Latostenmaa, Juho Yliniemi, and Katja Ohenoja. "**Boliden Harjavalta copper and nickel smelter-review of smelter operations, slags and slag valorisation studies**." In Proceedings of the 6th International Slag Valorisation Symposium, pp. 1-5. 2019.

1.4 Converting of Copper Matte

1.4.1 General consideration

507. Devia, Manuel, Roberto Parra, Claudio Queirolo, Mario Sánchez, and Igor Wilkomirsky. "**Copper smelting and converting: past and present Chilean developments**." Mineral Processing and Extractive Metallurgy 128, no. 1-2 (2019): 108-116.

508. Itagaki, Kimio, Hong Yong Sohn, and Manuel Pérez-Tello. "**Basic Principles of Sulfide Smelting and Converting with Oxygen–Rich Gas**." Sulfide Smelting (2002): 15-39.

509. Taskinen, Pekka, Guven Akdogan, Ilkka Kojo, Markku Lahtinen, and Ari Jokilaakso. "**Matte converting in copper smelting**." Mineral Processing and Extractive Metallurgy 128, no. 1-2 (2019): 58-73.

510. Stubina, Nathan M. "**Thermal Processing: Pyrometallurgy—Non-ferrous: Innovations in Non-ferrous Pyrometallurgical Processing: Case Study of the Peirce–Smith Converter**." Innovative Process Development in Metallurgical Industry: Concept to Commission (2016): 67-76.

511. Martín, Antonio, Jesús Hurtado, and Francisco Jiménez. "**Atlantic Copper PS-Converters Environmental Improvements: A Continuous Commitment to the Future**." In International Smelting Technology Symposium: Incorporating the 6th Advances in Sulfide Smelting Symposium, pp. 99-106. Hoboken, NJ, USA: John Wiley & Sons, Inc., 2012.

512. Navarra, A., and J. Kapusta. "**Decision-making software for the incremental improvement of Peirce-Smith converters**." In International Peirce-Smith Converting

Centennial Symposium, Proceedings of the TMS Annual Meeting, San Francisco, CA, USA, pp. 15-19. 2009.

513. Ek, M., and P. Olsson. "**Recent developments on the Peirce-Smith converting process at the Rönnskär smelter**." Converter and Fire Refining Practices (2005): 19-26.

514. Sohn, Hong Yong. "**Beyond the Peirce-Smith converter: Recent advances in sulfide smelting processes**." JOM 46 (1994): 50-50.

515. Tomova, F. "**Research on methods of predicting the state of the Peirce-Smith converters for the purposes of predictive maintenance**." Journal of Automatics and Informatics 2 (2014): 14-21.

516. Wing, K., J. P. Kapusta, R. Harris, A. E. Wraith, and R. Parra. "**Modelling Peirce-Smith converter operating cost**." JOM 57, no. 7 (2005): 52-57.

517. Warner, A. E. M., J. Liu, F. Javor, R. Lawson, W. Shellshear, T. Hoang, and R. Falcioni. "**Developments in Peirce–Smith converting at Inco's Copper Cliff smelter during the last 35 years**." Converter and fire refining practice. San Francisco, CA: TMS (2005): 27-43.

518. Vemey, L. R. "**Peirce-Smith copper converter operations and economics**." In Copper 87 4, no. 55 (1987): 75.

519. Gonzales, T. W., D. Snashall, O. Pasca, and Robert David. "**Converter operation at BHP San Manuel Smelter**." Copper 99- Cobre 99 (1999): 417-431.

520. Filzwieser, Andreas, Thomas Prietl, P. L. Nystedt, and Peter Olsson. "**Implementation of the RHI COP KIN System in Peirce-Smith-Converters**." RHI bulletin: the journal of refractory innovations (2003): 13-15.

521. Mori, K., N. Nagai, K. Morita, and O. Nakano. "**Recent operation and improvement at the Sumitomo Toyo Peirce-Smith converters**." In International Peirce-Smith Converting Centennial (The Minerals, Metals and Materials Society Conference, 2009), pp. 151-160. 2009.

522. Rigby, A. J., T. Warner, and K. Scholey. "**Controlling the Process Parameter Affecting the Refractory Requirements for Peirce-Smith Converters and Anode Vessels**." TMS 2005 Converting and Fire Refining (2005): 213-222.

523. Lennartsson, Andreas, Fredrik Engström, Bo Björkman, and Caisa Samuelsson. "**Modelling of a Cu-making converter: a necessary tool for improved recycling**." In International Process Integration Forum for the Steel Industry: 09/06/2014-10/06/2014. 2014.

524. Chen, S., H. Mansikkaviita, M. Rytkonen, and I. Kylmakorpi. "**Continuous improvement in Peirce-Smith converter design–Kumera's approach**." In Proceedings of the International Peirce-Smith Converting Centennial Symposium (TMS Conference), Warrendale, PA: TMS, pp. 361-365. 2009.

525. Boshnakov, K., T. Ginchev, V. Petkov, and E. Mihailov. "**Strategy for predictive maintenance of Peirce-Smith converters**." Proceedings of the Technical University of Sofia 62 (2012): 345-354.

526. Kawai, T., M. Nishiwaki, and S. Hayashi. "**Copper concentrate smelting in Peirce-Smith converters at Onahama Smelter**." In Converter and Fire Refining Practices (The Minerals, Metals and Materials Society Conference, 2005), pp. 119-123. 2005.

527. Tanaka, S., M. Hamamoto, M. Hashimoto, and S. Udo. "**Operation and improvements on Peirce-Smith converters at the Tamano Smelter**." In Converter and Fire Refining Practices (The Minerals, Metals and Materials Society Conference, 2005), pp. 79-88.

528. Vos, R. A., C. A. Levac, L. Ulveling, and T. J. Evans. "**The Injection of Copper Concentrate into Peirce-Smith Converters at the Home Smelter, Noranda Copper Smelting and Refining**." In 32nd Annual Conference of Metallurgists, Quebec City, QC. 1993.

529. Navarra, A., and C. Acuña. "**The structure of Peirce-Smith converting schedules**." In Ralph Lloyd Harris Memorial Symposium—Conference Proceedings, pp. 427-439. 2013.

530. Lehner, Theo, and A. G. Ross. "**Progress in converting and casting**." In TMS annual meeting: 13/02/2005-17/02/2005, pp. 3-18. Minerals, Metals & Materials Society, 2005.

531. Mattila, T. "**New emerging technologies in copper converting**." (2003).

532. Rigby, a. J. "**refractory requirements for peirce-smith converters**." converter and fire refining practices 2, no. 1200 (2005): 213.

533. Ahmed, H., L. Ricardez-Sandoval, and M. Vilkko. "**Optimal Scheduling of Peirce-Smith Converter in Copper Smelting Process. Processes 2021, 9, 2004**." (2021).

534. Fukushima, K., K. Baba, H. Kurokawa, and M. Yamagiwa. "**Development of Automation Systems for Copper Converters and Anode Casting Wheel at Toyo Smelter**." Process Control and Automation in Extractive Metallurgy (1989): 113-130.

535. Vignes, Alain. "**Sulfide and Matte Smelting and Converting Operations**." Extractive Metallurgy 3: Processing Operations and Routes (2013): 185-215.

536. Björkman, Bo, and Gunnar Eriksson. "**Quantitative equilibrium calculations on conventional copper smelting and converting**." Canadian Metallurgical Quarterly 21, no. 4 (1982): 329-337.

537. LIRA, MUFU. "**Improvements on Converter Operating Practice at Mufulira Smelter**." In International Smelting Technology Symposium: Incorporating the 6th Advances in Sulfide Smelting Symposium, p. 107. John Wiley & Sons, 2012.

538. Rigby, a. J. "**optimization of the refractory lining life of copper converters**."

539. Chen, Jun, Xiaoqi Peng, and Xiuming Tang. "**Error Correction of Support Vector Regression Model for Copper-Matte Converting Process**." In Proceedings of the 2015 Chinese Intelligent Automation Conference: Intelligent Technology and Systems, pp. 117-127. Berlin, Heidelberg: Springer Berlin Heidelberg, 2015.

540. Verney, lr. "**peirce smith copper converter operations and economics, paper from copper 87, volume 4, pyrometallurgy of copper, an international conference held in vina del mar, chile, nov 30- dec 3, 1987**." papers (1988).

541. Navarra, A., and F. Mucciardi. "**Discrete event simulation to quantify upgrades of Peirce-Smith converting aisles**." Applications of Computers and Operations Research in the

542. Hadjiski, Mincho, Kosta Boshnakov, and Todor Ginchev. "**Cost Oriented Redesign of Condition-Based Maintenance of Copper Converting Process**." IFAC Proceedings Volumes 46, no. 8 (2013): 250-255.

543. Rannantie, Suvi. "**Implementation, analysis and GUI design of statistical batch model for Peirce Smith Converters**." Master's thesis, 2007.

544. Johnson, R. E., N. J. Themelis, and G. Eltringham. "**A survey of worldwide copper converter practices**." Copper and Nickel Converters (1979): 1-32.

545. Lehner, Th, O. Ishikawa, T. Smith, J. Floyd, P. Mackey, and C. Landolt. "**The 1993 Survey of Worldwide Copper and Nickel Converter Practices**." Converting, Fire Refining and Casting (1994): 1-58.

546. Price, T., C. Harris, S. Hills, W. Boyd, and A. Wraith. "**Peirce-Smith converting: another 100 years**." International peirce-smith converting centennial. San Francisco: TMS (The Minerals, Metals & Materials Society) (2009): 15-19.

1.4.2 Thermodynamic and kinetics of copper converting

547. Pérez, Ismael, Ignacio Moreno-Ventas, Guillermo Ríos, and Tomás Bravo. "**Study of Industrial Copper Matte Converting Using Micrography and Thermochemical Calculations**." Metallurgical and Materials Transactions B 51 (2020): 1432-1445.

548. Nagamori, M., and P. J. Mackey. "**Thermodynamics of copper matte converting: Part I. Fundamentals of the noranda process**." Metallurgical Transactions B 9 (1978): 255-265.

549. Nagamori, M., and P. J. Mackey. "**Thermodynamics of copper matte converting: part II. Distribution of Au, Ag, Pb, Zn, Ni, Se, Te, Bi, Sb and As between copper, matte and slag in the noranda process**." Metallurgical Transactions B 9 (1978): 567-579.

550. Nagamori, M., and P. C. Chaubal. "**Thermodynamics of copper matte converting: Part III. Steady-state volatilization of Au, Ag, Pb, Zn, Ni, Se, Te, Bi, Sb, and As from slag, matte, and metallic copper**." Metallurgical Transactions B 13 (1982): 319-329.

551. Nagamori, M., and P. C. Chaubal. "**Thermodynamics of copper matte converting: Part IV. A priori predictions of the behavior of Au, Ag, Pb, Zn, Ni, Se, Te, Bi, Sb, and As in the noranda process reactor**." Metallurgical Transactions B 13 (1982): 331-338.

552. Kyllo, A. K., and G. G. Richards. "**A kinetic model of the Peirce-Smith converter: Part I. Model formulation and validation**." Metallurgical and Materials Transactions 29, no. 1 (1998): 239.

553. Kyllo, A. K., and G. G. Richards. "**A kinetic model of the Peirce-Smith converter: Part II. Model application and discussion**." Metallurgical and Materials Transactions B 29 (1998): 251-259.

554. Tan, Pengfu. "**CuModel—a thermodynamic model and computer program of copper smelting and converting processes and its industrial applications**." In EPD Congress, pp. 411-422. 2004.

555. Tan, Pengfu. "**Applications of thermo-chemical and thermo-physical modeling in the copper converter industries**." International Peirce-Smith converting centennial (2009): 273-295.

556. Tan, Pengfu. "**Applications of thermodynamic modeling in copper converting operations**." International journal of materials research 98, no. 10 (2007): 995-1003.

557. Aminizadeh, N., and S. H. Mansouri. "**Thermo-chemical model of the Pierce-Smith copper converter**." Proceedings of the Institution of Mechanical Engineers, Part E: Journal of Process Mechanical Engineering 221, no. 3 (2007): 129-138.

558. Degterov, Sergei A., and Arthur D. Pelton. "**A thermodynamic database for copper smelting and converting**." Metallurgical and Materials Transactions B 30 (1999): 661-669.

559. Schmidt, J., K. Hein, and P. Koltzsch. "**Model Investigations on the Kinetics of Oxidic Reactions in a Converter**." Neue Hutte 34, no. 4 (1989): 138-141.

560. Vaarno, J. "**Modelling the thermodynamics of oxidation reactions in Peirce-Smith-converter**." (1997).

1.4.3 Copper and slag blow

561. Tan, Pengfu, and Pierre Vix. "**Modeling of Slag Blow in Copper Peirce-Smith Converters**." In First Extractive Metallurgy Operators' Conference. Eds: Peter Hayes. AusIMM, pp. 7-8. 2005.

562. Roselló, A., J. Martínez, P. Barrios, and F. Carrillo. "**Desulfurization rate during the copper blow in a peirce–smith converter**." Metallurgical and Materials Transactions B 39 (2008): 16-22.

563. Carrillo, F., R. Hernández, J. Martinez, and A. Roselló. "**Kinetics of the copper blow in the Peirce-Smith converter**." Información Tecnológica 15 (2004): 33-36.

564. Cardona, N., P. J. Mackey, P. Coursol, R. Parada, and R. Parra. "**Thermodynamic Modeling of Peirce-Smith Converter Slag at the Chagres Smelter, Chile**." Supplemental Proceedings: Materials Properties, Characterization, and Modeling 1 (2012): 117-124.

1.4.4 Matte, slag and white metal

1.4.5 Slag

565. Wartman, Frank S., and W. T. Boyer. **The Form of Copper in Converter Slag**. Vol. 2985. US Department of Commerce, Bureau of Mines, 1930.

566. Wolf, anton, and aleksandar m. Mitrasinovic. "**Metals coalescence in copper cliff converter slag**." journal of mining and metallurgy, section b: metallurgy 52, no. 2 (2016): 143-150.

567. Nikoo, sarafraz. "**Effect of slag basicity on corrosion of refractories in copper converter**." in unitecr'01. Proc. Unified int. Tech. Conf. On refractories. 7 th biennial worldwide congress., vol. 1, pp. 514-523. 2001.

568. Hou, Xing, Guoqing Xiao, Donghai Ding, Ningxuan Zhang, and Yunqin Gao. "**Effects of Cr_2O_3 content on viscosity and microstructure of copper converter slag**." Journal of Non-crystalline Solids 574 (2021): 121147.

569. Tan, Pengfu, and Pierre Vix. "**Modelling, control and optimisation of chemistry and viscosity of copper converter slag**." In EPD Congress, vol. 2006, pp. 1023-1034. 2006.

570. Fallah-Mehrjardi, Ata, Jani Jansson, Pekka Taskinen, Peter C. Hayes, and Evgueni Jak. "**Investigation of the freeze-lining formed in an industrial copper converting calcium ferrite slag**." Metallurgical and materials transactions B 45 (2014): 864-874.

571. Zhou, Shiwei, Yonggang Wei, Yu Shi, Bo Li, and Hua Wang. "**Characterization and recovery of copper from converter copper slag via smelting separation**." Metallurgical and Materials Transactions B 49 (2018): 2458-2468.

572. Karimova, Tursunoy Parkatovna, Shokhrukh Toshpo'latovich Khojiev, Malika Sayfullaevna Saidova, and Nigora Qobilovna. "**To Prevent the Loss of Copper with Slag during the Casting of the Converter Slag**." (2021).

573. Cuaubal, P. C., M. Nagamori, and H. Y. Sohn. "**Volatilization and slagging of lead in copper matte converting: computer simulation**." Canadian Metallurgical Quarterly 23, no. 4 (1984): 405-411.

574. Utigard, t. A., and a. Warczok. "**Density and viscosity of copper/nickel sulphide smelting and converting slags**." in proceedings of copper, pp. 423-437. 1995.

1.4.5.1 Matte

575. Barron, Miguel A., and Carlos A. Hernandez. "**Air-slag-matte interaction in a Peirce-Smith copper converter**." In Proceedings of the International Conference on Modeling, Simulation and Visualization Methods (MSV), p. 28. The Steering Committee of The World Congress in Computer Science, Computer Engineering and Applied Computing (WorldComp), 2016.

576. Liow, J. L., G. E. Assaad, P. Liovic, N. B. Gray, and M. R. Rudman. "**Modelling of slag-skimming in a Peirce-Smith converter**." In Fourth International Conference COPPER 99-COBRE 99, pp. 417-431. 1999.

577. Chen, Jiang, Ata Fallah-Mehrjardi, Andreas Specht, and Hugh St C. O'Neill. "**Measurement of minor element distributions in complex copper converting slags using quantitative microanalysis techniques**." Jom (2022): 1-10.

578. Mitarai, T., S. Akagi, and M. Maeda. "**Development of the Technique to Determine the End-Point of the Slag-Making Stage in Copper Converter, Paper from the**

1994 TMS International Symposium on Converting, Fire Refining and Casting, San Francisco, California, February 27-March 3, 1994." TMS Papers (1994): 169-180.

579. Roa-jofré, maximiliano f., víctor r. Parra-sánchez, gonzalo a. Reyes-alcántara, eugenia a. Araneda-hernández, eduardo r. Balladares-varela, roberto a. Parra-figueroa, and camila v. Mora-vilches. "**Experimental determination of the conversion rate of molten white metal by supplying individual air bubbles**." metals 12, no. 6 (2022): 980.

580. Nagamori, M., P. J. Mackey, and P. Tarassoff. "**The distribution of As, Sb, Bi, Se, and Te between molten copper and white metal**." Metallurgical and Materials Transactions B 6 (1975): 197-198.

1.4.6 Magnetite formation during copper converteting

581. Tan, Pengfu, and Pierre Vix. "**Control of magnetite formation during slag-making in copper PS converter**." In Converter and Fire Refining Practices (The Minerals, Metals and Materials Society Conference, 2005), pp. 247-258.

582. Kurochkin, A. F., and I. Onaev. "**Origin and Behavior of Magnetite in Copper Smelting Slags**." Izv. V. U. Z. Tsvetn. Metall. 6 (1981): 22-26.

583. Morales, C., J. Palacios, and M. Sanchez. "**Magnetite behaviour in Peirce Smith converters slag at Ilo copper smelter plant, Peru**." In VII International Conference on Molten Slags, Fluxes and Salts, The South African Institute of Mining and Metallurgy. 2004.

584. Zhou, Hao, Bo Li, Yonggang Wei, Hua Wang, Yindong Yang, and Alexander McLean. "**Magnetite reduction in copper converter slag using biodiesel produced from waste cooking oil**." Canadian Metallurgical Quarterly 58, no. 2 (2019): 187-195.

1.4.7 Phase distribution and equilibrium

585. Jak, E., T. Hidayat, D. Shishin, P. J. Mackey, and P. C. Hayes. "**Modelling of liquid phases and metal distributions in copper converters: transferring process fundamentals to plant practice**." Mineral Processing and Extractive Metallurgy 128, no. 1-2 (2019): 74-107.

586. Sun, Yongqi, Mao Chen, Zhixiang Cui, Leonel Contreras, and Baojun Zhao. "**Phase equilibrium studies of iron silicate slag in the liquid/spinel/white metal/gas system for copper converting process**." Metallurgical and Materials Transactions B 51 (2020): 426-432.

587. Chibwe, Deside K., Guven Akdogan, Chris Aldrich, and Pekka Taskinen. "**Characterisation of phase distribution in a Peirce–Smith converter using water model**

experiments and numerical simulation." Mineral Processing and Extractive Metallurgy 120, no. 3 (2011): 162-171.

1.4.8 Flux control

588. Stricklen, R. R., and W. Torres. "**High Grade Flux Usage in Southern Peru Copper Corporation Converters and Its Effect on Brick Consumption and Reverb Smelting Rate**." Converting, Fire Refining and Casting (1994): 371-380.

589. Eltringham, G. A. "**Developments in converter fluxing. In J. D. McCain, & J. M. Floyd (Eds.), Converting, fire refining and casting**." Warrendale, PA: TMS (1993): 323-331).

590. Schonewille, R. H., G. J. O'Connell, and J. M. Toguri. "**A quantitative method for silica flux evaluation**." Metallurgical Transactions B 24 (1993): 63-73.

591. Coursol, p., and p. Larouche. "**Using carbonate fluxes to remove oxygen and sulfur from blister copper**." jom 56 (2004): 42-45.

1.4.9 Splashing, Slopping and foaming over

592. Koohi, A. H., Mohammad Halali, and Masood Askari. "**Improvement of pierce-smith converter performance and reduction of splashing using smoothed particle hydrodynamics method**." Advanced Science Letters 19, no. 2 (2013): 425-428.

593. Zhao, Hongliang, Jingqi Wang, Fengqin Liu, and Hong Yong Sohn. "**Experimental Study on Bubble Distribution and Splashing in a Peirce–Smith Copper Converter**." Metallurgical and Materials Transactions B 52 (2021): 440-450.

594. Hattori, Y. "**A Model Study of Splash a Peirce-Smith Converter**." In Second International Conference on processing Materials for Properties, vol. 829. 2000.

595. Rosales, Marco, Alvaro Valencia, and Ramón Fuentes. "**A methodology for controlling slopping in copper converters by using lateral and bottom gas injection**." International Journal of Chemical Reactor Engineering 7, no. 1 (2009).

596. Liow, Jong-Leng, and Neil B. Gray. "**Slopping resulting from gas injection in a Peirce-Smith converter: water modeling**." Metallurgical Transactions B 21 (1990): 987-996.

597. Tan, pengfu, pierre vix, and paul telford. "**Controlling of foaming phenomena during copper blow in copper ps converter**."

598. Tan, Pengfu, Jared Ball, Ben Hogg, Darren Snashall, and Paul Telford. "**Modeling of copper converter foamover and operational improvements**." In EPD Congress 2011, pp. 787-799. Hoboken, NJ, USA: John Wiley & Sons, Inc., 2011.

599. Kapusta, J. P. "**Gas injection phenomena in converters-an update on buoyancy power and bath slopping**." In Proceedings of Cu2010, the Seventh International Copper-Cobre Conference, pp. 839-862. 2010.

600. Richards, G. G., K. J. Legard, A. A. Bustos, J. K. Brimacombe, and D. Jorgensen. "**Bath Slopping and Splashing in the Copper Converter, The Reinhardt Schumann Intern**." In Symposium on Innovative Technology and Reactor Design in Extraction Metallurgy, DR Gaskell, Ed. Colorado Springs, CO, TMS-AIME, Warrendale, PA, pp. 385-403. 1986.

601. Taylor, J. C. "**Approaches to Dust and Fume Control in Copper and Nickel Smelters**." TMS/AIME, (1979): 13.

1.4.10 Minor element in copper converting

602. Mendoza, Hernan, and Antonio Luraschi. "**Impurity Elimination in Copper Converting**." Converting, Fire Refining and Casting (1994): 191-202.

603. Holland, Keiran, Dmitry Sukhomlinov, Ville Naakka, Ari Jokilaakso, and Pekka Taskinen. "**Behavior of Co, Ni and precious metals in copper converting process: experimental study**." In Energy Technology 2018: Carbon Dioxide Management and Other Technologies, pp. 217-224. Cham: Springer International Publishing, 2018.

1.4.11 Transport phenomena in copper converting

604. Chibwe, Deside K., Guven Akdogan, Chris Aldrich, and Rauf H. Eric. "**CFD modelling of global mixing parameters in a Peirce-Smith converter with comparison to physical modelling**." Chemical product and process modeling 6, no. 1 (2011).

605. Chibwe, D. K., Guven Akdogan, Pekka Taskinen, and J. J. Eksteen. "**Modelling of fluid flow phenomena in Peirce-Smith copper converters and analysis of combined blowing concept**." Journal of the Southern African Institute of Mining and Metallurgy 115, no. 5 (2015): 363-374.

606. Almaraz, Aaron, César López, Isaac Arellano, Miguel A. Barrón, David Jaramillo, Fidel Reyes, and Gabriel Plascencia. "**CFD modelling of fluid flow in a Peirce–Smith converter with more than one injection point**." Minerals Engineering 56 (2014): 102-108.

607. Almaraz, Aarón, Cesar López, Miguel Angel Barron Meza, and Gabriel Plascencia. "**Numerical and physical modeling of turbulence in a peirce-smith copper converter**." Journal of Materials Science and Engineering. A 3, no. 7A (2013): 510.

608. Real, Cesar, Luis Hoyos, Francisco Cervantes, Raul Miranda, Manuel Palomar-Pardave, Miguel Barron, and Jesus Gonzalez. "**Fluid characterization of copper converters**." Mecánica computacional 11 (2007): 1311-1323.

609. Zhao, Hongliang, Jingqi Wang, Fengqin Liu, and Hong Yong Sohn. "**Flow zone distribution and mixing time in a Peirce—Smith copper converter**." International Journal of Minerals, Metallurgy and Materials (2022): 1-8.

610. Barron, Miguel, Cesar Lopez, Gabriel Plascencia, and Isaias Hilerio. "**Large Eddy Simulation of Bubbling-Jetting Transition in a Bottom Blown Copper Converter**." In MSV, pp. 91-96. 2010.

611. Soozanian Kashani, Mehdi, Reza Dehghani Yazdeli, and Ghanbar Ali Sheikhzadeh. "**Fluid dynamics in a copper converter: an investigation on mixing phenomena in an experimental model**." International Journal of Engineering 29, no. 1 (2016): 118-126.

612. Barrón, m. A., g. Plascencia, i. Hilerio, j. González, c. Real, and c. López. "**Numerical analysis of the onset of turbulence in a copper converter**."

613. Song, Kezhou, and Ari Jokilaakso. "**Transport phenomena in copper bath smelting and converting processes–A review of experimental and modeling studies**." Mineral Processing and Extractive Metallurgy Review 43, no. 1 (2022): 107-121.

614. Zhao, Hong-liang, Jing-qi Wang, and Feng-qin Liu. "**Experimental study on flow zone distribution and mixing time in a Peirce-Smith copper converter**."

615. Chibwe, D. K., G. Akdogan, and Pekka Taskinen. "**Numerical investigation of combined top and lateral blowing in a Peirce-Smith converter**." Chemical Product and Process Modeling 8, no. 2 (2013): 119-127.

616. Zhao, Xing, Hong-liang Zhao, Li-feng Zhang, and Li-qiang Yang. "**Gas–liquid mass transfer and flow phenomena in the Peirce–Smith converter: a water model study**." International Journal of Minerals, Metallurgy, and Materials 25 (2018): 37-44.

617. Lu, Tingting, Yadong Xiao, Yugao Zhou, Qiuqiong Su, Tao Wei, Fengqin Liu, and Hongliang Zhao. "**Numerical Simulation of Nozzle Height on the Effect of Fluid Flow in a Peirce–Smith Converter**." JOM 73, no. 10 (2021): 2938-2945.

618. Chibwe, D., Guven Akdogan, and Jacques Eksteen. "**Solid-liquid mass transfer in a Peirce-Smith converter: A physical modelling study**." Metallurgical and Mining Industry 3, no. 5 (2011): 202-210.

619. Lennartsson, Andreas, Fredrik Engström, Bo Björkman, and Caisa Samuelsson. "**Development of a model for copper converting**." Canadian Metallurgical Quarterly 52, no. 4 (2013): 422-429.

620. Schmidt, J., and K. Hein. "**Stroemungsuntersuchungen im Modell... (Investigation of the Flow Phenomena in a Peirce-Smith Converter Model By Means of a Laser-Doppler Anemometer).**" Neue Huette 34, no. 10 (1989): 385-387.

621. Barrios, Oscar, Miguel A. Barron, Dulce Y. Medina, and Isaias Hilerio. "**Computer Simulation of the Multiphase Flow in a Peirce-Smith Copper Converter**." Open Journal of Applied Sciences 8, no. 7 (2018): 296-303.

622. Navarra, A., G. Lemoine, N. Zaroubi, and T. Marin. "**Semi-discrete dynamics and simulation of Peirce-Smith converting**." In Extraction 2018: Proceedings of the First Global Conference on Extractive Metallurgy, pp. 273-285. Springer International Publishing, 2018.

623. Bustos, A. A., J. K. Brimacombe, and G. G. Richards. "**Heat flow in copper converters**." Metallurgical Transactions B 17 (1986): 677-685.

624. Adjei, Emmanuel. "**Physical modelling of mass transfer in a Peirce-Smith converter**." PhD diss., University of British Columbia, 1989.

625. Vaarno, Jussi, J. Pitkaelae, Tapio Ahokainen, and Ari Jokilaakso. "**Isothermal CFD-model of Peirce-Smith converting process**." (1997).

626. Resende, Alexandre Dolabella, and Felipe Terra Elias. "**Increasng refractory life in a pierce-smith converter through numerical simulations**." Felipe Terra Elias Magnesita, Contagem, Brazil (2014).

627. Chibwe, Deside Kudzai. "**Flow behavior, mixing and mass transfer in a peirce-smith converter using physical model and computational fluid dynamics**." PhD diss., Stellenbosch: University of Stellenbosch, 2011.

628. Zhao, Hong-liang, Xing Zhao, Liang-zhao Mu, Li-feng Zhang, and Li-qiang Yang. "**Gas-liquid mass transfer and flow phenomena in a peirce-smith converter: A numerical model study**." International Journal of Minerals, Metallurgy, and Materials 26 (2019): 1092-1104.

629. Adjei, E., and G. G. Richards. "**Physical Model of Mass Transfer in a Peirce-Smith Converter**." Copper.

630. Waterson, W. R., and I. T. Cameron. "**A comprehensive dynamic model of the Peirce-Smith copper converter: a first towards better converter-aisle operations**." Proceedings of AusIMM98 (1998): 401-406.

631. Almaraz, aaron, erik salas, miguel a. Barron, ricardo cuenca, david jaramillo, fidel reyes, and gabriel plascencia. "**Modelling of fluid flow in a ps converter with one and three injection points**." (2012).

632. Caballero, C., A. Moyano, P. Morales, C. Toro, H. Jara, L. Guzmán, and R. Díaz. "**A dynamic simulation for the validation tests of the Codelco-Chile continuous converting process**." Proceedings of the International Peirce-Smith Converting Centennial, San Francisco, CA, USA (2009): 15-19.

1.4.12 Industrial peirce-smith converting operations

1.4.12.1 TAUYERE

633. Bustos, A. A., J. K. Brimacombe, and G. G. Richards. "**Accretion growth at the tuyeres of a Peirce-Smith copper converter**." Canadian Metallurgical Quarterly 27, no. 1 (1988): 7-21.

634. Liow, J-L., P. Tsirikis, and N. B. Gray. "**Study of refractory wear in the tuyere region of a Peirce-Smith nickel convertor**." Canadian metallurgical quarterly 37, no. 2 (1998): 99-117.

635. Bustos, aa, jk brimacombe, and gg richards. "**Accretion growth at the tuyeres of a peirce-smith converter**." in cim bulletin, vol. 80, no. 902, pp. 88-88. 101 6th ave sw, ste 320, calgary ab tzp 3p4, canada: canadian inst mining metallurgy petroleum, 1987.

636. Fountain, cr, and nb gray. "**The measurement and analysis of tuyere pressure-fluctuations in the tuyeres of peirce-smith converters**." in cim bulletin, vol. 80, no. 902, pp. 80-80. 101 6th ave sw, ste 320, calgary ab tzp 3p4, canada: canadian inst mining metallurgy petroleum, 1987.

637. Wraith, A. E., P. J. Mackey, C. A. Levac, and P. Element. "**Converter and bath smelting vessel design-Blast delivery and tuyère performance: A reassessment of design characteristics**." In 4th International Conference COPPER 99/COBRE 99. Newcastle University, 1999.

638. Bustos, A. A., J. K. Brimacombe, G. G. Richards, A. Vahed, and A. Pelletier. "**Development of punchless operation of Peirce-Smith converters**." In Proceedings of the Copper 87–Cobre 87 International Conference, vol. 4, pp. 347-373. 1987.

639. Goñi, Ch, V. Bazán, R. Parra, J. Martínez, L. Albornoz, P. Fernández, and L. F. Verdeja. "**Modelling of Peirce-Smith converter tuyére zone wear mechanism**." Pyrometallurgy of Copper. Quebec: Canada 4, no. 2 (2003): 285-300.

640. Bustos, a. A., j. P. Kapusta, b. R. Macnamara, and m. R. Coffin. "**High oxygen shrouded injection at falconbridge**." in copper 99-cobre 99 international conference, vol. 6, pp. 93-107. 1999.

641. Kyllo, a. K., and g. G. Richards. "**Accretion growth on single-pipe tuyeres: part i. Model development and preliminary analysis**." metallurgical transactions b 24 (1993): 571-582.

642. Kyllo, a. K., and g. G. Richards. "**Accretion growth on single-pipe tuyeres: part ii. Model results and discussion**." metallurgical transactions b 24 (1993): 583-591.

643. Lee, m. S., t. J. Evans, and n. A. Molloy. "**Tuyere geometry effects on flow performance**." ironmaking & steelmaking 28, no. 4 (2001): 329-336.

644. Bustos, a. A., g. G. Richards, n. B. Gray, and j. K. Brimacombe. "**Injection phenomena in nonferrous processes**." metallurgical transactions b 15 (1984): 77-89.

645. Lind, p. "**tuyere pressure frequency measurements in a peirce smith**."

646. Bardin, I. P., S. G. Afanasiev, M. M. Shumov, Z. D. Epstein, and NI Mozgovoy Abroad. "**The tuyere in a protective shell to convert the nickel and copper mattes**."

1.4.12.2 Punch operation

647. Bustos, A. A., J. K. Brimacombe, G. G. Richards, A. Vahed, and A. Pelletier. "**Development of punchless operation of Peirce-Smith converters**." In Proceedings of the Copper 87–Cobre 87 International Conference, vol. 4, pp. 347-373. 1987.

648. Langois, B., J. F. Leroux, D. Bedard, and P. J. Mackey. "**New developments at the Gaspe Smelter-Lengthening of the Peirce-Smith Converters for increasing throughput**." In Proceedings of Copper 95, Vol. IV-Pyrometallurgy of Copper, pp. 147-166. Montreal, Canada: CIM, 1995.

649. Marinigh, M. J. "**Technology and operational improvements in tuyere punching, silencing, pyrometry and refractory drilling equipment**." In J. Kapusta, & T. Warner (Eds.), International PeirceeSmith converting centennial.. Warrendale, PA: TMS. pp. 199-215. 2009

1.4.12.3 Injection and flow pattern

650. Kapusta, J. P. T., J. Davis, G. A. Bezuidenhout, S. Lefume, and D. K. Chibwe. "**Industrial evaluation of sonic injection in a Peirce-Smith converter at the Lonmin Platinum smelter**." In Proceedings of the 51 st Conference of Metallurgists–Towards Clean Metallurgical Processing for Profit, Social and Environmental Stewardship Symposium, pp. 43-58. 2012.

651. Kapusta, Joël P. "**Sonic injection in bath smelting and converting: myths, facts and dreams**." In Ralph Lloyd Harris Memorial Symposium, Proceedings of the Materials Science & Technology 2013, pp. 267-318. 2013.

652. Chibwe, D. K., G. Akdogan, G. A. Bezuidenhout, J. P. T. Kapusta, S. Bradshaw, and J. J. Eksteen. "**Sonic injection into a PGM Peirce-Smith converter: CFD modelling and industrial trials**." Journal of the Southern African Institute of Mining and Metallurgy 115, no. 5 (2015): 349-354.

653. Chibwe, D., G. Akdogan, S. Bradshaw, G. Bezuidenhoudt, J. Davis, Jacques Eksteen, and J. Kapusta. "**Towards sonic injection in Peirce-Smith converters: A computational fluid dynamics (CFD) modelling study**." In Proceedings of 51st Annual Conference of Metallurgists 2012, pp. 117-129. MetSoc Publication, 2012.

654. Schmidt, j. "**flow-pattern tests to optimize the injection parameters for a peirce-smith converter**." neue hutte 36, no. 8 (1991): 318-319.

655. Devia, Manuel I., Ramon H. Fuentes, and Fernando J. Guevara. "**Gaseous injection phenomenology in Peirce-Smith converters**." Proc. Copper/Cobre 95 (1995): 239-253.

656. Vaarno, Jussi, Jyrki Pitkälä, Tapio Ahokainen, and Ari Jokilaakso. "**Modelling gas injection of a Peirce–Smith-converter**." Applied Mathematical Modelling 22, no. 11 (1998): 907-920.

657. Brimacombe, J. K., S. E. Meredith, and R. G. H. Lee. "**High-pressure injection of air into a Peirce-Smith copper converter**." Metallurgical Transactions B 15 (1984): 243-250.

658. Kimura, T., S. Tsuyuguchi, Y. Ojima, Y. Mori, and Y. Ishii. "**Refractory protection by high speed blowing in a PS converter**." JOM 38, no. 9 (1986): 38-42.

659. Brimacombe, J. K. "**Meredith. SE, Lee RGH, 1984," High Pressure Injection of air into a Peirce-Smith Copper Converter**." Advances in Sulfide Smelting: 841-854.

660. Vaarno, J. "**Numeric simulation of metallurgical gas injection processes Part II-Isothermal model of a Peirce-Smith-converter**." (1997).

661. Vaarno, J., T. Ahokainen, J. Pitkälä, and Ari Jokilaakso. "**Application for Modeling Submerged Gas Injection in a Peirce-Smith Converter**." In International Symposium on Sulfide Smelting'98: Current and future practices, 16.-19.2. 1998, San Antonio, Texas, USA, pp. 227-238. TMS, 1998.

662. Brimacombe, jk, se meredith, and rgh lee. "**high-pressure injection of air into a peirce-smith copper converter, chapter from advances in sulfide smelting, volume 2. Technology and practice**." books (1983).

663. Bustos, A. A., G. G. Richards, N. B. Gray, and J. K. Brimacombe. "**Injection phenomena in nonferrous processes**." Metallurgical Transactions B 15 (1984): 77-89.

664. Coleman, M., and G. Money. "**Increasing Capacity and Productivity in the Metals Markets through Pneumatic Conveying and Process Injection Technologies**." In The Minerals, Metals and Materials Society Conference, pp. 217-230. 2009.

665. Nikompattana, king ampur. "**Implementation of air liquide shrouded injector (alsi) technology at the thai copper industries smelter**."

1.4.12.4 SO_2 Emissions and off gas collection

666. Safe, Paykan, and Robert L. Stephens. "**Peirce-Smith converter hood design analysis using computational fluid dynamics modeling**." In EPD Congress, vol. 2000, pp. 51-61. 2000.

667. Safe, Paykan, J. Deakin, and S. Matson. "**Effective design of converter hoods**." In Proceedings of the 2002 TMS Annual Meeting, pp. 17-21. 2002.

668. Safen, P., and R. Stephens. "**Peirce-Smith converter hood design using computational fluid dynamics**". The Minerals." Metals & Materials Society, British Columbia, Canada (2000).

669. Solnordal, C. B., P. J. Witt, A. Manzoori, H. Namavari, E. Niknejad, and M. Davari. "**A correlation-based model for predicting gas extraction performance in a copper converting plant**." JOM 58, no. 10 (2006): 51-55.

670. Pineda, José A., and Gabriel Plascencia. "**Exergy in Copper Converting and Its Relation to SO_2 Emissions**." Journal of Sustainable Metallurgy 2, no. 3 (2016): 265-272.

1.4.12.5 Temperature control

1.4.12.6 Choice of temperature

1.4.12.7 Temperature measurement

1.4.13 Oxygen enrichment of peirceesmith converter blast

671. Tshilombo, KG & Pistorius, P. C. "**Oxygen activity measurements in simulated converter matte**." Journal of the Southern African Institute of Mining and Metallurgy 107, no. 2 (2007): 123-128.

1.4.14 Maximizing converter productivity

1.4.15 recent improvements in peirceesmith converting

672. Bustos, A. A., and J. P. Kapusta. "**High oxygen shrouded injection into copper and nickel converters**." In The brimacombe memorial symposium. Vancouver: Canadian Institute of Mining, Metallurgy and Petroleum, pp. 107-124. 2000.

673. Garrido, G. F., and R. G. H. Lee. "**Optimizing Oxygen Enrichment of High-Pressure Air Injection into Copper Converters**." Copper 87: Pyrometallurgy of copper 4 (1988): 375.

674. Boisvert, M., G. Janneteau, J-P. Landry, and C. Levac. "**Design and construction of the Noranda Converter at the Horne Smelter**." Sulfide Smelting'98: Current and Future Practices (1998): 569-583.

675. Brännström, Per, and Lennart Hedlund. "**Environmental improvements for Peirce-Smith converters with Outotec's converter hood technology for primary and secondary gas capture**." In Base Metals Conf, pp. 139-150. 2013.

676. Tanaka, S. "**Operation and Improvements on Peirce-Smith at the Tamano Smelter**." Converter and Fire Refining Practices (2005).

677. Vogt, J. "**Current converter practice at the Horne Smelter**." Copper and Nickel Converters (1979): 357-390.

1.5 Anode refining

678. Enriquez, A., Colin Nexhip, G. Poplar, and A. Deneys. "**An update on praxair coherent jet technology in anode refining at Kennecott Utah Copper**." Proceedings of Copper 2010 (2010): 2327-2339.

679. Jiménez-Espadafor Aguilar, Francisco José, José Antonio Vélez Godiño, Miguel Torres García, José María Gallardo Fuentes, and Eduardo Díaz Gutiérrez. "**Thermal Modeling of the Port on a Refining Furnace to Prevent Copper Infiltration and Slag Accretion**." (2021).

680. BAIER, RICHARD, and MICHAEL B. KUSHMA. "**Anode Furnace Refining**." Copper: The Science and Technology of the Metal, Its Alloys and Compounds 122 (1954): 119.

681. Melcher, G., and W. Wuth. "**Continuous Copper Refining: A New Process Compared With Conventional Thermal Copper Refining**." Erzmetall 31, no. 9 (1978): 402-408.

682. Eerola, Heikki, Kosti Jylha, and Pekka Taskinen. "**Thermodynamics of impurities in calcium ferrite slags in copper fire-refining conditions**." Trans Inst Min Metall 93 (1984).

683. Selivanov, E. N., A. I. Popov, N. I. Selmenskikh, and A. B. Lebed. "**Oxide inclusions in copper during its fire refining**." Non-ferrous Metals 2 (2013): 19-22.

684. Xia, Longgong, Zhiqian Yu, Gexiong Xu, and Zhihong Liu. "**A New Copper Scrap Fire-Refining Concept for Strengthening Arsenic Removal**." JOM (2022): 1-8.

685. Kolczyk, E., Z. Miczkowski, and J. Czernecki. "**Numerical modeling of copper reduction in fire refining process**." Archives of Metallurgy and Materials 61, no. 2A (2016): 521-528.

686. Mackey, P. J., and A. E. Wraith. "**Development of copper quality: an historical perspective**." Mineral Processing and Extractive Metallurgy 113, no. 1 (2004): 25-37.

687. Nakamura, Takashi, Fumio Noguchi, and Yasuaki Ueda. "**Fire refining of crude copper by alkaline carbonate fluxes**." Metallurgical Review of MMIJ (Mining and Metallurgical Institute of Japan) 3, no. 2 (1986): 102-116.

688. Esparducer, A., M. A. Fernandez, M. Segarra, J. M. Chimenos, F. Espiell, M. Garcia, and O. Guixà. "**Characterization of fire-refined copper recycled from scrap**." Journal of materials science 34 (1999): 4239-4244.

689. Chesnokov, Yu N., V. G. Lisienko, S. I. Holod, V. P. Anufriev, and A. V. Lapteva. "**Estimation of CO_2-Equivalent Emission under the Copper Fire Refining Process**." In IOP Conference Series: Earth and Environmental Science, vol. 72, no. 1, p. 012013. IOP Publishing, 2017.

690. Martínez, Mònica, Ana I. Fernández, Mercè Segarra, Helena Xuriguera, Ferran Espiell, and Núria Ferrer. "**Comparative study of electrical and mechanical properties of fire-refined and electrolytically refined cold-drawn copper wires**." Journal of materials science 42 (2007): 7745-7749.

691. Kojo, I. V., and P. Taskinen. "**The Thermodynamics of Copper Fire-Refining by Sodium Carbonate**." In Second International Symposium on Metallurgical Slags and Fluxes, pp. 723-737. 1984.

692. Camurri, Carlos P., Marta J. López, and Ricardo C. León. "**Rheology and metal forming of fire-refined copper**." Materials characterization 47, no. 3-4 (2001): 253-257.

693. Lisienko, V. G., S. I. Holod, and V. P. Zhukov. "**Modeling of metallurgical process of copper fire refining**." KnE Engineering (2018): 241-250.

694. Rigby, G. R., and B. Hamilton. "**A study of basic brick from copper anode furnaces**." Journal of the American Ceramic Society 44, no. 5 (1961): 201-205.

695. Goyal, Pradeep, Shriram V. Joshi, and Jimmy Wang. "**Porous plug gas injection in anode refining furnaces**." JOM 35 (1983): 52-58.

696. Rom'an-Moguel, G. J., F. Olvera, S. Aguirre, and B. S'anchez. "**Refining Copper Scrap by Gas Injection**." JOM 40, no. 9 (1988): 38-40.

697. Vukovic, Goran, and Klaus Gamweger. "**A Gas Purging System for Copper and Aluminum Furnaces**." JOM 69, no. 6 (2017): 1007-1012.

698. Edens, Torben, and Johann Steindor. "**Using Hydrogen as a Reductant in Fire Refining at Aurubis Hamburg's "Down-town" Smelter**." In Proceedings of the 61st Conference of Metallurgists, COM 2022, pp. 211-228. Cham: Springer International Publishing, 2023.

699. Devia, M., and A. Luraschi. "**Kinetics of Oxidation in the Fire Refining of Copper**." In 3 rd National Metallurgical Congress CONAMET'83(Annales del III Congreso Nacional de Metalurgia). 1983.

700. Trujillo, A. D., R. G. Kindel, O. I. Gonzalez, and S. N. Sharma. "**Fire Refining Practice at Chino Mines Div. of Kennecott Copper Corp**." TMS/AIME, (1979): 20.

701. Khudyakov, I. F., and S. Mastyugin. "**Oxidation of Nickel during the Fire Refining of Copper**." Tsvetn. Met. 6 (1986): 21-24.

702. Reygadas, pa, af otero, and aa luraschi. "**modelling and automatic control strategies for blister copper fire refining, paper from copper 87, volume 4, pyrometallurgy of copper, an international conference held in vina del mar, chile, nov 30- dec 3, 1987**." papers (1988).

703. Marín Alvarado, Tanai Lérac. **Factors affecting the rates of oxidation and reduction of liquid copper during fire refining**. 2006.

704. Park, H. K., and J. K. Yoon. "**A Study on Deoxidation by Reducing Gas and Injection Method in Fire Refining of Copper**." Journal of the Korean Institute of Metals 27, no. 6 (1989): 546-555.

705. Choshnova, daniela, and peter iliev. "**Enhancing the energy and environmental efficiency of тне fire refining of blister copper in anode furnace part i: optimization of the heat generation in the operations area of the furnace**." journal of chemical technology and metallurgy 53, no. 2 (2018): 306-310.

706. Marin-alvarado, tanai lerac, gabriel angel riveros-urzua, andrzej warczok, r. I. C. A. R. D. O. Ponce-herrera, torstein utigard, and daniel n. Smith-cruzat. "**Continuous fire reduction of liquid copper**." (2016).

707. Enriquez, Jun, Ryan Walton, Adrian Deneys, Allen Chan, Bryan Bielec, and Viktor Kilchyk. "**Reducing Refining Cycle Times to Extend Anode Furnace Campaign Life at Kennecott Copper**." In Extraction 2018: Proceedings of the First Global Conference on Extractive Metallurgy, pp. 519-531. Springer International Publishing, 2018.

708. Riveros, G. "**Advances in the copper fire refining process in Chile**." Converting, Fire Refining and Casting (1994): 237-253.

709. McKerrow, G. C., and D. G. Pannell. "**Gaseous deoxidation of anode copper at the Noranda smelter**." Canadian Metallurgical Quarterly 11, no. 4 (1972): 629-633.

710. Krag, P., W. Imrie, J. Berkoe, R. Vos, and J. Maciejewski. "**Anode Furnace Practice for High-Sulfur Blister**." Converting, Fire Refining and Casting (1994): 255-267.

711. Enriquez, Jun, Ryan Walton, Adrian Deneys, Allen Chan, Bryan Bielec, and Viktor Kilchyk. "**Reducing Refining Cycle Times to Extend Anode Furnace Campaign Life at Kennecott Copper**." In Extraction 2018: Proceedings of the First Global Conference on Extractive Metallurgy, pp. 519-531. Springer International Publishing, 2018.

712. Díaz-damacillo, lamberto, fidel reyes, alberto ingalls, claudio méndez, and gabriel plascencia. "**Mass transfer model for the de-oxidation of molten copper**." jom 69 (2017): 980-986.

713. Brantley, francis e., and carl h. Schack. **Deoxidation of blister copper by gaseous reduction**. Vol. 6113. Us department of the interior, bureau of mines, 1962.

714. Garner, william edward, t. J. Gray, and f. S. Stone. "**The oxidation of copper and the reactions of hydrogen and carbon monoxide with copper oxide**." proceedings of the royal society of london. Series a. Mathematical and physical sciences 197, no. 1050 (1949): 294-314.

715. Fukunaka, y., k. Nishikawa, h. S. Sohn, and z. Asaki. "**Desulfurization kinetics of molten copper by gas bubbling**." metallurgical transactions b 22 (1991): 5-11.

716. Wu, long, hongyang wang, and kai dong. "**Effect of sulfur content on copper recovery in the reduction smelting process**." metals 12, no. 5 (2022): 857.

1.6 Anode casting

717. Åberg, J., M. Vynnycky, and Hasse Fredriksson. "**Heat-flux measurements of industrial on-site continuous copper casting and their use as boundary conditions for numerical simulations**." Transactions of the Indian Institute of Metals 62 (2009): 443-446.

718. Huang, X., and Z. Yang. "**Design and application of taking-off device of casting wheel in Baiyin Copper Smelter**." Nonferrous Metals(China)(China) 54, no. 2 (2002): 61-62.

719. Pyzhov, S. S., and S. N. Makarova. "**Continuous Casting of Copper Anodes**." Tsvetn. Met. 12 (1984): 34-36.

720. AJABSHIRI, M., and S. Sharafi. "**Analyzing the Failure of Master Mould in Casting of Copper Anode Moulds and Suggesting a more Suitable Metal Mould**." (2006): 33-42.

721. Sahoo, M., G. Morin, D. Cousineau, and D. J. Kemp. "**Tundish Modification to Improve the Quality of Hazelett-Cast Copper Anodes, Paper from COPPER 95, Volume III, Electrorefining and Hydrometallurgy of Copper, International Conference held in Santiago, Chile, November 26-29, 1995**." Papers (1995): 175-187.

722. Barella, Silvia, Andrea Gruttadauria, Carlo Mapelli, and Davide Mombelli. "**Investigation of failure and damages on a continuous casting copper mould**." Engineering Failure Analysis 36 (2014): 432-438.

723. Wenzl, Christine. "**Structure and casting technology of anodes in copper metallurgy**." PhD diss., University of Leoben, 2008.

724. Shojaei, Mohammad Reza, Gholam Reza Khayati, Seyed Mohammad Javad Khorasani, and Nahid Assadat Yaghubi. "**Study the failure of casted copper anode: The formation of bumps defects on the surface of the anode during casting**." Engineering Failure Analysis 138 (2022): 106426.

725. Novak, Jelena Srnec, Alex Lanzutti, Denis Benasciutti, Francesco De Bona, Luciano Moro, and Andrea De Luca. "**Metallurgical and surface damage analysis in a copper mold after service**." Materials Today: Proceedings 5, no. 13 (2018): 26709-26714.

726. Wenzl, Christine, Iris Filzwieser, Gregor Mori, and Josef Pesl. "**Investigations on anode quality in copper electrorefining**." BHM Berg-und Hüttenmännische Monatshefte 153, no. 3 (2008): 91-96.

727. Owais, Ashour, Mohamed Abdel Hady Gepreel, and Essam Ahmed. "**Effect of thermal treatment of copper anodes on electrorefining process**." Hydrometallurgy 152 (2015): 55-60.

728. Deva, Nurten, and Muharrem Zabeli. "**Research on chemical composition of secondary copper anodes obtained from aqueous residues of refining process**." Scientific Bulletin of National Mining University 2 (2022).

729. Wenzl, Dipl-Ing Christine, I. Filzwieser, and A. Filzwieser. "**Anode casting-Physical anode quality**." In Proceedings of EMC, p. 1. 2007.

730. Chernomurov, F. M., T. G. Kalinovskaya, F. S. Kudlai, and V. N. Krivenko. "**Solidification Characteristics of Copper Anodes Upon Changes in the Design and Cooling Conditions of the Mold**." Tsvetn. Met. 3 (1986): 23-25.

731. Hakakari, H., and R. L. Pariani. "**Study of Operational Factors Affecting Copper Anode Quality, Paper from COPPER 95, Volume III, Electrorefining and Hydrometallurgy of Copper, International Conference held in Santiago, Chile, November 26-29, 1995**." Papers (1995): 165-173.

1.7 Refractories for copper Smelting

732. Mäkipää, Martti, and Pekka Taskinen. "**Refractory Wear in Copper Converters: Part I. Blister Copper-Refractory Interactions**." Scandinavian Journal of Metallurgy 9 (1980): 273-281.

733. Mäkipää, Martti, and Pekka Taskinen. "**Refractory Wear in Copper Converters Part II: Copper matte-refractory interactions**." Scandinavian journal of metallurgy 22, no. 4 (1993): 203-212.

734. Yurkov, Andrey. "**Refractories for the Metallurgy of Copper**." In Copper-From the Mineral to the Final Application. IntechOpen, 2022.

735. Malfliet, Annelies, Sina Lotfian, Lennart Scheunis, Veselin Petkov, Lieven Pandelaers, Peter Tom Jones, and Bart Blanpain. "**Degradation mechanisms and use of refractory linings in copper production processes: a critical review**." Journal of the European Ceramic Society 34, no. 3 (2014): 849-876.

736. Ludwig, Maciej, Edyta Śnieżek, Ilona Jastrzębska, Adam Piwowarczyk, Agnieszka Wojteczko, Yawei Li, and Jacek Szczerba. "**Corrosion of magnesia-chromite refractory by PbO-rich copper slags**." Corrosion Science 195 (2022): 109949.

737. Gómez-Rodríguez, Cristian, Yanet Antonio-Zárate, Josept Revuelta-Acosta, Luis Felipe Verdeja, Daniel Fernández-González, Jesús Fernando López-Perales, Edén Amaral Rodríguez-Castellanos, Linda Viviana García-Quiñonez, and Guadalupe Alan Castillo-Rodríguez. "**Research and development of novel refractory of MgO doped with ZrO_2 nanoparticles for copper slag resistance**." Materials 14, no. 9 (2021): 2277.

738. Xu, Lei, Min Chen, Nan Wang, Song Gao, and Yonglai Wu. "**Degradation mechanisms of magnesia-chromite refractory bricks used in oxygen side-blown reducing furnace**." Ceramics International 46, no. 11 (2020): 17315-17324.

739. Xu, Lei, Min Chen, Nan Wang, and Song Gao. "**Chemical wear mechanism of magnesia-chromite refractory for an oxygen bottom-blown copper-smelting furnace: A post-mortem analysis**." Ceramics International 47, no. 2 (2021): 2908-2915.

740. Chen, Liugang, Annelies Malfliet, Jef Vleugels, Bart Blanpain, and Muxing Guo. "**Degradation mechanisms of alumina-chromia refractories for secondary copper smelter linings**." Corrosion science 136 (2018): 409-417.

741. Chen, Liugang, Shuangliang Li, Peter Tom Jones, Muxing Guo, Bart Blanpain, and Annelies Malfliet. "**Identification of magnesia–chromite refractory degradation mechanisms of secondary copper smelter linings**." Journal of the European Ceramic Society 36, no. 8 (2016): 2119-2132.

742. Xu, Tengteng, Yibiao Xu, Yawei Li, Shaobai Sang, Qinghu Wang, Tianbin Zhu, Mithun Nath, and Bo Zhang. "**Corrosion mechanisms of magnesia-chrome refractories in copper slag and concurrent formation of hexavalent chromium**." Journal of Alloys and Compounds 786 (2019): 306-313.

743. Jastrzębska, Ilona, Maciej Ludwig, Edyta Śnieżek, Aleksandra Kalęba, Paweł Drożdż, and Jacek Szczerba. "**Corrosion study of novel Cr-free alumina-spinel refractory material dedicated to the copper industry**." Journal of the European Ceramic Society 42, no. 15 (2022): 7311-7327.

744. Chen, Liugang, Muxing Guo, Huayue Shi, Lennart Scheunis, Peter Tom Jones, Bart Blanpain, and Annelies Malfliet. "**The influence of ZnO in fayalite slag on the degradation of magnesia-chromite refractories during secondary Cu smelting**." Journal of the European Ceramic Society 35, no. 9 (2015): 2641-2650.

745. Yu, Zhiqian, Zhihong Liu, Fengchun Ye, and Longgong Xia. "**Corrosion mechanism of magnesia-chrome and alumina-chrome refractories in E-scrap smelting**." Ceramics International 48, no. 2 (2022): 2693-2703.

746. De Wilde, Evelien, Inge Bellemans, Mieke Campforts, Muxing Guo, Bart Blanpain, Nele Moelans, and Kim Verbeken. "**Investigation of high-temperature slag/copper/spinel interactions**." Metallurgical and Materials Transactions B 47 (2016): 3421-3434.

747. Perez, Ismael, Ignacio Moreno-Ventas, and Guillermo Rios. "**Chemical degradation of magnesia-chromite refractory used in the conversion step of the pyrometallurgical copper-making process: A thermochemical approach**." Ceramics International 44, no. 15 (2018): 18363-18375.

748. De Wilde, Evelien, Inge Bellemans, L. Zheng, Mieke Campforts, Muxing Guo, Bart Blanpain, Nele Moelans, and Kim Verbeken. "**Origin and sedimentation of Cu-droplets sticking to spinel solids in pyrometallurgical slags**." Materials Science and Technology 32, no. 18 (2016): 1911-1924.

749. Chen, Liugang, Muxing Guo, Huayue Shi, Shuigen Huang, Peter Tom Jones, Bart Blanpain, and Annelies Malfliet. "**Effect of ZnO level in secondary copper smelting slags**

on slag/magnesia-chromite refractory interactions." Journal of the European Ceramic Society 36, no. 7 (2016): 1821-1828.

750. Ludwig, Maciej, Edyta Śnieżek, Ilona Jastrzębska, Ryszard Prorok, Yawei Li, Ning Liao, Mithun Nath, Jozef Vlček, and Jacek Szczerba. "**Corrosion Resistance of MgO and Cr2O3-Based Refractory Raw Materials to PbO-Rich Cu Slag Determined by Hot-Stage Microscopy and Pellet Corrosion Test**." Materials 15, no. 3 (2022): 725.

751. Scheunis, Lennart, A. Fallah Mehrjardi, Mieke Campforts, Peter Tom Jones, Bart Blanpain, and Eugene Jak. "**The effect of phase formation during use on the chemical corrosion of magnesia–chromite refractories in contact with a non-ferrous PbO–SiO2 based slag**." Journal of the European Ceramic Society 34, no. 6 (2014): 1599-1610.

752. Pérez, Ismael, Ignacio Moreno-Ventas, and Guillermo Ríos. "**Post-mortem study of magnesia-chromite refractory used in Peirce-Smith Converter for copper-making process, supported by thermochemical calculations**." Ceramics International 44, no. 12 (2018): 13476-13486.

753. Hou, Xing, Donghai Ding, Guoqing Xiao, Endong Jin, Xiaochuan Chong, Jiyuan Luo, and Yunqin Gao. "**Corrosion mechanism of magnesia-chrome refractory bricks with FetO-SiO_2-Cr_2O_3 copper converter slag**." Ceramics International (2023).

754. De Wilde, Evelien, Inge Bellemans, Mieke Campforts, Muxing Guo, Kim Vanmeensel, Bart Blanpain, Nele Moelans, and Kim Verbeken. "**Study of the effect of spinel composition on metallic copper losses in slags**." Journal of Sustainable Metallurgy 3 (2017): 416-427.

755. Quan, Zhenghuang, Zhoufu Wang, Hao Liu, Yan Ma, Xitang Wang, Lianzhuo Zhou, Chengji Deng, and Gaofeng Fu. "**Dissolution mechanism of magnesium aluminate spinel in copper smelting slag based on the shrinking core reaction models of corrosion**." Materials Chemistry and Physics 291 (2022): 126722.

756. Pérez, Ismael, Ignacio Moreno-Ventas, Roberto Parra, and Guillermo Ríos. "**Post-mortem study of magnesia–chromite refractory used in a submerged arc furnace in the copper-making process**." JOM 70 (2018): 2435-2442.

757. Kleeberg, Cora. "**Review on operation of spinel-containing slags of the non-ferrous metallurgy**." Materials Science and Technology 38, no. 10 (2022): 607-621.

758. Liu, Hao, Yi An, Zhoufu Wang, Yan Ma, and Xitang Wang. "**Enhanced corrosion resistance of magnesia-chrome refractories impregnated with zirconia sol**." Ceramics International 49, no. 2 (2023): 2478-2485.

759. Scheunis, Lennart, Ata Fallah-Mehrjardi, Mieke Campforts, Peter Tom Jones, Bart Blanpain, Annelies Malfliet, and E. Jak. "**The effect of a temperature gradient on the phase**

formation inside a magnesia–chromite refractory in contact with a non-ferrous PbO–SiO_2–MgO slag." Journal of the European Ceramic Society 35, no. 10 (2015): 2933-2942.

760. Gregurek, D., J. Schmidl, K. Reinharter, V. Reiter, and A. Spanring. "**Copper anode furnace: Chemical, mineralogical and thermo-chemical considerations of refractory wear mechanisms**." Jom 70, no. 11 (2018): 2428-2434.

761. Chen, Mao, Yang Jiang, Zhixiang Cui, Chuandong Wei, and Baojun Zhao. "**Chemical degradation mechanisms of magnesia–chromite refractories in the copper smelting furnace**." Jom 70 (2018): 2443-2448.

762. Pérez, Ismael, Ignacio Moreno-Ventas, and Guillermo Ríos. "**Fundamentals of the refractory wear in an industrial anode furnace used in the copper-making process**." Ceramics International 45, no. 8 (2019): 9788-9798.

763. Nagraj, Samant, Mathias Chintinne, Muxing Guo, and Bart Blanpain. "**Investigation of Bath/Freeze Lining Interface Temperature Based on the Rheology of the Slag**." Jom 74, no. 1 (2022): 274-282.

764. Bellemans, Inge, Evelien De Wilde, Lisa Claeys, Tim De Seranno, Mieke Campforts, Bart Blanpain, Nele Moelans, and Kim Verbeken. "**Investigation of reactive origin for attachment of Cu droplets to solid particles**." Metallurgical and Materials Transactions B 48 (2017): 2459-2468.

765. Jiang, Yang, Mao Chen, Lijie Feng, Junhong Chen, and Baojun Zhao. "**High temperature reactions between Si3N4 bonded SiC materials and Cu, Cu_2O and matte**." Ceramics International 44, no. 1 (2018): 718-722.

766. Ossandón, Julio, Leandro Voisin, and Camila Pizarro. "**The Effect of Clay Minerals on Fayalite Slag Structure and Refractory Brick Wear during Copper Smelting**." Minerals 12, no. 11 (2022): 1431.

767. Pérez, Ismael, Ignacio Moreno-Ventas, Roberto Parra, and Guillermo Ríos. "**Comparative analysis of refractory wear in the copper-making process by a novel (industrial) dynamic test**." Ceramics International 45, no. 2 (2019): 1535-1544.

768. Jiang, Yang, Mao Chen, Junhong Chen, and Baojun Zhao. "**Interactions of MgO·Al2O3 spinel with Cu, Cu_2O and copper matte at high temperature**." Ceramics International 44, no. 12 (2018): 14108-14112.

769. Gregurek, D., C. Majcenovic, K. Budna, J. Schmidl, and A. Spanring. "**Wear phenomena in non-ferrous metal furnaces**." In Extraction 2018: Proceedings of the First Global Conference on Extractive Metallurgy, pp. 175-186. Springer International Publishing, 2018.

770. Jin, Zhe-nan, Jian-fang Lü, Hong-ying Yang, and Zhi-yuan Ma. "**Corrosion mechanism of magnesia-chromite refractories by ZnO-containing fayalite slags: Effect of funnel glass addition**." International Journal of Minerals, Metallurgy and Materials 26 (2019): 1604-1616.

771. Vadász, Pavol, and Dávid Medveď. "**Corrosion of basic refractories in copper metallurgy**." Acta Metallurgica Slovaca 21, no. 1 (2015): 61-67.

772. Chen, Mao, Zhixiang Cui, Chuandong Wei, and Baojun Zhao. "**Degradation mechanisms of refractories in a bottom blown copper smelting furnace**." In 9th International Symposium on High-Temperature Metallurgical Processing, pp. 149-157. Springer International Publishing, 2018.

773. Schlesinger, Mark E. "**Refractories for copper production**." Mineral Processing and Extractive Metullargy Review 16, no. 2 (1996): 125-146.

774. Hou, Xing, Donghai Ding, Guoqing Xiao, Ningxuan Zhang, Xiaochuan Chong, Jiyuan Luo, Endong Jin, Yunqin Gao, and Changkun Lei. "**Effects of La_2O_3 on the viscosity of copper smelting slag and corrosion resistance of magnesia refractory bricks**." Ceramics International 48, no. 17 (2022): 25103-25110.

775. Bazan, Vanesa, Elena Brandaleze, Roberto Parra, and Christian Goni. "**Penetration and dissolution of refractory of magnetite-chrome by fayalite slag**." Dyna 79, no. 173 (2012): 48-55.

776. Petkov, Veselin, Peter Tom Jones, Eddy Boydens, Bart Blanpain, and Patrick Wollants. "**Chemical corrosion mechanisms of magnesia–chromite and chrome-free refractory bricks by copper metal and anode slag**." Journal of the European Ceramic Society 27, no. 6 (2007): 2433-2444.

777. González, CA Rodríguez, W. F. Caley, and R. A. L. Drew. "**Copper matte penetration resistance of basic refractories**." Metallurgical and Materials Transactions B 38, no. 2 (2007): 167-174.

778. Gregurek, dean, katja reinharter, juergen schmidl, christine wenzl, and alfred spanring. "**Typical refractory wear phenomena in copper vessels and novel monitoring technologies**." china's refractories 30, no. 2 (2021): 16.

779. Kramlick, Emil S., W. R. Kelly, K. F. Ruckwardt, J. S. McDonald, M. A. Senne, C. Pistelli, O. Z. Jara et al. "**Copper converter refractory practices**." JOM 20 (1968): 43-54.

780. Lo, Wai Man. "**Corrosion of basic refactories in non-ferrous converters**." PhD diss., University of British Columbia, 2007.

781. Clark, C. Burton, and J. Spotts McDowell. "**Basic brick in copper converters—their mineralogical changes**." JOM 11, no. 2 (1959): 119-124.

782. Crites, Michael D., Musa Karakus, Mark E. Schlesinger, Michaela Somerville, and Shouyi Sun. "**Interaction of chrome-free refractories with copper smelting and converting slags**." Canadian metallurgical quarterly 39, no. 2 (2000): 129-134.

783. Sadri, a., p. Gebski, and e. Shameli. "**Refractory wear and lining profile determination in operating electric furnaces using stress wave non-destructive testing (ndt)**." in proc. Infacon, pp. 881-890. 2010.

784. Shima, Masao, and Yoshinori Itoh. "**Refractories of Flash Furnaces in Japan**." JOM 32 (1980): 12-16.

785. Powrozek, Z., B. Studencka, Z. Patzek, and T. Trochimowicz. "**Experience in using new types of refractory materials in copper metallurgy converters**." In Refractories in Non-Ferrous Metallurgy. 41 st International Colloquium on Refractories, pp. 16-18. 1998.

786. Okabe, Susumu, Ken-ichi Yamaguchi, Fumihiko Ogino, and Etsuji Kimura. "**Development of MgO-TiO_2 refractory for calcium-ferrite slag of the**." In Proceedings of the Copper 95-Cobre 95 International Conference: Pyrometallurgy of copper, vol. 4, p. 333. Canadian Institute of Mining, Metallurgy and Petroleum, 1995.

787. Nikolic, Stanko, Ben Hogg, and Paul Voigt. "**Freeze lining refractories in non-ferrous TSL smelting systems**." In TMS 2019 148th Annual Meeting & Exhibition Supplemental Proceedings, pp. 1149-1159. Springer International Publishing, 2019.

788. Wei, ji-he, jing-chang ma, yang-yi fan, neng-wen yu, sen-long yang, and shun-hua xiang. "**Back-attack phenomena of gas jets with submerged horizontally blowing and effects on erosion and wear of refractory lining**." isij international 39, no. 8 (1999): 779-786.

1.8 Analysis and sampling

789. Barabas, Silvio, and Joseph Kaminski. "**Application of the Pararosaniline-Formaldehyde Spectrophotometric Method to the Determination of Sulfur in Blister and Refined Copper**." Analytical Chemistry 35, no. 11 (1963): 1702-1705.

790. Myakalwar, Ashwin Kumar, Claudio Sandoval, Benjamín Sepúlveda, Rodrigo Fuentes, Roberto Parra, Eduardo Balladares, Alejandro Vásquez, Daniel Sbarbaro, and Jorge Yáñez. "**Laser induced breakdown spectroscopy for monitoring the molten phase desulfurization process of blister copper**." Analytica Chimica Acta 1178 (2021): 338805.

791. Vásquez, Alejandro, Francisco Pérez, Maximiliano Roa, Ignacio Sanhueza, Hugo Rojas, Victor Parra, Eduardo Balladares, Roberto Parra, and Sergio Torres. "**A radiometric technique for monitoring the desulfurization process of blister copper**." Sensors 21, no. 3 (2021): 842.

792. Stokreef, Arthur, Jack A. Barnes, Hans-Peter Loock, and Boyd Davis. "**Fiber optic probe for process control in copper smelters**." In Applied Industrial Optics: Spectroscopy, Imaging and Metrology, pp. T3A-1. Optica Publishing Group, 2019.

793. Myakalwar, Ashwin Kumar, Claudio Sandoval, Marizú Velásquez, Daniel Sbarbaro, Benjamín Sepúlveda, and Jorge Yáñez. "**LIBS as a spectral sensor for monitoring metallic molten phase in metallurgical applications—A review**." Minerals 11, no. 10 (2021): 1073.

794. Kelvin, Michelle, Steven Verpaele, Yamini Gopalapillai, Craig Poland, Matthew I. Leybourne, and Daniel Layton-Matthews. "**Application of quantitative mineralogy to determine sources of airborne particles at a European copper smelter**." Heliyon (2023).

795. Yañez, Jorge, Sergio Torres, Daniel Sbarbaro, Roberto Parra, and Carlos Saavedra. "**Analytical instrumentation for copper pyrometallurgy: Challenges and opportunities**." IFAC-PapersOnLine 51, no. 21 (2018): 251-256.

796. Díaz, Walter, Gonzalo Reyes, Carlos Toro, Ruimin Li, Eduardo Balladares, and Roberto Parra. "**Radiometric Temperature Measurement of Copper Concentrates in Flash Smelting Conditions Simulated at Laboratory Scale Coupled With a Macroscopic Chemical Reaction Model and Automated Mineralogical Characterization**." Metallurgical and Materials Transactions B (2022): 1-12.

797. Pignolet-Brandom, Susanne, Richard D. Hagni, and Norman DH Munroe. "**Reflected Light Microscopy and Electron Microprobe Analysis of Feeds and Products from the Laboratory Flash Smelting of Copper Sulfide Concentrates**." (1985): 1.

798. Laurila, Toni, Rolf Hernberg, Risto Oikari, Timo Joutsenoja, Petteri Mikkola, Tiina Ranki-Kilpinen, and Pekka Taskinen. "**Pyrometric temperature and size measurements of chalcopyrite particles during flash oxidation in a laminar flow reactor**." Metallurgical and materials Transactions B 36 (2005): 201-208.

799. Larenas, Edmundo. "**Online temperature measurements during copper concentrate flash combustion at laboratory scale by a spectral technique**." (2016).

800. Akagi, S. "**Development of Nippon Mining type converter tuyere thermometer**." Journal of the Mining and Materials Processing Institute of Japan(Japan) 112, no. 6 (1996): 416-419.

1.9 Energy and ESG aspects

801. Rötzer, Nadine, and Mario Schmidt. "**Historical, current, and future energy demand from global copper production and its impact on climate change**." Resources 9, no. 4 (2020): 44.

802. Koppelaar, R. H. E. M., and H. Koppelaar. "**The ore grade and depth influence on copper energy inputs**." Biophysical Economics and Resource Quality 1 (2016): 1-16.

803. Kuckshinrichs, Wilhelm, Petra Zapp, and Witold-Roger Poganietz. "**CO_2 emissions of global metal-industries: The case of copper**." Applied Energy 84, no. 7-8 (2007): 842-852.

804. Liu, Lingchen, Dong Xiang, Huiju Cao, and Peng Li. "**Life Cycle Energy Consumption and GHG Emissions of the Copper Production in China and the Influence of Main Factors on the Above Performance**." Processes 10, no. 12 (2022): 2715.

805. CHEN, Zhuo, Zhen-yu ZHU, Xiao-na WANG, and Yan-po SONG. "**Online monitoring and assessment of energy efficiency for copper smelting process**." energy 25 (2019): 26.

806. Barati, Mansoor, Shaghayegh Esfahani, and T. A. Utigard. "**Energy recovery from high temperature slags**." Energy 36, no. 9 (2011): 5440-5449.

807. Coursol, P., P. J. Mackey, J. P. T. Kapusta, and N. Cardona Valencia. "**Energy consumption in copper smelting: A new Asian horse in the race**." Jom 67, no. 5 (2015): 1066-1074.

808. Gaines, Linda L. **Energy and materials flows in the copper industry**. No. ANL/CNSV-11. Argonne National Lab., IL (USA), 1980.

809. Coursol, P., P. J. Mackey, and C. M. Díaz. "**Energy consumption in copper sulphide smelting**." In Proceedings of copper, vol. 2, pp. 649-668. 2010.

810. Moreno-Leiva, Simón, Jannik Haas, Tobias Junne, Felipe Valencia, Hélène Godin, Willy Kracht, Wolfgang Nowak, and Ludger Eltrop. "**Renewable energy in copper production: A review on systems design and methodological approaches**." Journal of Cleaner Production 246 (2020): 118978.

811. Zhang, Liqun, Huihui Zhou, Xing Chen, Guijian Liu, Chunlu Jiang, and Liugen Zheng. "**Study of the micromorphology and health risks of arsenic in copper smelting slag tailings for safe resource utilization**." Ecotoxicology and environmental safety 219 (2021): 112321.

812. Nikolić, Djordje, Ivan Jovanović, Ivan Mihajlović, and Živan Živković. "**Multi-criteria ranking of copper concentrates according to their quality–An element of environmental management in the vicinity of copper–Smelting complex in Bor, Serbia**." Journal of environmental management 91, no. 2 (2009): 509-515.

813. Gabasiane, Tlotlo Solomon, Gwiranai Danha, Tirivaviri A. Mamvura, Tebogo Mashifana, and Godfrey Dzinomwa. "**Environmental and socioeconomic impact of copper slag—A review**." Crystals 11, no. 12 (2021): 1504.

814. Kabata-Pendias, A. L. I. N. A., E. D. W. A. R. D. Bolibrzuch, and P. I. O. T. R. Tarłowski. "**Impact of a copper smelter on agricultural environments Part I. Contamination of soils**." Rocz Glebozn 32, no. 3 (1981): 207-214.

815. Li, Xiang, Xueqian Wang, Bing Cai, Langlang Wang, Li Yuan, and Ping Ning. "**Investigation of heavy metal flows in a copper pyrometallurgical process of a typical smelter**." Process Safety and Environmental Protection (2023).

816. González-Castanedo, Yolanda, Teresa Moreno, Rocío Fernández-Camacho, Ana María Sánchez de la Campa, Andrés Alastuey, Xavier Querol, and Jesús de la Rosa. "**Size distribution and chemical composition of particulate matter stack emissions in and around a copper smelter**." Atmospheric Environment 98 (2014): 271-282.

817. Germani, Mark S., Mark Small, William H. Zoller, and Jarvis L. Moyers. "**Fractionation of elements during copper smelting**." Environmental Science & Technology 15, no. 3 (1981): 299-305.

818. Wu, Zhicheng, Hao Zhang, Lingyu Shao, Yifan Wang, Wenchao Gao, Dingzhen Wang, Weihong Wu, Chenghang Zheng, and Xiang Gao. "**Nonferrous metal flue gas purification based on high-temperature electrostatic precipitation**." Process Safety and Environmental Protection 154 (2021): 202-210.

819. Liu, Hui, Fenghua Shen, Qingzhu Li, Minneng Wen, Hongliang Zhang, Linhua Jiang, Chenghang Zheng, Yan Liu, Tao Liu, and Liyuan Chai. "**Systematic control technologies for gaseous pollutants from non-ferrous metallurgy**." Journal of Environmental Sciences 123 (2023): 65-82.

820. Dimitrijević, Mile, Ana Kostov, Visa Tasić, and Novica Milosević. "**Influence of pyrometallurgical copper production on the environment**." Journal of Hazardous Materials 164, no. 2-3 (2009): 892-899.

821. Solnordal, C. B., P. J. Witt, A. Manzoori, H. Namavari, E. Niknejad, and M. Davari. "**Whole-of-system analysis using CFD to reduce emissions of fugitive gases inside a copper smelter building**." METPLANT 2004: Metallurgical Plant Design and Operating Strategies Proceedings (2004): 277-296.

822. Cruz-Robles, Irving, Jorge M. Islas-Samperio, Elisa Alonso, Alfonso J. Vázquez-Vaamonde, Carlos A. Pérez-Rábago, and Claudio A. Estrada. "**Reducing CO_2 emissions in the copper smelting process by using high-temperature solar heat: Tecno-economic assessment**." Applied Thermal Engineering (2023): 120270.

823. Zhang, Jiawei, Xiaohui Sun, Jianguo Deng, Guoliang Li, Zhijian Li, Jingkun Jiang, Qingru Wu, and Lei Duan. "**Emission characteristics of heavy metals from a typical copper smelting plant**." Journal of Hazardous Materials 424 (2022): 127311.

824. Wang, Hongyang, Rong Zhu, Kai Dong, Siqi Zhang, Ruimin Zhao, Zhenqiang Jiang, and Xinyi Lan. "**An experimental comparison: Horizontal evaluation of valuable metal extraction and arsenic emission characteristics of tailings from different copper smelting slag recovery processes**." Journal of Hazardous Materials 430 (2022): 128493.

825. Ginocchio, R. "**Effects of a copper smelter on a grassland community in the Puchuncavı Valley, Chile**." Chemosphere 41, no. 1-2 (2000): 15-23.

826. Wan, Xingbang, Pekka Taskinen, Junjie Shi, and Ari Jokilaakso. "**A potential industrial waste–waste co-treatment process of utilizing waste SO_2 gas and residue heat to recover Co, Ni, and Cu from copper smelting slag**." Journal of Hazardous Materials 414 (2021): 125541.

827. Zhou, Huihui, Guijian Liu, Liqun Zhang, Chuncai Zhou, Md Manik Mian, and Ayesha Imtiyaz Cheema. "**Strategies for arsenic pollution control from copper pyrometallurgy based on the study of arsenic sources, emission pathways and speciation characterization in copper flash smelting systems**." Environmental Pollution 270 (2021): 116203.

828. Živković, Živan, Marija Panić, Aleksandra Fedajev, and Milica Veličković. "**The Challenges of Increasing the Copper Smelter Capacity on Ambient Air Quality in Bor (Serbia)**." Water, Air, & Soil Pollution 234, no. 2 (2023): 82.

829. Adnan, Muhammad, Baohua Xiao, Peiwen Xiao, Peng Zhao, Ruolan Li, and Shaheen Bibi. "**Research progress on heavy metals pollution in the soil of smelting sites in China**." Toxics 10, no. 5 (2022): 231.

830. Wang, Yanchao, Zongguo Wen, and Huifang Li. "**Simulation of flows of hazardous elements in copper smelting process based on Bayesian network**." Journal of Cleaner Production 380 (2022): 135137.

831. Kojo, Ilkka V., Markus A. Reuter, Madeleine N. Scheidema, and Outotec Oyj. "**Primary copper smelting impact**." Proc. EMC 2015 1 (2015): 77-93.

832. Martley, E., B. L. Gulson, and H-R. Pfeifer. "**Metal concentrations in soils around the copper smelter and surrounding industrial complex of Port Kembla, NSW, Australia**." Science of the Total Environment 325, no. 1-3 (2004): 113-127.

833. Torrisi, c., and p. Trotta. "**Sustainable water use at olympic dam**." mining technology 118, no. 3-4 (2009): 193-204.

834. Alvarado, Sergio, Pedro Maldonado, and Iván Jaques. "**Energy and environmental implications of copper production**." Energy 24, no. 4 (1999): 307-316.

835. Miettinen, E., T. Ahokainen, and K. Eklund. "**Management of Copper Flash Smelting Off-Gas Line Gas FLow and Oxygen Potential**." Copper 2010, Vol. 3: Pyrometallurgy II (2010): 1003e1012.

836. Zhou, sijie, dongming zeng, chong yan, jiaqi huang, shuai wang, and yonghua zhou. "**Research and application of the virtual simulation system teaching method in copper pyrometallurgy**." international journal of modeling, simulation, and scientific computing 12, no. 01 (2021): 2050064.

837. Röben, fritz tc, diran liu, markus a. Reuter, manuel dahmen, and andré bardow. "**The demand response potential in copper production**." journal of cleaner production 362 (2022): 132221.

838. Navarra, a. "**automated scheduling and scientific management of copper smelters**." mineral processing and extractive metallurgy 125, no. 1 (2016): 39-44.

839. Johnson, b. D., and j. E. Myers. "**preliminary validation of trioxide (As2O3) dust fallout modelled from a environmental copper smelter pm in namibia**." in understanding the geological and medical interface of arsenic-as 2012: proceedings of the 4th international congress on arsenic in the environment, 22-27 july 2012, cairns, australia, p. 431. Crc press, 2012.

840. Verney, L. R., and J-L. Corbiau. "**The Impact of Sulphuric Acid Production and Environmental Issues on Copper Processing**." Pr. Inst. Met. Niezelaz. 12, no. 1 (1983): 78-102.

841. Devitt, T. W. **Control of copper smelter fugitive emissions**. Final report Mar 76-Oct 79. No. PB-80-203227. PEDCo-Environmental, Inc., Cincinnati, OH (USA), 1980.

842. Warczok, Andrzej, and G. Riveros. "**Energy efficiency in batch continuous and one-step copper pyrometallurgical processes**." Improving energy efficiency in the APEC mining industry (2004).

843. Copper, extractive metallurgy of. "**Furnace dimensions and heat loss rates for primary smelting furnaces**." extractive metallurgy of copper: pyrometallurgy and electrolytic refining 1 (1976): 386.

844. Skopov, G. V. "**Energy criteria for selecting a sulfide concentrate melting method in copper production**." Metallurgist 61, no. 5-6 (2017): 444-447.

845. Aboura, Khalid. "**A Statistical Model for Shutdowns due to Air Quality Control for a Copper Production Decision Support System**." Organizacija 48, no. 3 (2015): 198-202.

846. Zhang, Yan, Xiao-long Tang, Hong-hong Yi, and Jie-yun Ma. "**Estimation of SO_2 emission factors from copper smelting industry in Yunnan Province, China**." Journal of Central South University 20 (2013): 742-748.

847. Barros, Kayo Santana, Vicente Schaeffer Vielmo, Belén Garrido Moreno, Gabriel Riveros, Gerardo Cifuentes, and Andréa Moura Bernardes. "**Chemical composition data of the main stages of copper production from sulfide minerals in Chile: a review to assist circular economy studies**." Minerals 12, no. 2 (2022): 250.

848. **conservation, and productivity at copper cliff**." JOM 44, no. 9 (1992): 50-55.

1.10 Bath matte smelting

849. Alvear, G. R. F., M. Hourn, and J. C. Salas. "**Xstrata Technology's approach for the processing of copper bearing materials**." In Proc. of Copper, vol. 2013, pp. 389-400. 2013.

850. Hoefele, e. O., and j. K. Brimacombe. "**Flow regimes in submerged gas injection**." metallurgical transactions b 10 (1979): 631-648.

851. Kapusta, j. P. T. "**sonic injection in sulphide bath smelting: an update**." journal of the southern african institute of mining and metallurgy 118, no. 11 (2018): 1131-1139.

1.10.1 Submerged tuyere: Noranda process

852. Harris, C. "**Bath smelting in the Noranda process reactor and the El Teniente Converter compared**." Copper 99- Cobre 99 (1999): 305-318.

853. El-Barnachawy, S., G. Kachaniwsky, H. Persson, and D. Poggi. "**Oxygen Use at Noranda's Horne Smelter**." In Proceedings of the Metallurgical Society of the Canadian Institute of Mining and Metallurgy, pp. 185-198. Pergamon, 1987.

1.10.2 Submerged tuyere: Teniente process

854. Carrascom, C., J. Bobadilla, and G. Duarte. "**Evolution of the Teniente converter—Caletones smelter**." In Proc. 6th Int. Copper Cobre Conf.(Toronto, Canada, 2007). 2007.

855. Rosales, M., J. Font, and R. Fuentes. "**A Fluid-Dynamic Review of the Teniente Converter**." In Proceedings of the Cu 2010 Conference, Clausthal-Zellerfeld, Germany, GDMB, pp. 1095-1113. 2010.

856. Bergh, L. G., P. Chacana, and C. Carrasco. "**Diagnosis and control strategy for a Teniente Converter**." IFAC Proceedings Volumes 38, no. 1 (2005): 274-279.

857. Pérez-Cortes, S., Y. Aguilera-Carvajal, J. Hurtado-Cruz, and J. P. Vargas-Norambuena. **"Computational fluid dynamics simulation of cooling system for copper smelter gases by Teniente Converter with evaporative cooler**." Revista Internacional de Métodos Numéricos para Cálculo y Diseño en Ingeniería 33, no. 4 (2017).

1.10.3 Vanyukov submerged tuyere smelting

858. Mussabekov, n., and b. K. Mukhanov. "**Development of a mathematical model for a compound technological complex of vanyukov melting in order to control the material and thermal regime**." kompleksnoe ispolzovanie mineralnogo syra 327, no. 4 (2023): 15-22.

859. Lisienko, v. G., g. K. Malikov, m. V. Morozov, v. V. Belyaev, and v. A. Kirsanov. "Simulation of the solidification of the melt in the vanyukov furnace in the case of emergency stoppage." russian journal of non-ferrous metals 54 (2013): 287-291.

860. Bystrov, v. P., a. N. Fyodorov, a. A. Komkov, and m. L. Sorokin. "**Use of the vanyukov process for the smelting of various charges**." in ausimm extractive metallurgy conference, pp. 477-482. 1992.

861. Zhang, h. L., c. Q. Zhou, w. U. Bing, and y. M. Chen. "**Numerical simulation of multiphase flow in a vanyukov furnace**." journal of the southern african institute of mining and metallurgy 115, no. 5 (2015): 457-463.

862. Selivanov, E. N., G. V. Skopov, R. I. Gulyaeva, and A. V. Matveev. "**Material Composition of the dust from the electrostatic precipitators of a vanyukov furnace at the middle ural copper smelter**." Metallurgist 58 (2014): 431-435.

863. Dyussebekova, M. A., B. K. Kenzhaliyev, S. A. Kvyatkovskiy, E. A. Sit'ko, and D. Nurkhadianto. "**The main reasons for increased copper losses with slags from vanyukov furnace**." Metalurgija 60, no. 3-4 (2021): 309-312.

864. Vaisburd, S., D. G. Brandon, S. Kozhakhmetov, and E. Kenzhaliyev. "**Physicochemical properties of matte-slag melts taken from Vanyukov's furnace for copper extraction**." Metallurgical and materials transactions B 33 (2002): 561-564.

1.10.4 Top Submerged Lance

865. Alvear, Gerardo R., Simon P. Hunt, and Bangqi Zhang. "**Copper ISASMELT-dealing with impurities**." In Proc.: Kongoli F, Reddy RG, editors. Advanced Processing of Metals and Materials, Sohn International Symposium, Proceedings, San Diego, CA, United States, pp. 673-685. 2006.

866. Alvear, F., P. Arthur, and P. Partington. "**Feasibility to profitability with copper IsaSmelt**." Proceedings of Copper 2010 2 (2010): 615-630.

867. Errington, WJ*, Edwards, JS* & Hawkins, P. "**Isamelt technology-current status and future development**." Journal of the Southern African Institute of Mining and Metallurgy 97, no. 4 (1997): 161-167.

868. Voigt, Paul, Alistair Burrows, Michael Somerville, and Chunlin Chen. "**Direct-to-Blister Copper Smelting with the ISASMELT™ Process**." In 8th International Symposium on High-Temperature Metallurgical Processing, pp. 261-267. Springer International Publishing, 2017.

869. Li, Yun, and P. ARHTUR. "**Yunnan Copper Corporation's new smelter—China's first Isasmelt**." In Yazawa International Symposium, Metallurgical and Materials processing: principles and technologies, vol. 2, pp. 371-384. 2003.

870. Edwards, J. S. "**ISASMELT–a 250,000 tpa copper smelting furnace**." ISASMELTTM: un horno de fundición de cobre de 250 (1998).

871. Binegar, Alan H. "**Cyprus Isasmelt start-up and operating experience**." In Proceedings of Copper, vol. 95, pp. 117-132. 1995.

872. Burrows, A. S., G. R. F. Alvear, and A. T. Tynybayev. "**Smelting of Kazakhstan Concentrates at Ust–Kamenogorsk Using a Copper ISASMELT™ Furnace**." In Proceedings of Copper, pp. 39-48. 2013.

873. de Vries, D., S. Hunt, N. Dyussekenov, M. Milovanov, and H. M. Chikashi. "**Design, commissioning and operation of an ISASMELT™ furnace at Kansanshi copper smelter**." In Proceedings of "Copper 2016" Conference. 2016.

874. Herrera, E., and L. Mariscal. "**Controlling SO_3 formation in the off-gases process from the IsasmeltTM furnace at southern Peru Ilo smelter**." In Proceedings of Copper, vol. 3, pp. 61-74. 2013.

875. MacLeod, I. M., W. Harlen, R. A. Cockerell, and S. Crisafulli. **"Temperature control of a Copper Isasmelt plant**." In 1997 European Control Conference (ECC), pp. 1189-1194. IEEE, 1997.

876. Burrows, alistair, phil partington, john sakala, and paul hermit mascrenhas. "**Isasmelt™ at mufulira—increased flexibility on the zambian copperbelt**." metals and material processing in a clean environment: sustainable non-ferrous smelting in 21st century 1 (2012): 217-226.

877. Alvear, f., p. Arthur, and p. Partington. "**Feasibility to profitability with copper isasmelt**." proceedings of copper 2010 2 (2010): 615-630.

878. Kolczyk, ewa, zdzisław miczkowski, and józef czernecki. "**Influence of selected parameters on phenomena of two-phase flow and heat exchange in TSL furnace–numerical investigation**." international journal of numerical methods for heat & fluid flow (2017).

879. Zhao, hong-liang, pan yin, li-feng zhang, and sen wang. "**Water model experiments of multiphase mixing in the top-blown smelting process of copper**

concentrate." international journal of minerals, metallurgy, and materials 23 (2016): 1369-1376.

880. Marcuson, samuel w., carlos díaz, and haydn davies. "**Top-blowing, bottom-stirring process for producing blister copper**." jom 46, no. 8 (1994): 61-64.

881. Schonewille, ronald hiram. "**Oxidation of copper-sulphur matte by submerged gas injection, mass transfer rates and physical phenomena**." phd diss., 1998.

882. Henao, Hector M., Leonid A. Ushkov, and Evgueni Jak. "**Thermodynamic predictions and experimental investigation of slag liquidus and minor element partitioning between slag and matte in support of the copper Isasmelt smelting process commissioning and optimisation at Kazzinc**." In The 9th international conference on molten slags, fluxes and salts, Molten, vol. 12. 2012.

883. Arthur, Philip, and James Edwards. "**ISASMELT–a quiet revolution**." EMC 2003 (2003).

1.10.5 Chinese bath smelting technology developments: SKS-BBS process and side-blow smelting

884. Chen, M., Z. Cui, C. Wei, and B. Zhao. "**Investigation of the accretions in bottom blown copper smelting furnace**." (2016): 1184-1194.

885. Bing, L. "**Development of oxygen bottom-blowing copper smelting &converting technology**." In The Proceedings of the Copper 2016 International Conference, pp. 1265-1272. Kobe Japan, 2016.

886. Liao, L. L., Q. M. Wang, Q. H. Tian, and X. Y. Guo. "**Multiphase equilibrium modeling study on the oxygen bottom blowing copper smelting (SKS) process**." In Proceedings of the 9th International Copper Conference (Copper 2016), Kobe, Japan, pp. 13-16. 2016.

887. Wang, Qin-meng, Xue-yi Guo, and Qing-hua Tian. "**Copper smelting mechanism in oxygen bottom-blown furnace**." Transactions of nonferrous metals society of China 27, no. 4 (2017): 946-953.

888. Wei, W., L. Tao, Y. Weiyan, T. Bin, and L. Wenjiang. "**Industrial application of side-blowing furnace smelting process in China Nerin**." In Proceedings of the 58th Annual Conference of Metallurgists (COM) Hosting the 10th International Copper Conference 2019, pp. 18-21. 2019.

889. Zhao, Baojun, and Jinfa Liao. "**Development of Bottom-blowing copper smelting technology: A review**." Metals 12, no. 2 (2022): 190.

890. Wang, Qinmeng, Qiongqiong Wang, Qinghua Tian, and Xueyi Guo. "**Simulation study and industrial application of enhanced arsenic removal by regulating the proportion of concentrates in the SKS copper smelting process**." Processes 8, no. 4 (2020): 385.

891. Wang, Qin-meng, Song-song Wang, Miao Tian, Ding-xuan Tang, Qing-hua Tian, and Xue-yi Guo. "**Relationship between copper content of slag and matte in the SKS copper smelting process**." International Journal of Minerals, Metallurgy, and Materials 26 (2019): 301-308.

892. Song, Kezhou, and Ari Jokilaakso. "**CFD Modeling of Multiphase Flow in an SKS Furnace: The Effect of Tuyere Arrangements**." Metallurgical and Materials Transactions B 52 (2021): 1772-1788.

893. Song, Kezhou, and Ari Jokilaakso. "**The CFD Modeling of Multiphase Flow in an SKS Furnace: The Effect of Tuyere Diameter and Bath Depth**." JOM 74, no. 4 (2022): 1488-1498.

894. Song, Kezhou, and Ari Jokilaakso. "**CFD Modeling of Multiphase Flow in an SKS Furnace with New Tuyere Arrangements**." Metallurgical and Materials Transactions B (2022): 1-20.

895. Song, Kezhou, and Ari Jokilaakso. "**CFD Modeling of Multiphase Flow in an SKS Furnace**." (2021).

896. Jokilaakso, Ari. "**Cfd Modeling of the Multiphase Flow in an Sks Furnace-the Effect of Melt Density and Viscosity**."

897. Wang, qinmeng, xueyi guo, qinghua tian, tao jiang, mao chen, and baojun zhao. "**Effects of matte grade on the distribution of minor elements (pb, zn, as, sb, and bi) in the bottom blown copper smelting process**." metals 7, no. 11 (2017): 502.

898. Wang, dongxing, yan liu, zimu zhang, pin shao, and ting'an zhang. **"Dimensional analysis of average diameter of bubbles for bottom blown oxygen copper furnace**." mathematical problems in engineering 2016 (2016).

899. Zhu, zhenyu, ping zhou, zhuo chen, p. Long, and l. Zhang. "**Numerical simulation on effect of air injection on two-phase flow in oxygen-enriched side-blown furnace**." journal of central south university (science and technology) 53, no. 2 (2022): 398-408.

900. Shui, lang. "**fluid dynamics studies related to bottom blown copper smelting furnace**." (2015).

901. Wang, qinmeng, xueyi guo, qinghua tian, tao jiang, mao chen, and baojun zhao. "**Development and application of skssim simulation software for the oxygen bottom blown copper smelting process**." metals 7, no. 10 (2017): 431.

902. Kapusta, joël pt, françois larouche, and enzo palumbo. "**Adoption of high oxygen bottom blowing in copper matte smelting: why is it taking so long**." in proceedings of the com2015 the conference of metallurgists, toronto, on, canada, pp. 23-26. 2015.

903. Wang, dongxing, yan liu, zimu zhang, pin shao, and ting'an zhang. "**Experimental study of bottom blown oxygen copper smelting process for water model**." in aip conference proceedings, vol. 1542, no. 1, pp. 1304-1307. American institute of physics, 2013.

904. Liao, l. L., q. M. Wang, q. H. Tian, and x. Y. Guo. "**Multiphase equilibrium modeling study on the oxygen bottom blowing copper smelting (sks) process**." in proceedings of the 9th international copper conference (copper 2016), kobe, japan, pp. 13-16. 2016.

905. Shui, lang, zhixiang cui, xiaodong ma, m. Akbar rhamdhani, anh v. Nguyen, and baojun zhao. "**Understanding of bath surface wave in bottom blown copper smelting furnace**." metallurgical and materials transactions b 47 (2016): 135-144.

906. Cui, zhixiang, hongjie yan, dianbang shen, zhiqiang cui, and pengfei yu. "**The research of metallurgical reaction engineering in oxygen bottom blowing copper smelting process**." in 5th international symposium on high-temperature metallurgical processing, pp. 547-554. Hoboken, nj, usa: john wiley & sons, inc., 2014.

907. Kapusta, joël pt. "**submerged gas jet penetration: a study of bubbling versus jetting and side versus bottom blowing in copper bath smelting**." jom 69, no. 6 (2017): 970-979.

908. Xiao, yadong, tingting lu, yugao zhou, qiuqiong su, liangzhao mu, tao wei, hongliang zhao, and fengqin liu. "**Computational fluid dynamics study on enhanced circulation flow in a side-blown copper smelting furnace**." jom 73 (2021): 2724-2732.

909. Xiao, yadong, jie wang, tingting lu, fengqin liu, chao lv, and hongliang zhao. "**An experimental study on gas–liquid flow and mixing behavior in a copper side-blown smelting furnace**." metallurgical and materials transactions b (2023): 1-9.

910. Zhao, baojun, and jinfa liao. "**Development of bottom-blowing copper smelting technology: a review**." metals 12, no. 2 (2022): 190.

911. Xiao, jun-bing, hong-jie yan, markus schubert, sebastian unger, liu liu, eckhard schleicher, and uwe hampel. "**Effect of nozzle geometry on pressure drop in submerged gas injection**." journal of central south university 26, no. 8 (2019): 2068-2076.

912. Liao, jinfa, keqin tan, and baojun zhao. "**Enhanced productivity of bottom-blowing copper-smelting process using plume eye**." metals 13, no. 2 (2023): 217.

913. Lu, tingting, liangzhao mu, yadong xiao, hongliang zhao, and fengqin liu. "**CFD study on bottom-blown copper smelting furnace with unsymmetric gas injection**." journal of sustainable metallurgy 8, no. 3 (2022): 1235-1244.

914. Chen, Peng, Hui Xiao, Jiang Chen, Lin Chen, Duchao Zhang, Weifeng Liu, and Tianzu Yang. "**Oxygen-rich side-blown bath smelting of copper dross: a process study**." Journal of Sustainable Metallurgy 6 (2020): 344-354.

915. Wang, Qinmeng, Qinghua Tian, and Xueyi Guo. "**Mechanism of oxygen-enriched bottom blowing copper smelting process (SKS)**." In 2016-Sustainable Industrial Processing Summit, vol. 8, pp. 117-128. Flogen Star Outreach, 2016.

916. Li, xiaolong, yan liu, dongxing wang, and tingan zhang. "**Emulsification and flow characteristics in copper oxygen-rich side-blown bath smelting process**." metals 10, no. 11 (2020): 1520.

917. WANG, Dong. "**Water Model Study of Bubble Behavior in Matte Smelting Process with Oxygen Bottom Blowing**." Journal of Northeastern University (Natural Science) 34, no. 12 (2013): 1755.

1.11 Alternatives to pierce-smith converting

1.11.1 Hoboken converter

918. Bustos, A. A., M. Cardoen, and B. Janssens. "**High oxygen enrichment at UM-Hoboken converters**." In Proceedings of the Copper, pp. 26-29. 1995.

919. Bhappu, r. R., k. H. Larson, and r. D. Tunis. "**Cyprus miami mining corporation smelter modernization project summary and status**." in epd congress 1994, pp. 555-570. 1994.

920. Voltura, S. A. (2004). **Continuous improvements at the Phelps Dodge Miami Mining Smelter**. Mining, Metallurgy & Exploration, 21(3), 158-163.

921. Vieira, Lucas C., Marcella F. Guzzo, Mauricio Bittencourt Marques, Marcos Henrique Carlos de Souza, Redouane Merdjani, and Florian Kongoli. "**Optimization and Control of Hoboken Converter Operations with FLOGEN CONTOP Control Expert System**." In 2017-Sustainable Industrial Processing Summit, vol. 1, pp. 91-92. Flogen Star Outreach, 2017.

922. Smieszek, Z. "**Evaluation of the Hoboken converter at Glogow, Poland. Report for Jan 76-Feb 79**." (1980).

923. Vieira, Lucas C., Marcella F. Guzzo, Frederico C. Leite, Mauricio Bittencourt Marques, Marcos Henrique Carlos de Souza, Redouane Merdjani, and Florian Kongoli. "**Optimization and Control Of Hoboken Converter Operations With Flogen Contop Control Expert System**." In 2016-Sustainable Industrial Processing Summit, vol. 8, pp. 89-90. Flogen Star Outreach, 2016.

924. Gomez, J. D. "**Paipote Smelter: Seven Years Operating Hoboken Converters**." Copper and Nickel Converters (1979): 291-311.

925. Pagador, R., N. Wachgama, C. Khuankla, J. P. Kapusta, J. P. T. Kapusta, and A. E. M. Warner. "**Operation of the Air Liquide shrouded injector (ALSI) technology in a Hoboken siphon converter**." In Proceedings of the International Peirce-Smith Converting Centennial Symposium, pp. 367-381. The Minerals, Metals and Materials Society of AIME, Warrendale, PA, 2009.

926. Leroy, J. L., and P. J. Lenoir. "**Hoboken Type of Copper Converter and Its Operation**." (1968).

927. Chausteur, R., A. Surny, and J. P. Stevens. "**Cost Comparison between Pierce-Smith and Hoboken Converters**." TMS Paper (1974).

928.

1.11.2 Flash converting

929. Kojo, ilkka, markku lahtinen, and elli miettinen. "**Flash converting–sustainable technology now and in the future**." international peirce-smith converting centennial (2009): 383-395.

930. Perez-Tello, Manuel. **Experimental investigation and computer simulation of the continuous flash converting process of solid copper mattes**. The University of Utah, 1999.

931. Li, Ming-zhou, Jie-min Zhou, Chang-ren Tong, Wen-hai Zhang, Zhuo Chen, and Jin-liang Wang. "**Thermodynamic modeling and optimization of the copper flash converting process using the equilibrium constant method**." Metallurgical and Materials Transactions B 49 (2018): 1794-1807.

932. Shook, Andrew A. "**Flash converting of chalcocite concentrate: a study of the flame**." PhD diss., University of British Columbia, 1992.

933. Asteljoki, J. A., L. K. Bailey, D. B. George, and D. W. Rodolff. "**Flash converting—Continuous converting of copper mattes**." JOM 37, no. 5 (1985): 20-23.

934. S Chaubal, P. C., H. Y. Sohn, D. B. George, and L. K. Bailey. "**Mathematical modeling of minor-element behavior in flash smelting of copper concentrates and flash converting of copper mattes**." Metallurgical Transactions B 20 (1989): 39-51.

935. Suominen, Risto Olavi, Ari Tapani Jokilaakso, Pekka Antero Taskinen, and Kaj Rainer Lilius. "**Morphology and mineralogy of copper matte particles reacted in simulated flash converting conditions**." Scandinavian journal of metallurgy 23, no. 1 (1994): 30-36.

936. Davies, H., S. Marcuson, G. Osborne, and A. Warner. "**Flash converting of chalcocite concentrate at INCO's Port Colborne Pilot Plant**." Extractive Metallurgy of Copper, Nickel and Cobalt. 1 (1993): 623-637.

937. Suominen, Risto Olavi, Ari Tapani Jokilaakso, Pekka Antero Taskinen, and Kaj Rainer Lilius. "**Behaviour of copper mattes in simulated flash converting conditions**." Scandinavian journal of metallurgy 20, no. 4 (1991): 245-250.

938. Morgan, G. J., and J. K. Brimacombe. "**Kinetics of the flash converting of MK (chalcocite) concentrate**." Metallurgical and Materials Transactions B 27 (1996): 163-175.

939. Kojo, Ilkka V., Ari Jokilaakso, and Pekka Hanniala. "**Flash smelting and converting furnaces: a 50 year retrospect**." JOM 52, no. 2 (2000): 57-61.

940. Swinbourne, D. R., and Tak Seng Kho. "**Computational thermodynamics modeling of minor element distributions during copper flash converting**." Metallurgical and Materials Transactions B 43 (2012): 823-829.

941. Pérez-Tello, M., I. M. Madrid-Ortega, and H. Y. Sohn. "**Model for the fragmentation of copper matte particles during flash converting**." Mining, Metallurgy & Exploration 25 (2008): 53-60.

942. Perez-Tello, Manuel, Hong Yong Sohn, and Philip John Smith. "**Experimental investigation and three-dimensional computational fluid-dynamics modeling of the flash-converting furnace shaft: Part II. Formulation of three-dimensional computational fluid-dynamics model incorporating the particle-cloud description**." Metallurgical and materials transactions B 32 (2001): 869-886.

943. George-Kennedy, David, Ryan Walton, D. George, and Colin Nexhip. "**Flash converting after 10 years**." In 11th international flash smelting congress, Bulgaria-Spain. Proceeding of the 11th Flash smelting congress, Bulgaria/Spain, pp. 79-97. 2005.

944. Hanniala, P., I. V. Kojo, and M. Kyto. "**Kennecott-Outokumpu flash converting process--copper by clean technology**." Sulfide Smelting'98: Current and Future Practices (1998): 239-247.

945. Yu, Feng, Zhihong Liu, Fengchun Ye, Longgong Xia, and Ari Jokilaakso. "**A study of selenium and tellurium distribution behavior, taking the copper matte flash converting process as the background**." JOM 73 (2021): 694-702.

946. Jiao, Q., L. Wu, and N. J. Themelis. "**Mathematical modeling of flash converting of copper matte**." Mathematical Modelling of Materials Processing Operations (1987): 835-858.

947. Victorovich, G. S. "**Oxygen Flash Converting for Production of Copper**." Extractive Metallurgy of Copper, Nickel and Cobalt. 1 (1993): 501-529.

948. Hanniala, Pekka, I. V. Kojo, and M. Kyto. "**The Kennecott--Outokumpu Flash Converting Process**." Converting, fire refining and casting (1994): 107-119.

949. Holopainen, Hannu, Seppo Kemppinen, Kari Myöhänen, and Rauno Peippo. "**Latest developments in gas cooling in copper smelters**." In Proceedings of Copper 95 International Conference, vol. 4, pp. 313-332. 1995.

950. Hanniala, Pekka, Tuula Mäkinen, and Markku Kytö. "**Flash technology for converting**." EMC '91: Non-Ferrous Metallurgy–Present and Future (1991): 191-203.

951. George, David B., Colin Nexhip, David George-Kennedy, Robert Foster, and Ryan Walton. "**Copper matte granulation at the Kennecott Utah copper smelter**." In EPD Congress, pp. 577-589. 2006.

952. Suominen, Risto, A. Jokilaakso, P. Taskinen, and K. Lilius. "**Behaviour of copper mattes in simulated flash converting conditions**." (1990).

953. Anjala, Yrjö, P. Hanniala, J. Sulanto, and J. Asteljoki. "**Outokumpu Flash Smelting in Copper Metallurgy--the Latest Developments and Applications**." In Copper Metallurgy'88/Metalurgia Miedzi'88--Proceedings, pp. 7-25. 1988.

954. Riihilahti, Kirsi M., Hong Yong Sohn, Ari Jokilaakso, and Manuel Perez-Tello. "**Oxidation of copper matte particles under simulated flash converting conditions**." (1997).

955. Yu, Feng, Longgong Xia, Yinbin Zhu, Ari Jokilaakso, and Zhihong Liu. "**Reaction Behavior of Na 2 SO 4-Containing Copper Matte Powders in a Simulated Flash Converting Process**." Metallurgical and Materials Transactions B 52 (2021): 3468-3476.

1.11.3 Submerged tuyere Noranda continuous converting

956. Tarassoff, P. "**Process R & D—the noranda process**." Metallurgical Transactions B 15 (1984): 411-432.

957. Zamalloa, M., and E. Carissimi. "**Slag chemistry of the new Noranda continuous converter**." Copper 99- Cobre 99 (1999): 123-136.

958. McDermid, J. R., J. F. Leroux, P. J. Mackey, N. Stubina, and L. J. Surges. "**The effect of process changes on greenhouse gas emissions from Noranda's Canadian copper operations**." (2001).

959. Wong, Henry KT, Catharine M. Banic, Stéphane Robert, Zdenek Nejedly, and J. L. Campbell. "**In-stack and in-plume characterization of particulate metals emitted from a copper smelter**." Geochemistry: Exploration, Environment, Analysis 6, no. 2-3 (2006): 131-137.

960. Sun, Yongqi, Mao Chen, Zhixiang Cui, Leonel Contreras, and Baojun Zhao. "**Equilibria of iron silicate slags for continuous converting copper-making process based on phase transformations**." Metallurgical and Materials Transactions B 51 (2020): 2039-2045.

961. Mackey, P. J. "**Continuous converting of matte in the Noranda Converter: Part I Overview and metallurgical background**." In Fuel and Energy Abstracts, vol. 38, no. 3, pp. 178-178. Elsevier Science, 1997.

962. Levac, C., P. J. Mackey, C. Harris, and P. Barbe. "**Continuous converting of matte in the Noranda converter: part II—pilot testing and plant evaluation**." In Proceedings of COPPER, vol. 95, pp. 351-366. 1995.

963. Mackey, P. J., J. B. W. Bailey, and G. D. Hallett. "**The Noranda Process--an Update**." Copper Smelting--an Update (1982): 213-236.

964. Themelis, nj, tarassof. P, gd hallett, and gc mckerrow. "**Noranda process-alternative to reverberatory and converter smelting of copper**." journal of metals 24, no. 4 (1972): 25.

965. Prevost, y. "**first year of operation of the noranda continous converter**." in copper 99-cobre 99 (fourth international conference), volume 5, smelting operations and advances, pp. 269-282. 1999.

966. Rosenktanz, r. D., and u. S. Bwau. "**2.9 noranoa continuous smelting**." 52r (1980): 196.

967. Mackey, P. J. "**Developments in the continuous converting of copper matte**." In Challenges in Process Intensification: Proceedings of the International Symposium on Challenges in Process Intensification, Montreal, Quebec, August 24-29, 1996, p. 313. Canadian Institute of Mining, Metallurgy and Petroleum, 1996.

968. Sharma, S. N., and Robert J. Anderson. "**Design Developments and Operation of Waste-Heat Recovery System from Noranda Process**." JOM 35, no. 1 (1983): 68-76.

1.11.4 Top submerged lance converting

969. Gwynn-Jones, Stephen, Phil Conradie, Stanko Nikolic, Bennie Henning, Martin Bakker, Hugo Joubert, and Brett Francis. "**Using CFD analysis to optimise top submerged lance furnace geometries**." In 12th International Conference on CFD in Oil & Gas, Metallurgical and Process Industries, Norway. 2017.

970. Kandalam, Avinash, Michael Stelter, Markus Reinmöller, Markus A. Reuter, and Alexandros Charitos. "**Determining the Bubble Dynamics of a Top Submerged Lance Smelter**." In REWAS 2022: Developing Tomorrow's Technical Cycles (Volume I), pp. 541-551. Cham: Springer International Publishing, 2022.

971. Valencia, Alvaro, Marco Rosales-Vera, and Camilo Orellana. "**Fluid dynamics in a teniente type copper converter model with one and two tuyeres**." Advances in Mechanical Engineering 5 (2013): 902874.

972. Valencia, Alvaro, Marco Rosales-Vera, and Camilo Orellana. "**Research Article Fluid Dynamics in a Teniente Type Copper Converter Model with One and Two Tuyeres**." (2013).

973. Schaaf, M., Z. Gómez, and A. Cipriano. "**Real-time hybrid predictive modeling of the Teniente Converter**." Journal of Process Control 20, no. 1 (2010): 3-17.

974. Schaaf, Max, Zacarías Gómez, and Aldo Cipriano. "**Estimation of phases levels in a Teniente converter using machine vision**." IFAC Proceedings Volumes 42, no. 23 (2009): 282-285.

975. Yazawa, Akira, and Motonori Eguchi. "**Equilibrium Studies on Cu Slags Used in Continuous Converting**." Extractive Metallurgy of Copper. 1 (1976).

976. Kaur, Rajneet Rosey. "**FCS slag for continuous copper converting**." PhD diss., RMIT University, 2007.

977. Li, Wenjie, Shibo Wang, Jianxin Xu, Jianhang Hu, Hua Wang, Yuling Zhai, Qingtai Xiao, Ge Deng, and Dongbo Li. "**Numerical Investigation of the Enhanced Stirring Characteristics of a Multi-Lance Top-Blowing Continuous Converting Furnace for Lance Arrangement and Variable-Velocity Blowing**." Energies 16, no. 5 (2023): 2412.

978. Hadjiski, Mincho, and Kosta Bosnhakov. "**Learning-Based Optimization of Copper Converter Predictive Maintenance**." In ANNA'18; Advances in Neural Networks and Applications 2018, pp. 1-6. VDE, 2018.

979. Tomova, fani. "**Application of the monte carlo method for forecasting the duration of peirce-smith converter campaigns**." journal of chemical technology & metallurgy 57, no. 4 (2022).

980. MacRae, A., M. Wallgren, B. Wasmund, J. Lenz, A. Majumdar, P. Zuliani, and P. Elvestad. "**Converting furnace upgrades at the Kidd Creek Metallurgical Division copper smelter**." Sulfide Smelting'98: Current and Future Practices (1998): 387-397.

981. 308.

982. Ahmed, Hussain, Luis Ricardez-Sandoval, and Matti Vilkko. "**Optimal Scheduling of the Peirce-Smith Converter in the Copper Smelting Process**." Processes 9, no. 11 (2021): 2004.

983. Chaubal, P. C., and M. Nagamori. "**Volatilization of bismuth in copper matte converting—computer simulation**." Metallurgical Transactions B 13 (1982): 339-348.

984. Riffo, Vladimir, and Alejandro Pulgar. "**Predictive Model of the Percentage of Copper in the Matte of the Teniente Converter Through an Artificial Neural Network**." JOM 74, no. 2 (2022): 396-404.

985. Wang, Songsong, Qinmeng Wang, Miao Tian, Xueyi Guo, Qinghua Tian, Zhi Wang, and Shengli Qu. "**Modeling of Copper Matte Continuous Converting Processes Based on Multithread Particle Swarm Optimization Algorithm**." JOM (2022): 1-6.

986. Valencia, A., M. Rosales, R. Paredes, C. Leon, and A. Moyano. "**Numerical and experimental investigation of the fluid dynamics in a Teniente type copper converter**." International Communications in Heat and Mass Transfer 33, no. 3 (2006): 302-310.

1.11.5 Metso Outotec Ausmelt converting

987. Matusewicz, R., S. Hughes, and J. Hoang. "**The Ausmelt continuous copper converting (C3) process**." Cu2007 3 (2007): 29-47.

988. Wood, Jacob, Robert Matusewicz, and Markus A. Reuter. "**Ausmelt C3 converting**." In The International Peirce-Smith Converting Centennial Symposium, 2009 TMS Annual Meeting, San Francisco, California, USA, pp. p397-406. 2009.

989. Georgalli, G. A., J. J. Eksteen, and M. A. Reuter. "**An integrated thermochemical-systems approach to the prediction of matte composition dynamics in an Ausmelt® nickel–copper matte converter**." Minerals Engineering 15, no. 11 (2002): 909-917.

990. Eksteen, J. J., G. A. Georgalli, and M. A. Reuter. "**Online prediction of the actual melt chemistry in an Ausmelt converter using a thermodynamicsystem identification hybrid modelling technique**." In Third International Sulphide Smelting Symposium, TMS, pp. 457-468. 2002.

991. Hughes, Stephen. "**Applying ausmelt technology to recover Cu, Ni, and Co from slags**." Jom 52, no. 8 (2000): 30-33.

992. Yuan, Haibin, Bin Cai, Xing-cheng SONG, Du-zuo TANG, and Bin Yang. "**Insight on the reduction of copper content in slags produced from the Ausmelt Converting Process**." Journal of Mining and Metallurgy, Section B: Metallurgy 57, no. 2 (2021): 155-162.

993. Floyd, J. M., and G. Guorgi. "**Converting mattes with the ausmelt furnace**." Converting, Fire Refining and Casting (1994): 131-140.

994. Wood, Jacob, Joey Hoang, and Stephen Hughes. "**Energy efficiency of the Outotec® ausmelt process for primary copper smelting**." Jom 69, no. 6 (2017): 1013-1020.

995. Sofra, Robert Matusewicz Joseph. "**Lead Smelting, Copper Smelting and Copper Converting Using Ausmelt Technology**." Non-ferrous Metals in the New Millenium (2001): 71.

996. Georgalli, G. A., J. J. Eksteen, M. A. Reuter, K. T. Hara, and N. McKenzie. "**Characterisation of an Ausmelt® Ni-Cu converter using semi-fundamental submodel**." In Proceedings of EMC, p. 1. 2003.

997. Hughes, Stephen, Markus Reuter, and Alan Kaye. "**Ausmelt technology-developments in copper**." (2007): 147-162.

998. Jarošíková, Alice, Vojtěch Ettler, Martin Mihaljevič, Bohdan Kříbek, and Ben Mapani. "**The pH-dependent leaching behavior of slags from various stages of a copper smelting process: Environmental implications**." Journal of environmental management 187 (2017): 178-186.

999. Swayn, Gavin P., Ken R. Robilliard, and John M. Floyd. "**Applying ausmelt processing to complex copper smelter dusts**." JOM 45, no. 8 (1993): 35-38.

1000. Mounsey, E. N., H. Li, and J. W. Floyd. "**The Design of the Ausmelt Technology Smelter at Zhong Tiao Shan's Houma Smelter, People's Republic of China**." Copper 99-Cobre 99 (1999): 357-370.

1001. Matusewicz, Robert, and Joe Sofra. "**Ausmelt Technology-Developments in Copper Converting**." In Proceedings of EMC, pp. 1-12. 2005.

1002. Institution of Mining and Metallurgy, K. R. Robilliard, W. E. Short, G. A. Guorgi, and B. R. Baldock. "**Ausmelt's top submerged lance technology applied to copper smelting**." Mining Latin America/Minería Latinoamericana: Challenges in the mining industry/Desafíos para la industria minera (1994): 411-421.

1003. Sofra, J. "**The Economic and Environment Benefits of Ausmelt Technology in Secondary Copper Smelting and Converting**." In Proceedings of Sessions and Symposia sponsored by the Extraction and Processing Division, pp. 339-348. TMS Annual Meeting, 1997.

1004. Li, H., and J. W. Floyd. "**The design of the Ausmelt Technology smelter at Zhong Tiao Shan's Houma smelter, People's Republic of China**." (1999).

1005. Reuter, Markus A., and Robert Matusewicz. "**Ausmelt's TSL technology: Innovating in energy efficient metal production, recycling and waste processing**." AusIMM Bulletin 2 (2008): 12-14.

1006. Mounsey, E. N., B. R. Baldock, and J. Sofra. "**The Development and Commercialisation of Ausmelt Technology in Non Ferrous Metals Converting Operations**." Minerals Processing (2000): 24-25.

1007. Floyd, J. M., E. N. Mounsey, and B. R. Baldock. "**Copper Converting at Bindura Nickel Corporation using Ausmelt Technology., Sulfide Smelting'98: Current and Future Practices**." In 1997 TMS Annual Meeting, Orlando, Florida, pp. 287-301. 1998.

1008. Georgalli, G. A., J. J. Eksteen, M. A. Reuter, and K. Hara. "**Systems modelling of furnaces using industrial data and fundamental submodels to predict the matte chanmistry dynamics in an ausmelt converter**." In Proc. European metallurgical conference, Hannover, Germany, pp. 1217-1238. 2003.

1009. Mounsey, E. N. "**Economic and technical evaluation for Ausmelt process systems for copper bearing materials**." In Proceedings of copper, vol. 95, pp. 189-204. 1995.

1010. Sofra, J., and R. W. Matusewicz. "**Ausmelt Technology–Copper Production Technology for the 21st Century**." Copper, 2003.

1011. Allanore, antoine, rodney jones, nathan stubina, corby anderson, and shijie wang. "**Alternative coolants and cooling system designs for safer freeze lined furnace operation**." ni-co 2013 (2016): 299.

1012. Tsymbulov, L. B., S. P. Pigarev, E. N. Selivanov, and V. M. Chumarev. "**Structure and properties of the slags of continuous converting of copper nickel-containing mattes and concentrates: I. Effect of the consumption of fluxing components on the structure and liquidus temperature of the slags**." Russian Metallurgy (Metally) 2011, no. 5 (2011): 397.

1013. Pigarev, S. P., L. B. Tsymbulov, E. N. Selivanov, and V. M. Chumarev. "**Structure and properties of the slags of continuous converting of copper nickel-containing mattes and concentrates: II. Effect of the SiO2/CaO ratio on the structure and liquidus temperature of the slags**." Russian Metallurgy (Metally) 2012, no. 3 (2012): 171-177.

1014. Pigarev, S. P., L. B. Tsymbulov, E. N. Selivanov, V. M. Chumarev, and S. A. Krasikov. "**Structure and properties of the slags of continuous converting of copper nickel-containing mattes and concentrates: III. Influence of the slag composition on the surface tension and density of slag melts**." Russian Metallurgy (Metally) 2012, no. 11 (2012): 919-923.

1015. Pigarev, S. P., L. B. Tsymbulov, S. A. Istomin, E. N. Selivanov, and V. M. Chumarev. "**Structure and properties of the slags of continuous converting of copper nickel-containing mattes and concentrates: IV. Influence of the slag temperature and composition on the slag melt viscosity**." Russian Metallurgy (Metally) 2013 (2013): 176-181.

1016. Tsymbulov, Leonid, Florian Kongoli, Sergey Pigarev, and Eugene Selivanov. "**Structure And Properties Of Slag Produced In The Course Of Continuous Converting Of Nickel Containing Copper Matte And Concentrates**." In 2011-Sustainable Industrial Processing Summit, vol. 1. Flogen Star Outreach, 2012.

1.11.6 Glencore Technology ISASMELT_ batch converting and ISACONVERT_continuous converting

1017. Tan, P. F., and Pierre Vix. "**Modelling and control of copper Isasmelt furnace**." In EPD Congress 2006 Proceedings, pp. 1111-1121. 2006.

1018. Rapkoch, John M., and Mario Cerna. "**Isasmelt copper converting: a review of possibilities and challenges**." In Sohn International Symposium; Advanced Processing of Metals and Materials Volume 8: International Symposium on Sulfide Smelting 2006, vol. 8, pp. 251-259. 2006.

1019. Hogg, Ben, Stanko Nikolic, Paul Voigt, and Paul Telford. "**ISASMELT™ technology for sulfide smelting**." In Extraction 2018: Proceedings of the First Global Conference on Extractive Metallurgy, pp. 149-158. Springer International Publishing, 2018.

1020. Barrett, K. R. "**The isasmelt process**." Erzmetall;(Germany) 46, no. 1 (1993).

1021. Li, Xun, Xing Zhu, Xianjin Qi, Kongzhai Li, Yonggang Wei, Hua Wang, Jianhang Hu, Xinghuan Hui, and Xin Zhang. "**Pyrolysis of arsenic-bearing gypsum sludge being substituted for calcium flux in smelting process**." Journal of Analytical and Applied Pyrolysis 130 (2018): 19-28.

1022. Mariscal, Leopoldo, and Enrique Herrera. "**ISASMELT TM slag chemistry and copper losses in the rotary holding furnaces slag at Ilo smelter**." In 8th international conference on molten slags, fluxes & salts, pp. 1241-1250. 2009.

1023. Rana, I. "**Converting Alternatives for Copper Smelting Processes**." Converting, Fire Refining and Casting (1994): 91-105.

1024. Jak, Eugene, Denis Shishin, Will Hawker, James Vaughan, and Peter C. Hayes. "**Improved copper smelter and converter productivity through the use of a novel high-grade feed**." In Extraction 2018: Proceedings of the First Global Conference on Extractive Metallurgy, pp. 265-271. Springer International Publishing, 2018.

1025. Arthur, Philip, Britt Bulter, James Edwards, Chris Fountain, Simon Hunt, and Jorma Tuppurainen. "**The ISASMELTTM Process-an Example of Successful Industrial R&D**." In Yazawa Symposium San Diego. 2003.

1026. Mwanza, Trevor, Matthias Eggert, Winson Chirwa, Mark Prince, Nurzhan Dyussekenov, and Dennis Marschall. "**Kansanshi Copper Smelter ISACONVERT™ Furnace Tapping System Design, Operation, and Improvements**." In Furnace Tapping 2022, pp. 233-244. Cham: Springer International Publishing, 2022.

1.11.7 Chinese continuous converting technologies

1.11.7.1 Bottom blowing converting

1027. Liu, Zhihong, and Longgong Xia. "**The practice of copper matte converting in China**." Mineral Processing and Extractive Metallurgy 128, no. 1-2 (2019): 117-124.

1028. Wang, Songsong, and Xueyi Guo. "**Thermodynamic Modeling of Oxygen Bottom-Blowing Continuous Converting Process**." In Extraction 2018: Proceedings of the First Global Conference on Extractive Metallurgy, pp. 573-583. Springer International Publishing, 2018.

1029. Xu, Feiyan, Tao Weng, Keqin Tan, Jinfa Liao, Baojun Zhao, and Sui Xie. "**Distribution and Control of Arsenic during Copper Converting and Refining**." Metals 13, no. 1 (2022): 85.

1030. Park, Jooho, Joonho Lee, and Joo Hyun Park. "**Effect of Oxygen Blowing on Copper Droplet Formation and Emulsification Phenomena in the Converting Process**." Journal of Sustainable Metallurgy 7, no. 3 (2021): 831-847.

1031. Jie, Yan. "**Development on Copper Smelters in China Today**." Engineering Solutions for Sustainability: Materials and Resources II (2015): 43-54.

1032. Yan, J. "**Recent operation of the oxygen bottom-blowing copper smelting and continuous copper converting technologies**." In Proceedings of the 9th International Copper Conference (Copper 2016), Kobe, Japan, pp. 13-16. 2016.

1033. Liu, S. H. "**Operation practice of copper matte bottom blowing continuous converting**." Nonferrous Met (Extr Metall) 12 (2016): 17-19.

1034. Roumeliotis, Ioannis John. "**Desulfurization of INCO semi-blister copper**." (1999).

1035. Tanaka, fumito. "**Continuous copper converter**." converter and fire refining practices (2005): 223.

1.11.7.2 Top-blown multilance continuous converting technology

1036. Li, Wenjie, Shibo Wang, Jianxin Xu, Jianhang Hu, Hua Wang, Yuling Zhai, Qingtai Xiao, Ge Deng, and Dongbo Li. "**Numerical Investigation of the Enhanced Stirring Characteristics of a Multi-Lance Top-Blowing Continuous Converting Furnace for Lance Arrangement and Variable-Velocity Blowing**." Energies 16, no. 5 (2023): 2412.

1037. Li, Wenjie, Shibo Wang, Jianxin Xu, Jianhang Hu, Hua Wang, Yuling Zhai, Qingtai Xiao, Ge Deng, and Dongbo Li. "**Numerical Investigation of the Enhanced Stirring Characteristics of a Multi-Lance Top-Blowing Continuous Converting Furnace for Lance Arrangement and Variable-Velocity Blowing**." Energies 16, no. 5 (2023): 2412.

1.12 Continuous copper making processes

1.12.1 Single-stage process: direct to blister flash process

1038. Ranasinghe, D. J., R. Russell, R. Muthuraman, and Z. Dryga. "**Process optimization by means of heat and mass balance based modelling at Olympic Dam**." Copper 2010 3 (2010): 1063-1078.

1039. Taskinen, Pekka, and Ilkka Kojo. "**Fluxing options in the direct-to-blister copper smelting**." In Proceedings of molten 2009 international conference, pp. 1139-1151. 2009.

1040. Chen, Chunlin, Ling Zhang, and Sharif Jahanshahi. "**Application of MPE model to direct-to-blister flash smelting and deportment of minor elements**." In Proceeding of Copper. 2013.

1041. Rogóż, K., and M. Kucharski. "**The rate of metal oxygen reduction from the slag of the direct-to-blister flash smelting process**." Archives of Metallurgy and Materials 55, no. 1 (2010): 317-323.

1042. Madej, P., and M. Kucharski. "**Influence of Temperature on the Rate of Copper Recovery From the Slag of The Flash Direct-To-Blister Process by AaSolid Carbon Reducer**." Archives of Metallurgy and Materials 60 (2015).

1043. Taskinen, Pekka. "**Direct-to-blister smelting of copper concentrates: the slag fluxing chemistry**." Mineral processing and extractive metallurgy 120, no. 4 (2011): 240-246.

1044. Swinbourne, D. R., R. C. West, M. E. Reed, and A. Sheeran. "**Computational thermodynamic modelling of direct to blister copper smelting**." Mineral Processing and Extractive Metallurgy 120, no. 1 (2011): 1-9.

1045. Vartiainen, A., I. V. Kojo, and C. Rojas. "**Ferrous calcium silicate slags in direct-to-blister flash smelting**." In Yazawa International Symposium on Metallurgical and Materials Processing: Principles and Technologies, pp. 277-290. 2003.

1046. Czernecki, J., Z. Smieszek, St Gizicki, J. Dobrzanski, and M. Warmuz. "**Problems with elimination of the main impurities in the KGHM Polska Miedz S. A. copper concentrates from the copper production cycle(shaft furnace process, direct blister smelting in a flash furnace)**." Sulfide Smelting'98: Current and Future Practices (1998): 315-343.

1047. Asteljoki, J. "**Direct Smelting of Blister Copper--Pilot Flash Smelting Tests of Olympic Dam Concentrate**." Pyrometallurgy87 (1987): 19-52.

1048. Bydałek, A. W., W. Wołczyński, A. Bydałek, P. Schlafka, and P. Kwapisiński. "**Analysis of separation mechanism of the metallic phase of slag in the direct-to-blister process**." Archives of Metallurgy and Materials 60 (2015).

1049. Taskinen, Pekka, Markku Kaskiala, Kaisa Miettinen, and Jani Jansson. "**Freeze-lining formation and microstructure in a direct-to-blister flash smelting slag**." Journal for Manufacturing Science & Production 13, no. 1-2 (2013): 77-83.

1050. Kojo, I. V., and P. Hanniala. "**Direct Blister Production by Outokumpu Flash Smelting since the start up of GLOGOW II Smelter and Future Trends**." Rudy i Metale Nieżelazne 46, no. 5-6 (2001): 266-270.

1051. Gostynski, Zbigniew, Dariusz Haze, and Stanislaw Szymanski. "**Flash smelting furnace of the KGHM Glogow copper plant technological and process challenges as a driving force of its continuous modernization**." Rudy i Metale Niezelazne 51, no. 7 (2006): 393-396.

1052. Vartiainenl, asmo, ilkka v. Kojo, and cesar acufia rojas. "**Ferrous calcium silica te slags in direct-to-blister**."

1053. Czernecki, J., Z. Śmieszek, Z. Miczkowski, G. Krawiec, and S. Gizicki. "**Problems of lead and arsenic removal from copper production in a one-stage flash-smelting process**." In Copper, vol. 2, pp. 669-683. 2010.

1054. Tuominen, Jukka, Yrjö Anjala, and Peter Björklund. "**Slag Cleaning of Outokumpu Direct-to-Blister Flash Smelting Slags**." Cu2007 3 (2007): 339-350.

1055. Hanniala, pekka, and ilkka v. Kojo. "**From autogeneous sulflde smel ting to the production network-outokumpu flash technology..;. S trendsetter in: copper**."

1056. Wang, Songsong, Qinmeng Wang, Xueyi Guo, and Keqin Tan. "**Operation and Fundamentals of Direct Anode Copper Production from Matte**." Metallurgical and Materials Transactions B 54, no. 2 (2023): 487-498.

1057. Somerville, Michael, Chunlin Chen, Gerardo RF Alvear F, and Stanko Nikolic. "**Fluxing strategies for the direct to blister smelting of high silica and low iron copper concentrates**." In Advances in Molten Slags, Fluxes, and Salts: Proceedings of the 10th International Conference on Molten Slags, Fluxes and Salts 2016, pp. 667-675. Springer International Publishing, 2016.

1058. Sun, Yongqi, Mao Chen, Zhixiang Cui, Leonel Contreras, and Baojun Zhao. "**Development of ferrous-calcium silicate slag for the direct to blister copper-making process and the equilibria investigation**." Metallurgical and Materials Transactions B 51 (2020): 973-984.

1059. Mukono, Tichaona. "**The effect of acid soluble copper concentrates on the operations of the flash smelting and slag cleaning furnaces at Nchanga smelter of Konkola copper mines plc**." PhD diss., The University of Zambia, 2017.

1060. Hanniala, P., and J. Sulanto. "**The Development Trends of the Outokumpu Flash Smelting Process for the Year 2000.(Abstract Only)**." Metallurgical Processes for the Year 2000 and Beyond (1989): 1988.

1061. Smieszek, Z., S. Sedzik, W. Grabowski, S. Musial, and S. Sobierajski. "**Glogow 2 Copper Smelter--Seven Years of Operational Experience**." Extraction Metallurgy'85 (1985): 1049-1056.

1062. Mponda, Enock, and Timothy Smith. "**Design, Development and Early operations of the Konkola Copper Mines Nchanga Smelter Direct Blister Flash Process, Chingola, Zambia**." In AIP Conference Proceedings. American Institute of Physics, Ste. 1 NO 1 Melville NY 11747-4502 United States, 2012.

1063. Taskinen, Pekka, Tero Kolhinen, and Yrjö Anjala. "**The influence of reaction shaft conditions on the behaviour of impurities in flash smelting and direct blister smelting**." Outotec Research Oy. Pori, Finland.

1064. Zhou, Shiwei, Xiang Guo, Bo Tian, Bo Li, and Yonggang Wei. "**Investigation on Direct-to-Blister Smelting of Chalcocite via Thermodynamics and Experiment**." Metals 11, no. 1 (2020): 19.

1.12.2 Two-stage process: Dongying-Fangyuan process

1065. Zhao, Baojun, Zhixiang Cui, and Zhi Wang. "**A new copper smelting technology–bottom blown oxygen furnace developed at Dongying Fangyuan Nonferrous Metals**."

In 4th international symposium on high-temperature metallurgical processing, TMS, Warrendale, pp. 3-10. 2013.

1066. Cui, Zhi-xiang, Zhi Wang, Hai-bin Wang, Chuan-bing Wei, Peng Hou, and Wu-zhao Du. "**Two-step copper smelting process at Dongying Fangyuan**." In Extraction 2018: Proceedings of the First Global Conference on Extractive Metallurgy, pp. 427-434. Cham: Springer International Publishing, 2018.

1067. Chen, Mao, Zhixiang Cui, and Baojun Zhao. "**Slag chemistry of bottom blown copper smelting furnace at Dongying Fangyuan**." In 6th International Symposium on High-Temperature Metallurgical Processing, pp. 257-264. Springer International Publishing, 2016.

1068. Wang, Zhi, Zhixiang Cui, Chuanbing Wei, and Haibin Wang. "**Two-step copper smelting process at dongying fangyuan**." In 8th International Symposium on High-Temperature Metallurgical Processing, pp. 639-647. Springer International Publishing, 2017.

1069. Wang, zhi, haibin wang, xueyi guo, zhixiang cui, and baojun zhao. "**Simplified process for making anode copper**." in 9th international symposium on high-temperature metallurgical processing, pp. 3-12. Springer international publishing, 2018.

1070. Tang, Guangwu, Armin K. Silaen, Hongjie Yan, Zhixiang Cui, Zhi Wang, Haibin Wang, Kaile Tang, Ping Zhou, and Chenn Q. Zhou. "**CFD study of gas-liquid phase interaction inside a submerged lance smelting furnace for copper smelting**." In 8th International Symposium on High-Temperature Metallurgical Processing, pp. 101-111. Springer International Publishing, 2017.

1071. Cui, Z. X., Z. Wang, C. B. Wei, H. B. Wang, P. Hou, and W. Z. Du. "**Plant practice of two-step copper smelting process at Dongying Fangyuan**." Nonferr Met 4 (2018): 24-27.

1072. Tang, Guangwu, Kaile Tang, Armin K. Silaen, Hongjie Yan, Zhixiang Cui, Zhi Wang, Haibin Wang, Ping Zhou, and Chenn Q. Zhou. "**CFD Modeling of Flow and Chemical Reactions in a Submerged Lance Copper Smelting Furnace**." In 9th International Symposium on High-Temperature Metallurgical Processing, pp. 103-114. Springer International Publishing, 2018.

1073. Cui, Wenzhao, Mao Chen, and Baojun Zhao. "**Pyrometallurgical recovery of valuable metals from flue dusts of copper smelter through lead alloy**." In PbZn 2020: 9th International Symposium on Lead and Zinc Processing, pp. 539-547. Springer International Publishing, 2020.

1074. Tang, Kaile. "**Comprehensive study of flow and chemical reactions in a submerged lance copper smelting furnace**." PhD diss., Purdue University, 2018.

1075. Wang, Qinmeng, and Xueyi Guo. "**Investigation of the oxygen bottom blown copper smelting process**." In Extraction 2018: Proceedings of the First Global Conference on Extractive Metallurgy, pp. 445-461. Springer International Publishing, 2018.

1.12.3 The Mitsubishi process

1076. Goto, m., h. Asao, s. Okabe, n. Kohno, y. Miyamoto, t. Igarashi, and s. Nayashi. "**Injection smelting techniques of the mitsubishi continuous process and their application to the peirce-smith converter**." in cim bulletin, vol. 80, no. 902, pp. 88-88. 101 6th ave sw, ste 320, calgary ab tzp 3p4, canada: canadian inst mining metallurgy petroleum, 1987.

1077. Surapunt, supachai, and nozomu hasegawa. "**Distribution behavior of arsenic, antimony and bismuth in the smelting stage of the mitsubishi process**." in yazawa international symposium on metallurgical and materials processing: principles and technologies, pp. 375-381. 2003.

1078. Coursol, Pascal, Nagendra Tripathi, Phillip Mackey, Tony Leggett, and Adam Salomon de Friedberg. "**Slag chemistry of the Mitsubishi S and Cl furnaces at the Xstrata Copper-Kidd metallurgical site**." Canadian Metallurgical Quarterly 49, no. 3 (2010): 255-262.

1079. Kimura, Etsuji. "**Fundamental research of lancing mechanism in Mitsubishi continuous smelting furnace**." Transactions of the Iron and Steel Institute of Japan 23, no. 6 (1983): 522-529.

1080. Asaki, Zenjiro, Toru Taniguchi, and Mineo Hayashi. "**Kinetics of the reactions in the smelting furnace of the Mitsubishi process**." JOM 53 (2001): 25-27.

1081. Shibasaki, T., and M. Hayashi. "**Top-blown injection smelting and converting: The Mitsubishi process**." JOM 43, no. 9 (1991): 20-26.

1082. Goto, Moto, and Takumi Echigoya. "**Effect of injection smelting jet characteristics on refractory wear in the Mitsubishi process**." JOM 32, no. 11 (1980): 6-11.

1083. Suzuki, T., T. Yanagida, M. Goto, T. Echigoya, and N. Kikumoto. "**Recent operation of Mitsubishi continuous copper smelting and converting process at Naoshima**." Copper Smelting--an Update (1982): 51-76.

1084. Goto, M., and N. Kikumoto. "**Process Analysis of Mitsubishi Continuous Copper Smelting and Converting Process**." TMS/AIME, (1981): 15.

1085. Okabe, S., and E. Kimura. "**Injection metallurgy for continuous copper smelting and converting: fundamental aspects of Mitsubishi process**." In The Howard Worner International Symposium on Injection in Pyrometallurgy, pp. 83-96. 1996.

1086. Park, Jong-ha, Soo-sang Park, Xue-feng Han, and Kyung-woo Yi. "**Numerical analysis on fluid flow and heat transfer in the smelting furnace of mitsubishi process for Cu refining**." Metals and Materials International 22 (2016): 118-128.

1087. Kulczycka, Joanna, Łukasz Lelek, Anna Lewandowska, Herbert Wirth, and Joseph D. Bergesen. "**Environmental impacts of energy-efficient pyrometallurgical copper smelting technologies: The consequences of technological changes from 2010 to 2050**." Journal of Industrial Ecology 20, no. 2 (2016): 304-316.

1088. SHIMIZU, Takashi. "**Copper Business and Recycling Business at Naoshima Smelter & Refinery**." Journal of MMIJ 123, no. 12 (2007): 614-619.

1089. Goto, Moto, Eiki Oshima, and Mineo Hayashi. "**Control aspects of the Mitsubishi continuous process**." JOM 50 (1998): 60-64.

1090. Goto, Moto, Mineo Hayashi, and Susumu Okabe. "**Oxygen Utilization for the Mitsubishi Continuous Smelting Process at the Naoshima Smelter**." In Proceedings of the Metallurgical Society of the Canadian Institute of Mining and Metallurgy, pp. 31-48. Pergamon, 1987.

1091. Brondoni, Silvio M. "**Competitive circular economy management. The Mitsubishi corporation case**." Symphonya. Emerging Issues in Management (2020): 10-25.

1092. Shibasaki, T., M. Hayashi, and Y. Nishiyama. "**Recent operation at Naoshima with a larger Mitsubishi furnace line**." Extractive Metallurgy of Copper, Nickel and Cobalt. 2 (1993): 1413-1428.

1093. Regan, J. G., and T. Furukawa. "**Mitsubishi Metal Plans Texas Copper Smelter**." Am. Met. Mark. 97, no. 12 (1989): 2.

1094. Yanagida, T. "**Construction of a large scale Mitsubishi continuous smelting furnaces line and improvement of productivity at Naoshima Smelter and Refinery**." J. Min. Mater. Process. Inst. Jpn.(Japan) 109, no. 8 (1993): 581-586.

1095. Furukawa, T. "**Mitsubishi Metal Plans US Smelter for Copper, Eyes Site Near Houston**." Am. Met. Mark. 96, no. 241 (1988): 2.

1096. Farricker, M. "**Mitsubishi Sees Copper Plant OK**." Am. Met. Mark. 97, no. 232 (1989): 2.

1097. Goto, M., S. Kawakita, N. Kikumoto, and O. Iida. "**High intensity operation at Naoshima Smelter**." JOM 38, no. 9 (1986): 43-46.

1098. Goto, M., and K. Kanamori. "**Converting Furnace Operation of Mitsubishi Process**." Copper and Nickel Converters (1979): 210-224.

1099. Park, Soo Sang, and Joo Hyun Park. "**Removal of Pb from Molten Copper by Fe t O-SiO_2 (-CaO, Al_2O_3) Slag Treatment in Mitsubishi Process**." In Celebrating the Megascale: Proceedings of the Extraction and Processing Division Symposium on Pyrometallurgy in Honor of David GC Robertson, pp. 243-250. Springer International Publishing, 2016.

1100. Goto, M. "**The Construction and Start up Operation of Gresik Smelter and Refinery**." Journal of the Mining and Materials Processing Institute of Japan(Japan) 118, no. 8 (2002): 525-528.

1101. Shibasaki, T. "**Application of computer control to mitsubishi continuous copper smelting process**." (1978).

1102. Suzuki, T. **Behavior of impurities in Mitsubishi continuous copper smelting and converting process**. 1975.

1103. Rutledge, P. "**Mitsubishi metal previews its promising new continuous copper smelting process**." (1975).

1104. Suzuki, T., T. Yanagida, M. Goto, S. Kawakita, T. Echigoya, and N. Kikumoto. "**Test operation for smelting more tonnages of copper concentrates at the Mitsubishi continuous copper smelting and converting process**." In JOURNAL OF METALS, vol. 35, no. 12, pp. A16-A16. 420 COMMONWEALTH DR, WARRENDALE, PA 15086: MINERALS METALS MATERIALS SOC, 1982.

1105. Iida, O., M. Hayashi, and M. Goto. "**Process designs on new smelter projects of the Mitsubishi continuous copper smelting and converting process**." Proceedings of the Nickel–Cobalt 97 (1997): 17-20.

1106. Yusuke Kimura, Ken-ichi Yarnaguchil. "**The Influence of Sodium Oxide on the Distribution Behavior of Some Elements at the S-Furnace of the Mitsubishi Process**." In 3rd International Symposium on High-Temperature Metallurgical Processing, p. 175. John Wiley & Sons, 2012.

1.13 Theory to practice: pyrometallurgical industrial processes

1.13.1 General considerations

1107. Pietrzyk, S., and B. Tora. "**Trends in global copper mining–a review**." In IOP conference series: materials science and engineering, vol. 427, no. 1, p. 012002. IOP Publishing, 2018.

1108. Raumolin, Jussi. **Problems related to the transfer of technology in the mining sector with special reference to Finland**. No. 269. ETLA Discussion Papers, 1988.

1109. Milliken, Clint L. "**What is the Future of the Copper Smelter**?." JOM 22, no. 8 (1970): 51-54.

1110. Kongoli, Florian. **Materials Processing Fundamentals and New Technologies: Yazawa International Symposium on Metallurgical and Materials Processing Principles and Technologies 2003 Volume 1**. FLOGEN STARS OUTREACH, 2003.

1111. Graedel, Thomas E., Marlen Bertram, Kensuke Fuse, Robert B. Gordon, Reid Lifset, H. Rechberger, and S. Spatari. "**The contemporary European copper cycle: The characterization of technological copper cycles**." Ecological Economics 42, no. 1-2 (2002): 9-26.

1112. Schipper, Branco W., Hsiu-Chuan Lin, Marco A. Meloni, Kjell Wansleeben, Reinout Heijungs, and Ester van der Voet. "**Estimating global copper demand until 2100 with regression and stock dynamics**." Resources, Conservation and Recycling 132 (2018): 28-36.

1113. Ahmed, Hussain, and Matti Vilkko. "**Coordination strategy based on hard-heuristics and price-updating scheme for copper smelting process**." Computers & Chemical Engineering (2023): 108198.

1114. Wilson, R., K. Perez, N. Toro, R. Parra, P. J. Mackey, and A. Navarra. "**Mine-to-smelter integration framework for regional development of porphyry copper deposits within the Chilean context**." Canadian Metallurgical Quarterly 61, no. 1 (2022): 48-62.

1115. Parameswaran, Krishna, Joe Wilhelm, and Roberto Camorlinga. "**Sustainable Development Considerations in Primary copper Smelting**." In Extraction 2018: Proceedings of the First Global Conference on Extractive Metallurgy, pp. 241-252. Springer International Publishing, 2018.

1116. Barr, Glenn, Jennifer Defreyne, and Keith Mayhew. "**CESL copper process–an economic alternative to smelting**." CESL Engineering (2005): 1-13.

1117. Jak, Evgueni. "**The role of research in pyrometallurgy technology development—from fundamentals to process improvements—future opportunities**." In Extraction 2018: Proceedings of the First Global Conference on Extractive Metallurgy, pp. 19-37. Springer International Publishing, 2018.

1118. Kapusta, Joël PT. "**JOM world nonferrous smelters survey, part I: copper**." JOM 56, no. 7 (2004): 21-27.

1119. Pradenas, Lorena, Jorge Zúñiga, and Víctor Parada. "**CODELCO, Chile programs its copper-smelting operations**." Interfaces 36, no. 4 (2006): 296-301.

1120. Vera, B. Galvarino, and B. Rolando Campos. "**Codelco Chile Copper Concentrate Smelting Technologies**." Extraction Metallurgy'85 (1985): 117-147.

1121. Toro, Norman, Luís Ayala, Kevin Pérez, Jonathan Castillo, and Alessandro Navarra. "**Economic and strategic analysis of the current situation of Chilean copper smelters**." In AIP Conference Proceedings, vol. 2281, no. 1, p. 020008. AIP Publishing LLC, 2020.

1122. Kozhanov, V. A., V. A. Popov, and E. E. Mushik. "**Ways to increase competitiveness and efficiency of metal goods production from scrap and nonferrous waste**." Metallurgical and Mining Industry 2, no. 2 (2010): 153.

1123. Stephens, Robert. "**The International Symposium on sulfide smelting'98: Current and future practices**." JOM 50, no. 7 (1998): 27.

1124. Habashi, F. "**Copper metallurgy at the crossroads**." Journal of mining and metallurgy, Section B: Metallurgy 43, no. 1 (2007): 1-19.

1125. Boulamanti, Aikaterini, and Jose Antonio Moya. "**Production costs of the non-ferrous metals in the EU and other countries: Copper and zinc**." Resources Policy 49 (2016): 112-118.

1126. Mokmeli, Mohammad, and Masoumeh Torabi Parizi. "**Low-grade chalcopyrite ore, heap leaching or smelting recovery route?**." Hydrometallurgy 211 (2022): 105885.

1127. Sohn, H. Y., S. Kang, and J. Chang. "**Sulfide smelting fundamentals, technologies and innovations**." Mining, Metallurgy & Exploration 22 (2005): 65-76.

1128. Bartlett, Robert W., Richard J. McClincy, and Rolf J. Wesely. "**Smelting copper without converters**." JOM 37, no. 5 (1985): 17-19.

1129. Caley, Earle R., and Dudley T. Easby. "**The smelting of sulfide ores of copper in preconquest Peru**." American Antiquity 25, no. 1 (1959): 59-65.

1130. Kapell, Gerhard, and Wolfgang Leutloff. "**Contimelt: a new continuous melting and refining process for copper**." JOM 36 (1984): 62-66.

1131. Zhang, Bao-jing, Li-ping Niu, Ting-an Zhang, Zhi-qiang Li, Dong-liang Zhang, and Chao Zheng. "**Alternative reduction of copper matte in reduction process of copper slag**." ISIJ International 57, no. 5 (2017): 775-781.

1132. Barr, Glenn, Jennifer Defreyne, David Jones, and Robert Mean. "**On-Site Processing vs. Sale of Copper Concentrates**." Perth, Australia (2005).

1133. Díaz-Borrego, Francisco J., Bernabé Escobar-Peréz, and María del Mar Miras-Rodríguez. "**Estimating copper concentrates benchmark prices under dynamic market conditions**." Resources Policy 70 (2021): 101959.

1134. Wood, jacob, and stephen hughes. "**Future development opportunities for the outotec ausmelt process [c]**." in proceedings of copper 2016. Kobe, pp. 361-372. 2016.

1135. Campos, rolando, and l. Torres. "**Caletones smelter: two decades of technological improvements**." extractive metallurgy of copper, nickel and cobalt. 2 (1993): 1441-1460.

1136. Landolt, c. "**extractive metallurgy of copper, nickel and cobalt. Vol. Ii. Copper and nickel smelter operations**." denver (1993): 1993.

1137. White, matthew, ross haywood, wesley taylor, shu chen, john ranasinghe, and robert west. "**Improved copper flash smelting at olympic dam**." in ausimm metplant conference, perth, australia. 2015.

1138. Tuominen, jukka, and ilkka v. Kojo. "**Blister flash smelting—efficient and flexible low-cost continuous copper process**." in tms annual meeting. 2005.

1139. Ghodrat, maryam, m. Akbar rhamdhani, geoffrey brooks, syed masood, and glen corder. "**Techno economic analysis of electronic waste processing through black copper smelting route**." journal of cleaner production 126 (2016): 178-190.

1140. Hawker, william, james vaughan, evgueni jak, and peter c. Hayes. "**The synergistic copper process concept**." mineral processing and extractive metallurgy 127, no. 4 (2018): 210-220.

1141. Czernecki, j. "**copper metallurgy at the kghm polska miedz sa-present state and perspectives**." in copper 99-cobre 99 (fourth international conference), volume 5, smelting operations and advances, pp. 189-203. 1999.

1142. Filzwieser, andreas, martina hanel, hans-jörg krassnig, rolf degel, timm lux, and alexander bergs. "**Iltec technology—new pathways towards safe and effective cooling**." in pbzn 2020: 9th international symposium on lead and zinc processing, pp. 683-694. Springer international publishing, 2020.

1143. Degel, r., j. L. Joubert, i. Filzwieser, a. Filzwieser, and m. Hanel. "**Innovative solutions in copper production lines**." proceedings of the emc, leipzig, germany (2017).

1144. Kapusta, joël pt. "**jom world nonferrous smelters survey, part i: copper**." jom 56, no. 7 (2004): 21-27.

1145. Floyd, j. M. "**converting an idea into a worldwide business commercializing smelting technology**." metallurgical and materials transactions 36, no. 5 (2005): 557.

1146. Hirai, y. "**recent operation of the flash smelting furnance at saganoseki smelter**." in copper 99-cobre 99 (fourth international conference), volume 5, smelting operations and advances, pp. 671-684. 1999.

1147. Holmström, a., g. Berg, m. Andersson, s. Carrasco, and d. Deutsch. "**Development of partial roasting technology for arsenic containing copper concentrates**." in proceeding of copper 2013 international conference, pp. 965-978. 2013.

1148. Sepulveda, ja. "**Modernization of southern peru copper's ilo smelter**." in paper presented at the 9th international flash smelting congress. 1999.

1149. Jansson, j., p. Björklund, m. Lahtinen, h. Heinonen, m. Jåfs, and k. Fagerlund. "**The future of smelting is digital–outotec solutions**." copper 2016 (2016): 349-360.

1150. Joubert, hugo, and isobel mc dougall. "**Designing furnace lining/cooling systems to operate with a competent freeze lining**." in tms 2019 148th annual meeting & exhibition supplemental proceedings, pp. 1181-1195. Springer international publishing, 2019.

1151. Riekkola-vanhanen, marja. "**Finnish expert report on best available techniques in copper production and by-production of precious metals**." (1999).

1152. Marczeski, w. D., and t. L. Aldrich. "**Retrofitting hayden plant to flash smelting**." aime papers (1986).

1153. Newman, c. J., t. I. Probert, and a. J. Weddick. "**kennecott utah copper smelter modernization, presented at the sme annual meeting, orlando, florida, march 9-11, 1998**." sme papers (1998): 6.

1154. Sadri, afshin, pawel gebski, koorosh mirkhani, and gordon mcgarrie. "**New and innovative non-destructive testing (ndt) techniques for inspection and monitoring of metal smelting furnaces**." in ndt in canada 2009, conference and the 6th international workshop: advances in signal processing for non destructive evaluation of the materials. 2009.

1155. Baba, Kozo. "**The toyo copper smelter of Sumitomo Metal Mining**." JOM 49, no. 10 (1997): 41-43.

1156. Alvear F, Gerardo RF, and Stanko Nikolic. "**ISASMELT™ for recycling of valuable elements contributing to a more sustainable society**." REWAS 2013: Enabling Materials Resource Sustainability (2016): 100-109.

1157. Mackey, P. J., and A. D. Church. "**Review of recent developments in pyrometallurgy**." JOM 33, no. 4 (1981): 28-35.

1158. Rehren, thilo, petar leshtakov, petya penkova, v. Nikolov, and w. Schier. "**Reconstructing chalcolithic copper smelting at akladi cheiri, chernomorets, bulgaria**." der schwarzmeerraum vom neolithikum bis in die früheisenzeit (6000-600 v. Chr.). Kulturelle interferenzen in der zirkumpontischen zone und kontakte mit ihren nachbargebieten (2016): 205-214.

1159. Burrows, Alistair, and Turarbek Azekenov. "**Ust-Kamenogorsk Metallurgical Complex: A Silent Achiever**." In Extraction 2018: Proceedings of the First Global Conference on Extractive Metallurgy, pp. 365-378. Springer International Publishing, 2018.

1160. Tarasov, A. V., and V. M. Paretsky. "**Development of autogenous copper smelting processes in Russia and CIS countries**." C. Diaz, J. Kapusta, & C. Newman, Copper (2003): 173-187.

1161. Taylor, patrick r., and teuku ar putra. "**Pyrometallurgical processing technologies for treating high arsenic copper concentrates**." in celebrating the megascale: proceedings of the extraction and processing division symposium on pyrometallurgy in honor of david gc robertson, pp. 197-211. Springer international publishing, 2016.

1162. Lagos, Gustavo, David Peters, Marcos Lima, and José Joaquín Jara. "**Potential copper production through 2035 in Chile**." Mineral Economics 33 (2020): 43-56.

1163. Jones, Rodney T., and Phillip J. Mackey. "**An overview of copper smelting in southern Africa**." Copper Cobalt Africa 2, no. 8 (2015): 499-504.

1.13.2 Technology evolution since 1970

1164. Melcher, Gerhard, Erich Muller, and Horst Weigel. "**The KIVCET cyclone smelting process for impure copper concentrates**." JOM 28, no. 7 (1976): 4-8.

1165. Warner, N. A. "**Low intensity continuous copper smelting**." Mineral Processing and Extractive Metallurgy 119, no. 1 (2010): 39-48.

1166. Laputka, Mark, and Weiguo Xie. "**A Review of Recent Advances in Pyrometallurgical Process Measurement and Modeling, and Their Applications to Process Improvement**." Mining, Metallurgy & Exploration 38, no. 2 (2021): 1135-1165.

1167. Holappa, Lauri, and Pekka Taskinen. "**Process innovations and sustainability in Finnish metallurgical industries**." Mineral Processing and Extractive Metallurgy 126, no. 1-2 (2017): 70-80.

1168. Memary, R., D. Giurco, G. M. Mudd, S. H. Mohr, and Z. Weng. "**Copper case study: Australian resources, technology and future scenarios**." (2012).

1169. Warhurst, Alyson, Gavin Bridge, and C. Brundenius. "**Economic Liberalisation, Innovation, and Technology Transfer: Opportunities for cleaner production in copper mining and processing**." Technological Change and the Environmental Imperative: The Challenge to the Copper Industry. Cheltenham: Edward Elgar (2003): 11-43.

1170. Lyman, Shari Lee Wright. "**United States copper smelting technology responses to clean air regulation**." PhD diss., The University of Utah, 2003.

1171. Nikolić, Ivica, Isidora Milošević, Nenad Milijić, Aca Jovanović, and Ivan Mihajlović. "**New approach to multi-criteria ranking of the copper concentrate smelting processes**

based on the PROMETHEE/GAIA methodology." Acta Polytechnica Hungarica 16, no. 1 (2019): 143-164.

1172. Forsén, Olof, Jari Aromaa, and Mari Lundström. "**Primary copper smelter and refinery as a recycling plant—a system integrated approach to estimate secondary raw material tolerance**." Recycling 2, no. 4 (2017): 19.

1173. Moskalyk, R. R., and A. M. Alfantazi. "**Review of copper pyrometallurgical practice: today and tomorrow**." Minerals Engineering 16, no. 10 (2003): 893-919.Yazawa, Akira. "**Thermodynamic considerations of copper smelting**." Canadian Metallurgical Quarterly 13, no. 3 (1974): 443-453.

1174. YAZAWA, Akira. "**Trends of technology in nonferrous pyrometallurgy**." Tetsu-to-Hagane 65, no. 8 (1979): 1250-1263.

1175. Yazawa, Akira. **New Technologies in Copper, Lead and Zinc Extractive Metallurgy**. Tôhoku University, 1986.

1176. Tan, Pengfu. "**Technical Developments and Improvements in Xstrata Copper Smelter in Australia**." Minerals, Metals and Materials Society/AIME, 420 Commonwealth Dr., P. O. Box 430 Warrendale PA 15086 United States.[np]. Feb (2011).

1177. Pérez, Kevin, Norman Toro, Edelmira Gálvez, Pedro Robles, Ryan Wilson, and Alessandro Navarra. "**Environmental, economic and technological factors affecting Chilean copper smelters–A critical review**." Journal of Materials Research and Technology 15 (2021): 213-225.

1178. Arias, Luis, Eduardo Balladares, Roberto Parra, Daniel Sbarbaro, and Sergio Torres. "**Sensors and process control in copper smelters: a review of current systems and some opportunities**." Minerals 11, no. 1 (2020): 1.

1179. Navarra, A., A. Ross, Norman Toro, Fernando Ayala, and T. Marin. "**Quantitative methods for copper smelter reengineering projects**." In Phillip Mackey Honorary Symposium, Proceedings of the Copper 2019 Conference, Vancouver, VA, Canada, pp. 18-21. 2019.

1180. Tisdale, D. G., S. J. Muinonen, M. D. Molinski, and A. G. Stokreef. "**A Novel Process to Reduce SO 2 Emissions During Electric Furnace Smelting of Sulphides**." In Ni-Co 2021: The 5th International Symposium on Nickel and Cobalt, pp. 307-315. Springer International Publishing, 2021.

1181. Valenzuela, Luis. "**The Chilean copper smelting industry in the mid-nineteenth century: phases of expansion and stagnation, 1834–58**." Journal of Latin American Studies 24, no. 3 (1992): 507-550.

1182. Zhang, Jun, Yuan-hong Qi, Ding-liu Yan, and Hai-chuan Xu. "**A new technology for copper slag reduction to get molten iron and copper matte**." Journal of Iron and Steel Research International 22, no. 5 (2015): 396-401.

1183. Yusupkhodjaev, A. A., Sh T. Khojiev, B. T. Berdiyarov, D. O. Yavkochiva, and J. B. Ismailov. "**Technology of processing slags of copper production using local secondary technogenic formations**." International Journal of Innovative Technology and Exploring Engineering 9, no. 1 (2019): 5461-5472.

1184. Stephens, Robert L. "**Innovations in smelter gas control**." JOM 51, no. 5 (1999): 35.

1185. Isaksson, Östen, and Theo Lehner. "**The rönnskär smelter project: production, expansion, and start-up**." JOM 52 (2000): 26-29.

1186. Institution of Mining and Metallurgy, C. R. Salazar, F. A. Hernandez, M. D. Strachan, and A. Cross. "**Application of Codelco—Chile pyrometallurgical techniques at the Nkana smelter, Zambia**." African Mining'91 (1991): 215-226.

1187. Krüger, Joachim. "**Optimisation Possibilities of Copper Smelting and-Processing**." Sustainable Metals Management: Securing our Future-Steps Towards a Closed Loop Economy (2006): 335-346.

1188. Theo, Lehner. "**Integrated recycling of non-ferrous metals at Boliden Ltd. Ronnskar smelter**." In Proceedings of the 1998 IEEE international symposium on electronics and the environment. ISEE-1998 (Cat. No. 98CH36145), pp. 42-47. Ieee, 1998.

1189. Moriyama, K., N. Kemori, and H. Kurokawa. "**Recent operation at the Sumitomo Toyo smelter**." In Proceedings of Copper, pp. 26-29. 1995.

1190. Hunt, S., and D. de Vries. "**KANSANSHI COPPER SMELTER: THE FIRST FOUR YEARS OF OPERATION**."

1191. Matkarimov, S. T., A. A. Yusupkhodjaev, Sh T. Khojiev, B. T. Berdiyarov, and Z. T. Matkarimov. "**Technology for the complex recycling slags of copper production**." Journal of Critical Reviews 7, no. 5 (2020): 214-220.

1192. Warczok, a., g. Riveros, r. Degel, j. Kunze, m. Kalischand h. Oterdoom, and sms siemag ag. "**latest results of the intensive slag cleaning reactor for metal recovery on the basis of copper (slag washing machine)**."

1193. Wallner, d. I. S., a. Filzwieser, m. B. Hanel, i. Filzwieser, and s. Ruhs. "**Furnace integrity–a holistic approach to face todays challenges**." in proceedings of emc, p. 1. 2017.

1194. Haglund, dan. "**In it for the long term? Governance and learning among chinese investors in zambia's copper sector**." the china quarterly 199 (2009): 627-646.

1195. Kennedy, M. W., A. MacRae, R. T. Jones, L. Kolbeinsen, P. Nos, and A. Filzwieser. "**Some considerations for safer furnace cooling**." As presented at COM (2015).

1196. Maeda, Y. "**Current Operation at Kosaka Smelter**." Sulfide Smelting'98 (1998).

1197. Marczeski, W. D., and T. L. Aldrich. "**Retrofitting Hayden plant to flash smelting**." AIME PAPERS (1986).

1198. Brundenius, Claes, and Bo Göransson. "**Technological change and pollution abatement in the copper industries of Chile and China**." Minerals and Energy 14, no. 2 (1999): 3-20.

1199. Hashiuchi, M., S. Okada, and T. Watanabe. "**Review of current operation at Tamano Smelter**." Copper Smelting--an Update (1982): 237-250.

1.13.3 Copper making technology classification

1200. Nikolic, Stanko, Ben Hogg, and Paul Voigt. "**ISASMELT™—flexibility in furnace design**." In Extraction 2018: Proceedings of the First Global Conference on Extractive Metallurgy, pp. 435-443. Springer International Publishing, 2018.

1201. Tan, Pengfu. "**Recent Improvements at Mount Isa Copper Smelter**." Minerals, Metals and Materials Society/AIME, 420 Commonwealth Dr., P. O. Box 430 Warrendale PA 15086 United States.[np]. Feb (2011).

1202. Nicol, S., T. Ryan, B. Hogg, and S. Nikolic. "**Towards Net Zero Pyrometallurgical Processing with the ISASMELT™ and ISACYCLE™**." In Advances in Pyrometallurgy: Developing Low Carbon Pathways, pp. 11-23. Cham: Springer Nature Switzerland, 2023.

1203. Arthur, P. S., and S. P. Hunt. "**ISASMELT™–25 years of continuous evolution**." In Floyd International Symposium on Sustainable Developments in Metals Processing. NSC Associates (Australia). 2005.

1204. Wood, Jacob, S. Creedy, Robert Matusewicz, and Markus Reuter. "**Secondary copper processing using Outotec Ausmelt TSL technology**." Proceedings of MetPlant (2011): 460-467.

1205. Navarra, Alessandro, Seng How Kuan, Roberto Parra, Boyd Davis, and Frank Mucciardi. "**Debottlenecking of conventional copper smelters**." In Proceedings of the International Conference on Industrial Engineering and Operations Management, Kuala Lumpur, Malaysia, pp. 8-10. 2016.

1206. Herneryd, Olov, Olof A. Sundstrom, and Allan Norro. "**Copper smelting in Boliden's Rönnskär works described**." JOM 6, no. 3 (1954): 330-338.

1207. Alexander, Christina, Hannu Johto, Mari Lindgren, Lauri Pesonen, and Antti Roine. "**Comparison of environmental performance of modern copper smelting technologies**." Cleaner Environmental Systems 3 (2021): 100052.

1208. Kaur, Rajneet, Colin Nexhip, David Krippner, David George-Kennedy, and M. Routledge. "**Kennecott-Outotec 'double flash'technology after 16 years**." In 13th international flash smelting congress, Zambia. 2011.

1209. Korhonen, Janne M., and Liisa Välikangas. "**Constraints and ingenuity: the case of Outokumpu and the development of flash smelting in the copper industry**." In Handbook of organizational and entrepreneurial ingenuity, pp. 254-276. Edward Elgar Publishing, 2014.

1210. Korhonen, Janne M. "**Tolerating the intolerable: Flash smelting of copper and the construction of technological constraints**." Technology and Culture 59, no. 2 (2018): 338-362.

1.13.4 Evolution to large-scale smelting

1211. Matusewicz, R. W., M. A. Reuter, S. P. Hughes, Shengdao Lin, and Laisheng Sun. "**Large scale copper smelting using Ausmelt TSL technology at the Tongling Jinchang Smelter**." In Proceedings of Copper, vol. 2010, pp. 961-70. 2010.

1.13.5 Chinese technology developments since 2000

1212. Zhang, Ling, Jiameng Yang, Zhijian Cai, and Zengwei Yuan. "**Analysis of copper flows in China from 1975 to 2010**." Science of the Total Environment 478 (2014): 80-89.

1213. Lu, Tao, Ladji Tikana, Constantin Herrmann, Yibing Ma, and Jinping Jia. "**Environmental hotspot analysis of primary copper production in China and its future improvement potentials**." Journal of Cleaner Production 370 (2022): 133458.

1214. Jiang, Kaixi, Lan Li, Yaping Feng, Haibei Wang, and Bang Wei. "**The Development of China's Primary Copper Smelting Technologies**." In Proceedings of the TT Chen Honorary Symposium on Hydrometallurgy, Electrometallurgy and Materials Characterization, pp. 167-176. Maitland, FL, USA: Wiley, 2012.

1215. Mackey, P. J. "**Evolution of the Large Copper Smelter—1800s to 2013**." In Celebrating the Megascale: Proceedings of the Extraction and Processing Division

Symposium on Pyrometallurgy in Honor of David GC Robertson, pp. 17-37. Springer International Publishing, 2016.

1216. Guo, X. Y., Y. Z. Zhang, Q. M. Wang, and Z. S. Yuan. "**Advanced copper smelting technologies used to quadruple China copper production between 2000 and 2015**." In 9th international copper conference (Copper 2016), Kobe, Japan, pp. 13-16. 2016.

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Chapter 2

2 Electrolytic refining

2.1 Fundamental principals of electrolytic refining

1217. Chen, t. T., and j. E. Dutrizac. "**The mineralogy of copper electrorefining**." jom 42, no. 8 (1990): 39-44.

1218. Xia, qinyi, qingming song, and zhenming xu. "**Electrorefining and electrodeposition for metal separation and purification from polymetallic concentrates after waste printed circuit board smelting**." waste management 158 (2023): 146-152.

1219. Rumbu, roger. **Review on copper hydrometallurgy**. Lulu. Com, 2019.

1220. Stelter, michael, and hartmut bombach. "**Process optimization in copper electrorefining**." advanced engineering materials 6, no. 7 (2004): 558-562.

1221. Rios, g., and i. Ruiz. "**Electrochemistry and copper industry**." in recent progress on electrochemistry at the iberian peninsula: proceeding book of the xl meeting of the specialized group of electrochemistry of the royal spanish society of chemistry and the xx iberian meeting of electrochemistry (huelva, 9th to 12th july 2019), pp. 5-8. Universidad de huelva, 2020.

1222. Harvey, w. W. "**material balance as the basis for process control in electrowinning and electrorefining**." hydrometallurgy 5, no. 4 (1980): 295-304.

1223. Flores, gerardo alvear, carlos risopatron, and joe pease. "**Processing of complex materials in the copper industry: challenges and opportunities ahead**." jom 72, no. 10 (2020): 3447-3461.

1224. Ettel, v. A., and b. V. Tilak. "**Electrolytic refining and winning of metals**." comprehensive treatise of electrochemistry: electrochemical processing (1981): 327-380.

1225. Parameswaran, krishna, chris mapes, aaron ibarra, justin landrum, and tracy morris. "**Sustainable development considerations in copper hydrometallurgy**." in extraction 2018: proceedings of the first global conference on extractive metallurgy, pp. 1279-1288. Cham: springer international publishing, 2018.

1226. Muir, d. M., a. J. Parker, j. H. Sharp, and w. E. Waghorne. "**Cuprous hydrometallurgy: part i. Electrorefining copper via acidic solutions of cuprous sulphate containing organic nitriles**." hydrometallurgy 1, no. 1 (1975): 61-77.

1227. Muir, d. M., a. J. Parker, j. H. Sharp, and w. E. Waghorne. "**Cuprous hydrometallurgy: part ii. The electrowinning of copper from cuprous sulphate solutions containing organic nitriles**." hydrometallurgy 1, no. 2 (1975): 155-168.

1228. Brown, alan p., raouf o. Loutfy, glenn m. Cook, and neng-ping yao. "**The electrorefining of copper from a cuprous ion complexing electrolyte**." jom 33 (1981): 49-57.

1229. Brown, alan p., and glenn m. Cook. **Electrorefining of copper from a cuprous ion complexing electrolyte. I. Initial evaluation of potential for energy savings**. No. Anl/oepm-78-6. Argonne national lab.(anl), argonne, il (united states), 1979.

1230. Hiskey, j. Brent. "**Principles and practical considerations of copper electrorefining and electrowinning**." copper leaching, solvent extraction, and electrowinning technology (1999): 169-186.

1231. Cifuentes, l. "**evans diagrams in copper electrometallurgy, paper from copper 95, volume iii, electrorefining and hydrometallurgy of copper, international conference held in santiago, chile, november 26-29, 1995**." papers (1995): 479-489.

1232. Stopic, srecko, and bernd friedrich. "**Advances in understanding of unit operations in non-ferrous extractive metallurgy 2021**." metals 12, no. 4 (2022): 554.

1233. Hoshi, yoshinao, yusuke ito, takayoshi kato, isao shitanda, and masayuki itagaki. "**Interpretation of negative resistance observed in electrochemical impedance during copper electrodeposition containing thiourea**." electrochemistry 83, no. 3 (2015): 142-149.

1234. Dini, jack w., and dexter d. Snyder. "**Electrodeposition of copper**." modern electroplating (2010): 33-78.

1235. Dutrizac, john e., and v. Ramachandran, eds**. Copper 99-cobre 99: Electrorefining and electrowinning**. Vol. 3. Tms, 1999.

1236. Maatgi, musbah kharis, omar m. Al-zubi, and hussan a. Bheej. "**The influence of different parameters on the electro refining of copper**." (2018).

1237. Abbas, hayder m., and sarmad t. Najim. "**Experimental study for the influence of operating parameters on copper electrorefining process**." iraqi journal of chemical and petroleum engineering 19, no. 1 (2018): 21-27.

1238. Dong, yongteng. "**Thermodynamic modeling of aqueous Fe-Cu-As-Sb-Bi-H_2SO_4 solutions and its application for redox potential determination in copper electrorefining from 25° c to 70° c**." (2021).

1239. Dong, yongteng, jiahao xu, bradford wesstrom, blanca r. Olave, juan sanchez, john p. Quinn, and guikuan yue. "**thermodynamic modeling of the Fe (Ii)–Fe (Iii)–Cu (Ii)–H2SO4–H2O solution and its application to determination of redox potential during copper electrorefining up to 70° c**." industrial & engineering chemistry research 60, no. 44 (2021): 15921-15935.

1240. Dong, yongteng, jiahao xu, and guikuan yue. "**speciation study of the aqueous Fe-Cu-As-Sb-Bi-H2SO4 system and prediction of redox potential in copper electrorefining from 25° c to 70° c**." chemical engineering science 255 (2022): 117656.

1241. Mckay, douglas j. "**the direct electrorefining of copper matte**." jom 45, no. 3 (1993): 44-48.

1242. Aromaa, jari. "**Electrorefining in sustainable metals production**." metals 12, no. 3 (2022): 372.

1243. Ludwig, andreas, menghuai wu, abdellah kharicha, alexander vakhrushev, jan bohácek, andreas kemminger, and ebrahim karimi-sibaki. "**Process simulation for the metallurgical industry: new insights into invisible phenomena**." bhm berg-und hüttenmännische monatshefte 158, no. 5 (2013): 184-188.

1244. Moats, michael s., and alexander derrickl. "**Overpotentials during copper electrowinning using**." electrometallurgy 2012 (2012): 127.

1245. Sedzimir, j., and b. Kustowska. "**Studies on the application of copper (i)-ammune sulphate electrolytes in copper electrorefining**." hydrometallurgy 8, no. 4 (1982): 355-364.

1246. O'donnell, john t. "**operation characteristics of the series system for electrolytic refining of copper**." (1949).

1247. Los, przemyslaw, aneta lukomska, sylwia kowalska, and marcin kwartnik. "**Laboratory and pilot scale tests of a new potential-controlled method of copper industrial electrolysis**." journal of the electrochemical society 161, no. 10 (2014): d593.

1248. Veilleux, b., a-m. Lafront, e. Ghali, and p. R. Roberge. "**The use of electrochemical noise measurements to detect bad copper electrorefining conditions**." journal of applied electrochemistry 33, no. 11 (2003).

1249. Shukla, abhijeet, and michael free. "**Modeling and measuring electrodeposition parameters near electrode surfaces to facilitate cell performance optimization**." phd diss., department of metallurgical engineering, university of utah, 2013.

1250. Pfalzgraff, chris l. "**do's and don'ts of tankhouse design and operation**." jergensen (ed.), copper leaching, solvent extraction and electrowinning technology, sme, littleton, colorado, pgs (1999): 217-221.

1251. Werner, joshua michael. "**Modeling and validation for optimization of electrowinning performance**." phd diss., the university of utah, 2017.

1252. Tucker, mandy. "**The development of a semi-empirical electrowinning model to predict process performance**." phd diss., stellenbosch: stellenbosch university, 2019.

1253. Stover, Dennis Eugene. **Electrochemical reactor design and kinetics: the copper electrorefining cell**. University of Michigan, 1975.

1254. Yopps, jerome. "**Electrolytic refining of copper by the series system**." (1959).

1255. Enrico, w. "**the southern Peru ilo refinery, design features, operation and improvement**." aqueous electrotechnologies: progress in theory and practice (1997): 73-86.

1256. Cifuentes, gerardo, josé hernández, jorge manríquez, and nicolas guajardo. "**Modeling operational parameters of a reactive electro-dialysis cell for electro-refining anodic scrap copper**." american journal of analytical chemistry 5, no. 15 (2014): 1011.

1257. Bailey, d. "**copper refining and production of semi-fabricated products at copper refineries ltd**." ausimm... (1998): 407.

1258. Mullick, u. P. "**Refining of blister copper**." (1969): 54-58.

1259. Weigner, l. "**Possibilities of the intensification of electrolytic refining of copper**." hutnik(prague) 31, no. 1 (1981): 33-36.

1260. Brown, a. P., r. O. Loutfy, and glenn m. Cook. **Electrorefining of copper from a cuprous ion complexing electrolyte. Ii. Experimental comparison of possible alternative electrolytes and preliminary cost engineering analysis**. No. Anl/oepm-80-2. Argonne national lab., il (usa), 1980.

1261. Wiertz, jacques v. "**Mining and metallurgical waste management in the chilean copper industry**." mine, water and environment (1999): 403-408.

1262. Chen, t. T., and j. E. Dutrizac. "**Application of electron microscopy to the electrorefining of copper**." scanning microscopy 2, no. 2 (1988): 10.

1263. Swanson, c. E., and m. F. Shaw. "**The interface of anode refining with electrorefining**." converting, fire refining and casting (1994): 269-284.

1264. Mosher, m. A. "**some practical aspects of copper refining in a multiple system tank house**." journal of the electrochemical society 107, no. 1 (1960): 7c.

1265. Heath, george l. "**Methods for the complete analysis of refined copper**." journal of the american chemical society 27, no. 3 (1905): 308-318.

1266. Tasić, viša, vladimir despotović, dragan r. Milivojević, and marijana pavlov. "**Monitoring of technological process in electrolytic refining plant as a part of distributed control system**."

1267. Corwin, frank r., and carleton s. Harloff. "**The series system of electrolytic copper refining at nichols copper co**." transactions of the american electrochemical society 57, no. 1 (1930): 231.

1268. Owen, mervyn m., and j. S. Jacobi. "**High intensity refining of copper at james bridge**." jom 27, no. 4 (1975): 10-15.

1269. Jacobi, j. S. "**present trends in electrolytic refining of copper and lead**." refining processes in metallurgy(raffinationsverfahren in der metallurgie) (1983): 11-20.

1270. Krynicki, j., c. Z. Grochowina, and a. Domagala. "**Influence of magnetic field on copper electrorefining**." in 10 th reporting meeting of the polish academy of sciences, division iv, metallurgy committee, 1981-1984, papers,, vol. 1, pp. 23-32. 1984.

1271. Titarenko, a. G., a. V. Pomosov, n. V. Ishchenko, l. M. Gryaznukhina, and l. M. Nusinzon. "**Optimization of electrolytic refining (of copper)**." tsvetn. Met. 8 (1982): 13-15.

1272. Zotkov, o. M., and m. Orekhov. "**Selecting cost-effective copper refining processes**." izv. V. U. Z. Tsvetn. Metall. 2 (1985): 108-113.

1273. Bennett, c. W., and c. O. Brown. **"Rapid refining of copper with a rotating cathode**." the journal of physical chemistry 17, no. 8 (2002): 685-694.

1274. Pradenas, lorena, abel campos, jesús saldaña, and victor parada. "**Scheduling copper refining and casting operations by means of heuristics for the flexible flow shop problem**." pesquisa operacional 31 (2011): 443-457.

2.2 Chemistry of electrorefining; Anodic dissolution and behavior of anode impurities

2.2.1 Anodic dissolution

1275. Zak, t. "**The behaviour of copper anodes during the electrodeposition of copper in acid baths**." transactions of the imf 40, no. 1 (1963): 104-112.

1276. Hu, yongpan, xijiao li, zhijuan jiao, guifei gao, boyu yuan, liang li, and chao wang. "**Investigation into the anodic dissolution processes of copper in neutral and acidic sulfate solutions with the in-line digital holography**." electrochemistry 84, no. 6 (2016): 378-382.

1277. Ding, lifeng, qiang li, jinxia yuan, xiaoyun dong, di peng, baoyi li, hongdao li, yanfeng xue, and yulan niu. "**Characteristic and control of electrochemical oscillation at**

the Anode during Electrolytic Refining Copper." int. J. Electrochem. Sci 15 (2020): 9532-9542.

1.13.6 Behavior of anode impurities

1278. Larouche, pascal. "**minor elements in copper**." phd diss., faculty of graduate studies and research in partial fulfillment of the requirements for the degree of master of engineering in mining and metallurgical engineering, mcgill university, montreal, canada, 2001.

1279. Iizuka, atsushi, akinori sugiyama, and etsuro shibata. "**Electrorefining behavior of copper shot-shaped anode containing high levels of platinum**." materials transactions 61, no. 5 (2020): 963-971.

1280. Parker, john g. **Occurrence and recovery of certain minor metals in the smelting-refining of copper**. Vol. 8778. Department of the interior, bureau of mines, 1978.

1281. Ostanin, n. I., v. M. Rudoy, i. P. Demin, t. N. Ostanina, and v. S. Nikitin. "**Statistical analysis of the distribution of impurities during copper electrorefining**." russian journal of non-ferrous metals 62, no. 5 (2021): 501-507.

1282. Free, michael, urian marshall, justin mcallister, daniel kim, and shijie wang. "**Copper electrorefining impurity evaluation**." in tt chen honorary symposium on hydrometallurgy, electrometallurgy and materials characterization, pp. 157-164. Hoboken, nj, usa: john wiley & sons, inc., 2012.

1283. Ntengwa, felix william. "**The effect of impurities, smootheners and other factors on the recovery of copper from solutions**." phd diss., 2008.

1284. Zeng, weizhi, michael l. Free, joshua werner, and shijie wang. "**Simulation and validation studies of impurity particle behavior in copper electrorefining**." journal of the electrochemical society 162, no. 14 (2015): e338.

1285. Marković, radmila, bernd friedrich, jasmina stevanović, and bore jegdić. "**Electrochemical behavior of copper with non-standard impurities content**." journal of engineering annals 7, no. 4 (2009): 47-50.

1286. Laforest, Paul. "**Understanding impurities in copper electrometallurgical processes**." Missouri university of science and technology, 2015.

1287. Maeda, yoshitsugu. "**The behavior of impurities during copper electrodeposition**." phd diss., the university of arizona, 1991.

1288. Jafari, shila, mikko kiviluoma, taina kalliomäki, elisabeth klindtworth, arif tirto aji, jari aromaa, benjamin p. Wilson, and mari lundström. "**Effect of typical impurities for the**

formation of floating slimes in copper electrorefining." international journal of mineral processing 168 (2017): 109-115.

1289. Noguchi, fumio, h. Itoh, and t. Nakamura. "**effect of impurities on the quality of electrorefined cathode copper; behavior of antimony in the anode, paper from copper 95, volume iii, electrorefining and hydrometallurgy of copper, international conference held in santiago, chile, november 26-29, 1995**." papers (1995): 337-348.

1290. Charles, w. "**Impurity behaviour and control in copper electrorefining**." in copper 87, vol. 3, hydrometallurgy and electrometallurgy of copper, pp. 451-465. Universidad de chile santiago, 1988.

1291. Publicover, w. E., and p. W. Taubenblat. "**Studies of impurity distribution in electrolytically refined copper cathodes**." journal of testing and evaluation 8, no. 5 (1980): 246-249.

1292. Antrekowitsch, stephan steinacker and jürgen. "**The role and influence of impurities on the quality of copper cathodes**."

1293. Verbruggen, florian, pieter ostermeyer, luiza bonin, antonin prévoteau, kristof marcoen, tom hauffman, tom hennebel, korneel rabaey, and michael s. Moats. "**Electrochemical codeposition of arsenic from acidic copper sulfate baths: the implications for sustainable copper electrometallurgy**." minerals engineering 176 (2022): 107312.

1294. Hyvãrinen, olli, raimo leimala, and asko parviainen. "**Recent trends in outokumpu practice for controlling various impurities in electrolytic copper refining**." in 21st annual cim conference of metallurgists, toronto, ontario. 1982.

1295. Wang, xuewen, qiyuan chen, zhoulan yin, pingmin zhang, ziping long, and zhongfu su. "**Removal of impurities from copper electrolyte with adsorbent containing antimony**." hydrometallurgy 69, no. 1-3 (2003): 39-44.

1296. Wang, shijie. "**Impurity control and removal in copper tankhouse operations**." jom 56, no. 7 (2004): 34-37.

1297. Kamath, balachandran p., a. K. Mitra, s. Radhakrishnan, and k. P. K. P. Shetty. "Electrolyte impurity control at chinchpada refinery of sterlite industries (india) limited." copper electrorefining and electrowinning (2003): 137-150.

1298. Brown, c. J. "**metallurgy control of copper electrolyte impurities using the eco-tec apu®**." cim/icm bulletin technical papers: september 2004 to january 2006: peer-reviewed technical papers published by the canadian institute of mining, metallurgy and petrolem (2006): 303.

1299. Mcallister, justin, daniel kim, and shijie wang. "**Study of electrolyte impurity precipitates at the kennecott utah copper ref inery**." in tt chen honorary symposium on hydrometallurgy, electrometallurgy and materials characterization, p. 131. John wiley & sons, 2012.

1300. Xiao, fa xin, dao cao, jian wei mao, and xiao ni shen. "**Mechanism of precipitate removal of arsenic and bismuth impurities from copper electrolyte by antimony**." in advanced materials research, vol. 402, pp. 51-56. Trans tech publications ltd, 2012.

1301. Zeraati, malihe, narendra pal singh chauhan, and ghasem sargazi. "**Removal of electrolyte impurities from industrial electrolyte of electro-refining copper using green crystallization approach**." chemical papers 75 (2021): 3873-3880.

1302. Wang, xuewen, qiyuan chen, zhoulan yin, mingyu wang, bingrui xiao, and fan zhang. "**Homogeneous precipitation of As, Sb and Bi impurities in copper electrolyte during electrorefining**." hydrometallurgy 105, no. 3-4 (2011): 355-358.

1303. Xiao, faxin, jianwei mao, dao cao, xiaoni shen, and alex a. Volinsky. "**The role of trivalent arsenic in removal of antimony and bismuth impurities from copper electrolytes**." hydrometallurgy 125 (2012): 76-80.

1304. Bounoughaz, m., m. Manzini, and e. Ghali. "**Behaviour of copper anodes containing oxygen, silver and selenium impurities during electro-refining**." canadian metallurgical quarterly 34, no. 1 (1995): 21-26.

1305. Markovic, r., v. Krstic, b. Friedrich, s. Stopic, j. Stevanovic, z. Stevanovic, and v. Marjanovic. "**Electrorefining process of the non-commercial copper anodes. Metals 2021, 11, 1187**." advances in understanding of unit operations in non-ferrous extractive metallurgy 2021 (2021): 115.

1306. Stoyanova, verka, eduard stefanov, bogomila planska, radina dimitrova, irina valtcheva, milen kadiyski, and vanya stoyanova. "**Arsenic removal in a stable form from industrial wastewater in the copper industry**." journal of chemical technology & metallurgy 57, no. 5 (2022).

1307. Paz-gómez, d. C., silvia maría pérez-moreno, m. J. Gázquez, j. L. Guerrero, i. Ruiz-oria, g. Ríos, and j. P. Bolívar. "**Arsenic removal procedure for the electrolyte from a hydro-pyrometallurgical complex**." chemosphere 281 (2021): 130651.

1308. Zeng, weizhi, joshua werner, and michael l. Free. "**Experimental studies on impurity particle behavior in electrolyte and the associated distribution on the cathode in the process of copper electrorefining**." hydrometallurgy 156 (2015): 232-238.

1.13.6.1 Au, Ag, and platinum-group metals

1309. Chen, t. T., and j. E. Dutrizac. "**A mineralogical study of the deportment and reaction of silver during copper electrorefining**." metallurgical and materials transactions b 20 (1989): 345-361.

1310. Chen, t. T., and j. E. Dutrizac. "**Gold in the electrorefining of copper and the decopperizing of copper anode slimes**." jom 56, no. 8 (2004): 48.

1311. Jaskula, m. "**quantitative evaluation of silver transfer in the copper electrorefining process**." transactions of the japan institute of metals 20, no. 11 (1979): 627-633.

1312. Caissey, j. "**electrorefining of copper anodes with high silver levels**." hydrometallurgy and electrometallurgy of copper 3 (1991): 329.

1313. Samsonov, a. I., v. A. Zolotukhin, v. N. Bredikhin, v. Chernjue, and a. T. Shevelev. "**Conditions of rational electrorefining of anodes from copper-silver scrap**."

1314. Dinardo, o., and j. E. Dutrizac. "**The solubility of silver chloride in sulphate media**." hydrometallurgy 26, no. 1 (1991): 47-59.

1315. Kucharska-giziewicz, e. A., and d. J. Mackinnon. "**Electrochemical behaviour of silver-containing copper anodes under simulated electrorefining conditions**." journal of applied electrochemistry 26 (1996): 51-57.

1316. Jaskula, m., and j. Hotlos. "**Quantitative estimation of the silver transfer at electrolytic refining of copper**." neue hutte 28, no. 4 (1983): 149-152.

1.13.6.2 Se and te

1317. Chen, t. T., and j. E. Dutrizac. "**the mineralogical behaviour of tellurium during copper electrorefining, paper from copper 95, volume iii, electrorefining and hydrometallurgy of copper, international conference held in santiago, chile, november 26-29, 1995**." papers (1995): 207-224.

1318. Baral, a., c. K. Sarangi, b. C. Tripathy, i. N. Bhattacharya, and t. Subbaiah. "**Copper electrodeposition from sulfate solutions—effects of selenium**." hydrometallurgy 146 (2014): 8-14.

1319. Chen, t. T., and j. E. Dutrizac. "**The deportment of selenium and tellurium during the electrorefining of copper**." minor elements (2000): 199-212.

1320. Lange, h. J., b. Geidel, k. Hein, and h. Baum. "**Studies of the anodic reactions of selenium during electrolytic refining of copper**." freiberger forschungsh. B, metall. Werkstofftech. (1980): 123-142.

1321. Wu, lian-kui, chao-chao li, ze-feng zhang, hua-zhen cao, jin xue, and guo-qu zheng. "**Effect of tellurium on copper electrodeposition in copper sulfate-sulfuric acid system**." journal of the electrochemical society 164, no. 7 (2017): d451.

1322. Cuizon, regina zarahfe a. "**a feasibility study for a tellurium recovery facility of pasar's copper refinery plant**." isabel, the philippines (2012).

1323. Stanković, zvonimir d., vladimir b. Cvetkovski, vesna j. Grekulović, milovan v. Vuković, and svetlana lj ivanov. "**The effect of tellurium presence in anodic copper on kinetics and mechanism of anodic dissolution and cathodic deposition of copper**." international journal of electrochemical science 8, no. 5 (2013): 7274-7283.

1324. Nassar, nedal t., haeyeon kim, max frenzel, michael s. Moats, and sarah m. Hayes. "**Global tellurium supply potential from electrolytic copper refining**." resources, conservation and recycling 184 (2022): 106434.

1.13.6.3 Pb and sn

1325. Chen, t. T., and j. E. Dutrizac. "**A mineralogical study of the effect of the lead content of copper anodes on the dissolution of arsenic, antimony and bismuth during copper electrorefining**." canadian metallurgical quarterly 42, no. 4 (2003): 421-432.

1326. Moats, michael s., shijie wang, and daniel kim. "**A review of the behavior and deportment of lead, bismuth, antimony and arsenic in copper electrorefining**." in tt chen honorary symposium on hydrometallurgy, electrometallurgy and materials characterization, pp. 1-21. Hoboken, nj, usa: john wiley & sons, inc., 2012.

1327. Hein, k., and h. Beyer. "**Cathode precipitation of tin during electrolytic copper refining**." neue hutte 27, no. 3 (1982): 83-86.

1.13.6.4 As, Bi, and Sb

1328. Zeng, weizhi, hui hu, ruiyang xiao, jianguang yang, shan liu, lin wu, changqi xiong, wenxiang guo, and yang yan. "**Study of in-situ precipitation of arsenic bearing crystalline particles during the process of copper electrorefining**." hydrometallurgy 199 (2021): 105546.

1329. Peng, ying-lin, ya-jie zheng, and wen-mi chen. "**The oxidation of arsenic from As (iii) to As (v) during copper electrorefining**." hydrometallurgy 129 (2012): 156-160.

1330. Dewalens, jacques, luc heerman, and luc van simaeys. "**The codeposition of copper and arsenic from H_2SO_4-$CuSO_4$-As_2O_3 solutions: electrochemical formation of copper arsenides**." journal of the electrochemical society 122, no. 4 (1975): 477.

1331. Wang, xuewen, xingming wang, and mingyu wang. "**Characteristics of BiAsO4 precipitate formation in copper electrolyte**." hydrometallurgy 171 (2017): 95-98.

1332. Wang, xuewen, xingming wang, yajie zheng, mingyu wang, yinglin peng, and tao cui. "**Solubilities of As, Sb and Bi in copper electrolyte and their existing forms in copper anode slime**." american journal of chemistry and application 6, no. 3 (2019): 38-44.

1333. Artzer, andrew joseph. **Removal of antimony and bismuth from copper electrorefining electrolyte by two proprietary solvent extraction extractants**. Missouri university of science and technology, 2019.

1334. De las torres, ai gonzález, g. Ríos, a. Rodríguez almansa, d. Sánchez-rodas, and michael s. Moats. "**Solubility of bismuth, antimony and arsenic in synthetic and industrial copper electrorefining electrolyte**." hydrometallurgy 208 (2022): 105807.

1335. Baltazar, v., p. L. Claessens, and j. Thiriar. "**Effect of arsenic and antimony in copper electrorefining**." the electrorefining and winning of copper (1987): 211-222.

1336. Stanković, z. D., v. Cvetkovski, and m. Vuković. "**The effect of antimony presence in anodic copper on kinetics and mechanism of anodic dissolution and cathodic deposition of copper**." journal of mining and metallurgy, section b: metallurgy 44, no. 1 (2008): 107-114.

1337. Noguchi, f., t. Nakamura, m. Yano, and y. Ueda. "**Form of antimony dissolve into electrolyte during copper electrorefining**." journal of the mining and materials processing institute of japan(japan) 109, no. 2 (1993): 121-125.

1338. Beauchemin, s., t. T. Chen, and j. E. Dutrizac. "**Behaviour of antimony and bismuth in copper electrorefining circuits**." canadian metallurgical quarterly 47, no. 1 (2008): 9-26.

1339. Xiao, fa-xin, jian-wei mao, dao cao, xiao-ni shen, and feng-zhang ren. "**Formation of antimonate in co-precipitation reaction of As, Sb and Bi in copper electrolytes**." minerals engineering 35 (2012): 9-15.

1340. Zhou, wen-ke, ying-lin peng, ya-jie zheng, and c. U. I. Tao. "**Reduction and deposition of arsenic in copper electrolyte**." transactions of nonferrous metals society of china 21, no. 12 (2011): 2772-2777.

1341. Xiao, fa-xin, dao cao, jian-wei mao, xiao-ni shen, and feng-zhang ren. "**Role of trivalent antimony in the removal of As, Sb, and Bi impurities from copper electrolytes**." international journal of minerals, metallurgy, and materials 20 (2013): 9-16.

1342. Noguchi, f., t. Nakamura, and y. Ueda. "**Behaviour of anode impurities in copper electrorefining--effect of bismuth, arsenic, antimony and oxygen in copper anode**." journal of the mining and materials processing institute of japan 105, no. 4 (1989): 321-327.

1343. Stanković, zvonimir d., vladimir b. Cvetkovski, and vesna j. Grekulović. "**The effect of Bi presence as impurity in anodic copper on the kinetics and mechanism of anodic dissolution and cathodic deposition of copper**." hemijska industrija 64, no. 4 (2010): 337-342.

1344. Wang, xue-wen, qi-yuan chen, zhou-lan yin, ming-yu wang, and fang tang. "**The role of arsenic in the homogeneous precipitation of As, Sb and Bi impurities in copper electrolyte**." hydrometallurgy 108, no. 3-4 (2011): 199-204.

1345. Xiao, fa-xin, c. A. O. Dao, jian-wei mao, xiao-ni shen, and feng-zhang ren. "**Role of Sb (v) in removal of As, Sb and Bi impurities from copper electrolyte**." transactions of nonferrous metals society of china 24, no. 1 (2014): 271-278.

1346. Minotas, julio c., hocine djellab, and edward ghali. "**Anodic behaviour of copper electrodes containing arsenic or antimony as impurities**." journal of applied electrochemistry 19 (1989): 777-783.

1347. Casas, j. M., j. P. Etchart, and l. Cifuentes. "**Aqueous speciation of arsenic in sulfuric acid and cupric sulfate solutions**." aiche journal 49, no. 8 (2003): 2199-2210.

1.13.6.5 Ni

1348. Chen, t. T., and j. E. Dutrizac. "*A mineralogical overview of the behavior of nickel during copper electrorefining*." metallurgical transactions b 21 (1990): 229-238.

1349. Stanković, z. D., v. Cvetkovski, and m. Rajčić-vujasinović. "**The effect of nickel presence in anodic copper on kinetics and mechanism of anodic dissolution and cathodic deposition of copper**." journal of the electrochemical society 148, no. 6 (2001): c443.

1350. Kirakosyan, t. V., n. V. Ishchenko, and l. M. Gryaznukhina. "**Electrolytic refining of nickel-containing copper**." tsvetn. Met. 7 (1988): 42-44.

1351. Wang, yu, lei li, hongjuan li, and hua wang. "**Electrodeposition of Cu^{2+} in presence of Ni^{2+} in sulfuric acid system**." ionics 25 (2019): 5045-5056.

1352. Titarenko, a. G., n. V. Ishchenko, t. V. Kirakosyan, l. M. Gryaznukhina, and m. Filippov. "**Behaviour of nickel during electrolytic refining of copper**." tsvetn. Met. 3 (1981): 37-39.

1.13.6.6 Oxygen and S

1353. Möller, claudia a., b. Myagmarsuren, and b. Friedrich. "**Effect of As, Sb, Bi and oxygen in copper anodes during electrorefining**." copper 2010: proceedings, hamburg, germany (2010).

1354. Weber, john robert. "**Effect of the anode oxygen content on the electrorefining of copper**." 1960-1969-mines theses & dissertations (1968).

1355. Friedrich, b., c. Möller, and m. Bayanmunkh. "**Effect of As, Sb, Bi and oxygen in copper anodes during electrorefining**."

1356. Moller, claudia a., myagmarsuren bayanmunkh, and bernd friedrich. "**Influence of As, Sb, Bi and O on copper anode behaviour--part 3: elemental distribution**." erzmetall: the world of metallurgy 62, no. 2 (2009): 70.

1357. Lamontagne, m., c. A. Pickles, and j. M. Toguri. "**Effect of oxygen on the Cu, Cu2Se and Ag system**." minerals engineering 12, no. 12 (1999): 1441-1457.

1358. Noguchi, fumio, takashi nakamura, yasuaki ueda, and nobuhiro matsumoto. "**Behaviour of anode impurities in copper electrorefining: effect of sulfur, arsenic and oxygen**." nihon kogyokaishi 104, no. 1210 (1988): 902-908.

2.2.2 Anode passivation

1359. Jin, s., and e. Ghali. "**Effect of some aromatic nitro compounds on the passivation of copper anodes during electrorefining**." journal of applied electrochemistry 21, no. 3 (1991): 247-254.

1360. Ninomiya, yuma, hideaki sasaki, takeshi yoshikawa, and masafumi maeda. "**Direct observation of pure Cu and Cu-Ag anode passivation in H_2SO_4-$CuSO_4$ aqueous solution by channel flow double electrode and optical microscopy**." metallurgical and materials transactions b 50 (2019): 407-415.

1361. Abe, s., b. W. Burrows, and v. A. Ettel. "**Anode passivation in copper refining**." canadian metallurgical quarterly 19, no. 3 (1980): 289-296.

1362. Gauthier, h., m. Manzini, and e. Ghali. "**Effect of lead and oxygen on the passivation of copper anodes**." canadian metallurgical quarterly 38, no. 1 (1999): 23-32.

1363. Jin, shize, and edward ghali. "**Influence of some bath additives on the passivation of copper anodes in H_2SO_4-$CuSO_4$ electrolyte**." canadian metallurgical quarterly 31, no. 4 (1992): 259-267.

1364. Tromans, desmond, and tawfik ahmed. "**active/passive behavior of copper in strong sulfuric acid**." journal of the electrochemical society 145, no. 2 (1998): 601.

1365. Jarjoura, george. **Effect of nickel on copper anode passivation**. National library of canada= bibliothèque nationale du canada, ottawa, 2001.

1366. Sędzimir, j., and w. Gumowska. "**Influence of electrolysis variables on the passivation time of copper anodes in copper electrorefining**." hydrometallurgy 24, no. 2 (1990): 203-217.

1367. Gauthier, h., m. Manzini, and e. Ghali. "**passivation of copper and copper alloys in acidic sulphate electrolyte**, paper from copper 95, volume iii, electrorefining and hydrometallurgy of copper, international conference held in santiago, chile, november 26-29, 1995." papers (1995): 241-252.

1368. Sędzimir, j., and w. Gumowska. "**Influence of electrolysis variables on the passivation time of copper anodes in copper electrorefining**." hydrometallurgy 24, no. 2 (1990): 203-217.

1369. Moller, claudia a., myagmarsuren bayanmunkh, and bernd friedrich. "**Influence of As, Sb, Bi and O on copper anode behaviour--part 1: passivation characteristics**." erzmetall: the world of metallurgy 61, no. 6 (2008): 357.

1370. Safizadeh, fariba, and edward ghali. "**Influence of electrolyte additives on Cu-Sb anode passivation during copper refining using electrochemical noise analysis**." in ecs meeting abstracts, no. 15, p. 1091. Iop publishing, 2011.

1371. Gumowska, wanda, and jerzy sędzimir. "**Influence of the lead and oxygen content on the passivation of anodes in the process of copper electro-refining**." hydrometallurgy 28, no. 2 (1992): 237-252.

1372. Cheng, xuan, and j. Brent hiskey. "**Fundamental studies of copper anode passivation during electrorefining: part i. Development of techniques**." metallurgical and materials transactions b 27 (1996): 393-398.

1373. Cheng, xuan, and j. Brent hiskey. "**Fundamental studies of copper anode passivation during electrorefining: part ii. Surface morphology**." metallurgical and materials transactions b 27 (1996): 610-616.

1374. Hiskey, j. Brent, and xuan cheng. "**Fundamental studies of copper anode passivation during electrorefining: part iii. The effect of thiourea**." metallurgical and materials transactions b 29 (1998): 53-58.

1375. Safizadeh, fariba. "**Monitoring deposit properties and passivation of impure copper anodes by electrochemical noise measurements**." phd diss., université laval, 2011.

1376. Chen, t. T., and j. E. Dutrizac. "**A mineralogical study of anode passivation in copper electrorefining**." copper 91(cobre 91) (1991).

1377. Jarjoura, g., and g. J. Kipouros. "**Cyclic voltametric studies of the effect of nickel on copper anode passivation in a copper sulfate solution**." canadian metallurgical quarterly 44, no. 4 (2005): 469-482.

1378. Safizadeh, fariba, and edward ghali. "**Monitoring passivation of Cu–Sb and Cu–Pb anodes during electrorefining employing electrochemical noise analyses**." electrochimica acta 56, no. 1 (2010): 93-101.

1379. Jarjoura, g., and g. J. Kipouros. "**Electrochemical studies on the effect of nickel on copper anode passivation in a copper sulphate solution**." canadian metallurgical quarterly 45, no. 3 (2006): 283-294.

1380. Moats, michael scott. **Electrochemical characterization of anode passivation mechanisms in copper electrorefining**. The university of arizona, 1998.

1381. Ilkhchi, m. Ojaghi, h. Yoozbashizadeh, and m. Sadegh safarzadeh. "**The effect of additives on anode passivation in electrorefining of copper**." chemical engineering and processing: process intensification 46, no. 8 (2007): 757-763.

1382. Khazaei feizabad, m. H., g. R. Khayati, r. Kafi hernashki, and s. M. J. Khorasani. "**Modeling and optimization of charge materials ranges in converter furnace with enhanced passivation time in copper electrorefining process: a mixture design approach**." international journal of engineering 34, no. 4 (2021): 966-975.

1383. Jarjoura, g., and g. J. Kipouros. "**Effect of nickel on copper anode passivation in a copper sulfate solution by electrochemical impedance spectroscopy**." journal of applied electrochemistry 36 (2006): 691-701.

1384. Lafront, anne-marie, fariba safizadeh, edward ghali, and georges houlachi. "**Study of the copper anode passivation by electrochemical noise analysis using spectral and wavelet transforms**." electrochimica acta 55, no. 7 (2010): 2505-2512.

1385. Palaniappa, m., m. Jayalakshmi, p. M. Prasad, and k. Balasubramanian. "**Chronopotentiometric studies on the passivation of industrial copper anode at varying current densities and electrolyte concentrations**." int. J. Electrochem. Sci 3 (2008): 452-461.

1386. Mori, kohei, yuta yamakawa, satoshi oue, yu-ki taninouchi, and hiroaki nakano. "**Effect of impurity ions and additives in solution of copper electrorefining on the passivation behavior of low-grade copper anode**." materials transactions 64, no. 1 (2023): 242-251.

1387. Lgodirilwe, labone, yasushi takasaki, kazutoshi haga, atsushi shibayama, rie sato, and yoshinari takai. "**The role of lead in suppressing passivation of high silver–containing copper anodes during electrorefining**." int. J. Soc. Mater. Eng. Resour 25, no. 1 (2022).

1388. Li, lei, hong-juan li, shi-wei qiu, and hua wang. "**Effect of additives on anode passivation in direct electrolysis process of copper—nickel based alloy scraps**." journal of central south university 25, no. 4 (2018): 754-763.

1389. Jin, s., h. Djellab, and e. Ghali. "**effect of some amino acid chelating agents on the passivation of copper anodes in copper sulfate/sulfuric acid electrolyte**." hydrometallurgy 24, no. 1 (1990): 53-65.

1390. Jin, shize, and edward ghali. "**Cathodic voltammetric study of copper passivation during electrorefining at 50 and 65° C**." canadian metallurgical quarterly 32, no. 4 (1993): 305-319.

1391. Ling, x., z. H. Gu, and t. Z. Fahidy. "**Effect of operating conditions on anode passivation in the electrorefining of copper**." journal of applied electrochemistry 24 (1994): 1109-1115.

1392. Ninomiya, yuma, hideaki sasaki, masao kamiko, takeshi yoshikawa, and masafumi maeda. "**Passivation of Cu–Sb anodes in H_2SO_4-$CuSO_4$ aqueous solution observed by the channel flow double electrode method and optical microscopy**." electrochimica acta 309 (2019): 300-310.

1393. Moller, claudia a., myagmarsuren bayanmunkh, and bernd friedrich. "**Influence of As, Sb, Bi and O on copper anode behaviour--part 1: passivation characteristics**." erzmetall: the world of metallurgy 61, no. 6 (2008): 357.

1394. Moller, Claudia A., Myagmarsuren Bayanmunkh, and Bernd Friedrich. "**Influence of As, Sb, Bi and O on Copper Anode Behaviour--Part 2: Anode Dissolution Behaviour and Anode Sludge Generation**." Erzmetall: The World of Metallurgy 62, no. 1 (2009): 6.

2.3 Slimes

2.3.1 Mineralogical characterization of anode slimes

1395. Chen, t. T., and j. E. Dutrizac. "**Mineralogical characterization of anode slimes—i. Anode copper from inca's copper cliff copper refinery**." canadian metallurgical quarterly 27, no. 2 (1988): 91-96.

1396. Chen, t. T., and j. E. Dutrizac. "**Mineralogical characterization of anode slimes—ii. Raw anode slimes from inco's copper cliff copper refinery**." canadian metallurgical quarterly 27, no. 2 (1988): 97-105.

1397. Chen, t. T., and j. E. Dutrizac. "**Mineralogical characterization of anode slimes—iii. Sulphation reactor slimes from inca's copper cliff copper refinery**." canadian metallurgical quarterly 27, no. 2 (1988): 107-116.

1398. Chen, t. T., and j. E. Dutrizac. "**Mineralogical characterization of anode slimes: part v—nickel-rich copper anodes from the ccr division of noranda minerals inc**." canadian metallurgical quarterly 29, no. 1 (1990): 27-37.

1399. Chen, t. T., and j. E. Dutrizac. "**Mineralogical characterization of anode slimes—iv. Copper-nickel-antimony oxide ("kupferglimmer") in ccr anodes and anode slimes**." canadian metallurgical quarterly 28, no. 2 (1989): 127-134.

1400. Chen, t. T., and j. E. Dutrizac. "**Mineralogical characterization of anode slimes: part 6—pressure leached slimes from the CCR division of noranda minerals inc**." canadian metallurgical quarterly 29, no. 4 (1990): 293-305.

1401. Chen, t. T., and j. E. Dutrizac. "**Mineralogical characterization of anode slimes: part 7—copper anodes and anode slimes from the chuquicamata division of codelco–chile**." canadian metallurgical quarterly 30, no. 2 (1991): 95-106.

1402. Chen, t. T., and j. E. Dutrizac. "**Mineralogical characterization of anode slimes: part 8—"silica" in copper anodes and anode slimes**." canadian metallurgical quarterly 30, no. 3 (1991): 173-185.

1403. Chen, t. T., and j. E. Dutrizac. "**Mineralogical characterization of anode slimes—9. The reaction of kidd creek anode slimes with various lixiviants**." canadian metallurgical quarterly 32, no. 4 (1993): 267-279.

1404. Chen, t. T., and j. E. Dutrizac. "**Mineralogical characterization of anode slimes: part 10. Tellurium in raw anode slimes**." canadian metallurgical quarterly 35, no. 4 (1996): 337-351.

1405. Melo aguilera, evelyn, maría cecilia hernández vera, joan viñals, and teófilo graber seguel. "**Characterization of raw and decopperized anode slimes from a chilean refinery**." metallurgical and materials transactions b 47 (2016): 1315-1324.

1406. Buzatu, mihai, petru moldovan, dionezie bojin, mihai buþu, iozsef juhasz, and elena pop. "**Characterization of the products and by-products obtained in the electrolytic refining of copper using scraps**." revista de chimie, bucuresti 6 (2008).

1407. Chen, t. T., and j. E. Dutrizac. "**Characterization of the liberator cell sludges from three copper electrorefineries**." Canadian metallurgical quarterly 48, no. 1 (2009): 61-68.

1408. Chen, t. T., and j. E. Dutrizac. "**Mineralogical characterization of anode slimes from the kidd creek copper refinery**." the electrorefining and winning of copper (1987): 499-525.

1409. Chen, t. T., and j. E. Dutrizac. "**The mineralogical characterization of tellurium in copper anodes**." metallurgical transactions b 24 (1993): 997-1007.

1410. Chen, t. T., and j. E. Dutrizac. "**Mineralogical characterization of a copper anode and the anode slimes from the la caridad copper refinery of mexicana de cobre**." metallurgical and materials transactions b 36 (2005): 229-240.

1411. Hait, jhumki, r. K. Jana, and s. K. Sanyal. "**Mineralogical characteristics of copper electrorefining anode slime and its leached residues**." industrial & engineering chemistry research 43, no. 9 (2004): 2079-2087.

1412. Zeng, weizhi, michael l. Free, and shijie wang. "**Studies of anode slime sintering/coalescence and its effects on anode slime adhesion and cathode purity in copper electrorefining**." journal of the electrochemical society 163, no. 2 (2015): e14.

1413. Hait, jhumki, and navneet singh randhawa. "**physico-chemical characteristics of deselenized copper anode slime**." in characterization of minerals, metals, and materials 2023, pp. 109-120. Cham: springer nature switzerland, 2023.

1414. Dutrizac, j. E., and t. T. Chen. "**A mineralogical comparison of the anode slimes from three canadian copper refineries**." hydrometallurgy and electrometallurgy of copper (1988): 467-486.

1415. Sawicki, j. A., j. E. Dutrizac, j. Friedl, f. E. Wagner, and t. T. Chen. "**197 au mössbauer study of copper refinery anode slimes**." metallurgical and materials transactions b 24 (1993): 457-462.

1416. Deva, nurten, musa rizaj, ismail duman, and florian kongoli. "**Anode slime gained during electrolysis process of secondary copper anodes**." iranian journal of chemistry and chemical engineering 38, no. 2 (2019): 121-126.

1417. Marković, r., b. Friedrich, j. Stevanović, b. Jugović, m. Dimitrijević, v. Gardić, and z. Stevanović. "**Characteristics of anode slime obtained from secondary copper anodes with high Ni content**." in 44th international conference of the slovak society of chemical engineering. 2017.

1418. Cifuentes, g., s. Hernández, p. Navarro, j. Simpson, c. Reyes, a. Naranjo, l. Tapia, e. Correa, n. Cornejo, and r. Abel. "**Control of the anodic slimes properties in copper electrorefining**."

1419. Cifuentes, g., s. Hernández, p. Navarro, j. Simpson, c. Reyes, a. Naranjo, and l. Tapia. "**Anodic slimes characteristics and behaviour in copper refining**." proceedings of the copper, phoenix, az, usa (1999): 10-13.

1420. Aaltonen, miamari. "**Characterization of adherent anode slimes in copper electrorefining**." master's thesis, 2014.

1421. Otto, christoph. "**Characterisation of anode slimes with regard to a multi-metal recovery**." phd diss., university of leoben, 2017.

1422. Zhang, huiting, cunjian weng, chunhua lai, xunqing wang, huatai wang, and yuan liu. "**Technological mineralogy of a copper anode slime in qinghai**." multipurpose utilization of mineral resources 2 (2022): 200-205.

1423. Xue-wen, wang, chen qi-yuan, yin zhou-lan, and xiao lian-sheng. "**Identification of arsenato antimonates in copper anode slimes**." hydrometallurgy 84, no. 3-4 (2006): 211-217.

1424. Fahidy, thomas z. "**a markovian analysis of the propagation kinetics of anode slimes in electrorefining cells**." hydrometallurgy 84, no. 1-2 (2006): 69-74.

1425. Kiviluoma, mikko, miamari aaltonen, jari aromaa, mari lundstrom, and olof forsen. "**Development of characterization methods for adherent anode slimes in copper electrorefining**." physicochemical problems of mineral processing 52, no. 1 (2016): 295-302.

1426. Gu, z. H., j. Chen, and t. Z. Fahidy. "**A study of anodic slime behaviour in the electrorefining of copper**." hydrometallurgy 37, no. 2 (1995): 149-167.

1427. Ling, x., z. H. Gu, and t. Z. Fahidy. "**Anode slime behaviour in a laboratory-scale copper electrorefining process**." the canadian journal of chemical engineering 72, no. 4 (1994): 683-694.

1428. Scott, j. D. "**Electrometallurgy of copper refinery anode slimes**." metallurgical transactions b 21 (1990): 629-635.

1429. Randhawa, navneet singh, and jhumki hait. "**Characteristics and processing of copper refinery anode slime**." in sustainable and economic waste management, pp. 263-288. Crc press, 2019.

2.3.2 Floating slimes

1430. Abe, s., and y. Takasawa. "**Prevention of floating slimes precipitation in copper electrorefining**." the electrorefining and winning of copper (1987): 87-98.

1431. Petkova, e. N. "**hypothesis about the origin of copper electrorefining slime**." hydrometallurgy 34, no. 3 (1994): 343-358.

1432. Hiskey, j. Brent. "**Mechanism and thermodynamics of floating slimes formation**." in proceedings of the tt chen honorary symposium on hydrometallurgy, electrometallurgy and materials characterization, orlando, fl, usa, pp. 11-15. 2012.

1433. Petkova, e. N. "**mechanisms of floating slime formation and its removal with the help of sulphur dioxide during the electrorefining of anode copper**." hydrometallurgy 46, no. 3 (1997): 277-286.

1434. Keller, edward. "**Composition and formation of tank residues in electrolytic copper refineries**." journal of the american chemical society 19, no. 10 (1897): 778-782.

2.4 Electrolyte

2.4.1 Electrolyte physico-chemical properties

1435. Kalliomäki, taina, arif t. Aji, shila jafari, waltteri leskinen, benjamin p. Wilson, jari aromaa, and mari lundström. "**Industrial validation of conductivity and viscosity models for copper electrolysis processes**." minerals engineering 171 (2021): 107069.

1436. Chibwe, chalwe, and margreth tadie. "**An experimental review of the physicochemical properties of copper electrowinning electrolytes**." mining, metallurgy & exploration 38, no. 2 (2021): 1225-1237.

1437. Kalliomäki, taina, jari aromaa, and mari lundström. "**Modeling the effect of composition and temperature on the conductivity of synthetic copper electrorefining electrolyte**." minerals 6, no. 3 (2016): 59.

1438. Lehtiniemi, i., t. Kalliomäki, l. Rintala, p. Latostenmaa, j. Aromaa, o. Forsén, and m. Lundström. "**Validation of electrolyte conductivity models in industrial copper electrorefining**." minerals & metallurgical processing 35 (2018): 117-124.

1439. Kalliomäki, taina, arif t. Aji, jari aromaa, and mari lundström. "**Viscosity and density models for copper electrorefining electrolytes**." in e3s web of conferences, vol. 8, p. 01050. Edp sciences, 2016.

1440. Price, derek c., and william g. Davenport. "**physico-chemical properties of copper electrorefining and electrowinning electrolytes**." metallurgical transactions b 12 (1981): 639-643.

2.4.2 Electrolyte composition

1441. Chibwe, chalwe. "**Investigating the influence of electrolyte composition on electrodeposition in copper electrowinning**." phd diss., stellenbosch: stellenbosch university., 2020.

1442. Cruz, daniel pedro. "**A method for iron determination during copper electrometallurgy and its application to the calculation of current efficiency**." phd diss., the university of texas at el paso, 2019.

1443. Saramak, d. "**optimal production of electrolytic copper determined by the concentration and distribution of copper concentrates to smelters on the example of KGHM**." archives of metallurgy and materials 56 (2011): 619-626.

2.4.3 Electrolyte additives; Leveling & grain-refining agents

1444. Moats, michael s., and j. Brent hiskey. "**The role of electrolyte additives on passivation behaviour during copper electrorefining**." canadian metallurgical quarterly 39, no. 3 (2000): 297-306.

1445. Conard, b. R., b. Rogers, r. Brisebois, and c. Smith. "**Inco copper refinery addition agent monitoring using cyclic voltammetry**." in proceedings of the international symposium on electrometallurigical plant practice, pp. 291-307. Pergamon, 1990.

1446. Aragón, juan, and juan camus. "**Effect of the concentration of chloride ion in the structure of electrodeposits of copper**." revista latinoamericana de metalurgia y materiales 31, no. 2 (2011): 128-133.

1447. Moffat, thomas p., b. Baker, daniel wheeler, and daniel josell. "**Accelerator aging effects during copper electrodeposition**." electrochemical and solid-state letters 6, no. 4 (2003): c59.

1448. Tantavichet, n., and m. D. Pritzker. "**Aspects of copper electrodeposition from acidic sulphate solutions in presence of thiourea**." transactions of the imf 84, no. 1 (2006): 36-46.

1449. Stanković, zvonimir d. "**the effect of Cl (i)$^-$ ions on kinetics and mechanism of anodic dissolution and cathodic deposition of copper**." electrochimica acta 29, no. 3 (1984): 407-409.

1450. Astakhova, r. K., a. B. Belen'kii, r. S. Krasikov, y. U. E. Kudryashov, a. E. Lebedev, e. M. Solov'ev, and s. V. Yakovleva. "**Behavior of some surfactants under conditions for the electrorefining of copper (dependence of polarization effects caused by the introduction of surfactants on their concentration in the solution). (Retroactive coverage)**." zhurnal prikladnoi khimii(uk) 63, no. 5 (1990): 1028-1032.

1451. Woo, tae-gyu, kyeong-won seol, hyun-woo lee, il-song park, dong-jin oh, and o. Kwon. "**The effect of arabic gum and chloride ion on the nucleation and growth of copper during electrodeposition**." journal of the korean institute of metals and materials 44, no. 7 (2006): 527-532.

1452. Bolzán, agustín e., i. B. Wakenge, roberto cv piatti, roberto carlos salvarezza, and alejandro jorge arvia. "**The behaviour of copper anodes in aqueous thiourea-containing sulphuric acid solutions. Open circuit potentials and electrochemical kinetics**." journal of electroanalytical chemistry 501, no. 1-2 (2001): 241-252.

1453. Brown, g. M., and g. A. Hope. "**Confirmation of thiourea/chloride ion coadsorption at a copper electrode by in situ sers spectroscopy**." journal of electroanalytical chemistry 413, no. 1-2 (1996): 153-160.

1454. Rzhevskij, i. V., e. M. Solov'ev, y. U. V. Blagodatin, and l. V. Volkov. "**tests of surface active substances(sas) of betaine class without sulfur content in copper electric refining under conditions of noril'sk integrated works**." tsvetnye metally(russia) 8 (1998): 27-30.

1455. Degrez, marc, j. L. Delplancke, and r. Winand. "**Inhibititor behaviour simulation in copper electrorefining and zinc electrowinning**." in proceedings of the symposium on modeling and simulation of electrolytic solution processes, p. 247. Electrochemical society, 1988.

1456. Mubarok, z., i. Filzwieser, and p. Paschen. "**Electrochemical and metallographic characteri-zation of inhibitor variation in copper refining electrolysis**." in proceedings of emc, p. 1. 2005.

1457. Stelter, michael, hartmut bombach, and nikolay nesterov. "**Using polyethylene glycols as alternative inhibitors in copper electrorefining**." jom 54 (2002): 32-36.

1458. Yao, yu-lin. "**functions of chloride in copper-refining electrolyte**." transactions of the electrochemical society 86, no. 1 (1944): 371.

1459. Muhlare, t. A., and d. R. Groot. "**The effect of electrolyte additives on cathode surface quality during copper electrorefining**." journal of the southern african institute of mining and metallurgy 111, no. 5 (2011): 371-378.

1460. Collet, thomas, noel hallemans, benny wouters, kristof ramharter, john lataire, rik pintelon, and annick hubin. "**An operando orp-eis study of the copper reduction reaction supported by thiourea and chlorides as electrorefining additives**." electrochimica acta 389 (2021): 138762.

1461. Collet, thomas, benny wouters, noël hallemans, kristof ramharter, john lataire, and annick hubin. "**The time-varying effect of thiourea on the copper electroplating process with industrial copper concentrations**." electrochimica acta 437 (2023): 141412.

1462. Lobos, maría gabriela, daniel luis ramírez, gonzalo riveros, patricia díaz, and humberto gomez. "**Electrochemical determination of copper and thiourea in the presence of an animal glue from strongly acidic solutions employed in the electrorefining processes of copper**." in ecs meeting abstracts, no. 42, p. 2500. Iop publishing, 2013.

1463. Li, jihua, yucheng xu, shiwei he, hui kong, yi luo, jiahao zhang, and lining zhang. "**Effects of gelatin on the kinetics of the cathodic process in copper electrorefining**." available at ssrn 4076107.

1464. Veilleux, b., a-m. Lafront, and e. Ghali. "**Influence of gelatin on deposit morphology during copper electrorefining using scaled industrial cells**." canadian metallurgical quarterly 41, no. 1 (2002): 47-62.

1465. Hospadaruk, vladimir. "**The effect of chloride on the deposition of copper, in the presence of arsenic, antimony and bismuth**." (1953).

1466. Alodan, maher abdullah. **Leveling effects of thiourea on copper electrodeposition**. University of minnesota, 1996.

1467. Weatherell, carl j. "**the size exclusion chromatography of animal glues in zinc electrolytes**." phd diss., carleton university, 1994.

1468. Alford, r. E. "**morphology modifier monitoring by polarisation measurement**." in proceedings of the international symposium on electrometallurigical plant practice, pp. 309-321. Pergamon, 1990.

1469. Davis, carol a., and greg a. Hope. "**Electrolytes containing glue are not as highly oriented, but there is still**." in proceedings of the symposium on quality management in industrial electrochemistry, vol. 93, no. 19, p. 172. Electrochemical society, 1993.

1470. Shimokawa, kimihiro, kenichi kawaguchi, kouji nishida, kuniaki murase, hiroyuki sugimura, and yasuhiro awakura. "**Reduced consumption of glue and electric power by continuous glue dissolution system installed at the tamano refinery**." journal of mmij 128, no. 3 (2012): 155-159.

1471. Artzer, andrew, michael moats, and jack bender. "**Removal of antimony and bismuth from copper electrorefining electrolyte: part ii—an investigation of two proprietary solvent extraction extractants**." jom 70, no. 12 (2018): 2856-2863.

1472. Bharucha, n. R., z. Zavorsky, and r. L. Leroy. "**Electrochemical determination of glue in copper refinery electrolyte**." metallurgical transactions b 9 (1978): 509-514.

1473. Saban, m. D., j. D. Scott, and r. M. Cassidy. "**Collagen proteins in electrorefining: rate constants for glue hydrolysis and effects of molar mass on glue activity**." metallurgical transactions b 23 (1992): 125-133.

1474. Stantke, peter. "**Using collamat to measure glue in copper electrolyte**." jom 54 (2002): 19-22.

1475. Brown, g. M., and g. A. Hope. "**SERS study of the adsorption of gelatin at a copper electrode in sulfuric acid solution**." journal of electroanalytical chemistry 397, no. 1-2 (1995): 293-300.

1476. Blechta, v. K., z. Z. Wang, and d. W. Krueger. "**Glue analysis and behavior in copper electrolyte**." metallurgical transactions b 24 (1993): 277-287.

1477. O'keefe, t. J., and l. R. Hurst. "**The effect of antimony, chloride ion, and glue on copper electrorefining**." journal of applied electrochemistry 8, no. 2 (1978): 109-119.

1478. Krzewska, s., l. Pajdowski, h. Podsiadly, and j. Podsiadly. "**Electrochemical determination of thiourea and glue in the industrial copper electrolyte**." metallurgical transactions b 15 (1984): 451-459.

1479. Hoffmann, james e. "**applying the haring cell to monitor glue addition**." jom 54 (2002): 24-27.

1480. Kerby, r. C., and w. A. Jankola. "**Monitoring of organic additives in electrolyte at cominco's lead/zinc operations**." in proceedings of the international symposium on electrometallurigical plant practice, pp. 323-330. Pergamon, 1990.

1481. Wang, heng, jianhang hu, kongzhai li, yu wang, feng zhang, and hua wang. "**Effect of additives on the direct electrodeposition of copper from acid solution containing 20 g/l copper (ii)**." international journal of electrochemical science 16, no. 1 (2021).

1482. Free, michael, ravindra bhide, and aphichart rodchanarowan. "**Improving the morphology of copper electrodeposits from halide media using additives and mass transport control**." ecs transactions 1, no. 13 (2006): 13.

1483. Fabian, c. P., m. J. Ridd, and m. E. Sheehan. "**Assessment of activated polyacrylamide and guar as organic additives in copper electrodeposition**." hydrometallurgy 86, no. 1-2 (2007): 44-55.

1484. Mubarok, m. Z., r. A. Lauten, r. Ellis, d. Ramdani, and m. Syaifudin. "**Study of electrochemical behaviour and surface morphology of copper electrodeposit from electrorefining with lignin-based biopolymer and thiourea as additives**." in extraction 2018: proceedings of the first global conference on extractive metallurgy, pp. 1509-1520. Springer international publishing, 2018.

1485. Verbruggen, florian, antonin prévoteau, luiza bonin, kristof marcoen, tom hauffman, tom hennebel, korneel rabaey, and michael s. Moats. "**Electrochemical codeposition of copper-antimony and interactions with electrolyte additives: towards the use of electronic waste for sustainable copper electrometallurgy**." hydrometallurgy 211 (2022): 105886.

1486. Wang, chwan-tsann. **The influence of additives and their interactions on copper electrorefining**. University of missouri-rolla, 1983.

1487. Hope, g. A., g. M. Brown, d. P. Schweinsberg, k. Shimizu, and k. Kobayashi. "**Observations of inclusions of polymeric additives in copper electrodeposits by transmission electron microscopy**." journal of applied electrochemistry 25 (1995): 890-894.

1488. Emekli, ugur, and alan c. West. "**Simulation of the effect of additives on electrochemical nucleation**." journal of the electrochemical society 157, no. 9 (2010): d479.

1489. Knuutila, k., o. Forsen, and a. Pehkonen. "**The effect of organic additives on the electrocrystallization of copper**." the electrorefining and winning of copper (1987): 129-143.

1490. Nkuna, e. H., and a. P. I. Popoola. "**Effect of chloride electrolyte additive on the quality of electrorefined copper cathode**." procedia manufacturing 35 (2019): 789-794.

1491. Abbas, hayder m., and sarmad t. Najim. "**Monitoring the effect of additive agents and other parameters on copper deposition by electro refining process**." international journal of current microbiology and applied sciences 6, no. 2 (2017): 270-284.

1492. Pearson, t., and j. K. Dennis. "**Effect of pulsed reverse current on the structure and hardness of copper deposits obtained from acidic electrolytes containing organic additives**." surface and coatings technology 42, no. 1 (1990): 69-79.

1493. Lin, yi-mao, and shi-chern yen. "**Effects of additives and chelating agents on electroless copper plating**." applied surface science 178, no. 1-4 (2001): 116-126.

1494. Koura, nobuyuki, yoshinori ejiri, motoyuki mamiya, yasushi idemoto, and futoshi matsumoto. "**Effects of gelatine and chloride ion on copper electrodeposition ii**." journal of the surface finishing society of japan 51, no. 9 (2000): 938-944.

1495. Huang, chin an, jo hsuan chang, and fu yong hsu. "**Electrocrystallization behavior of copper electrodeposited from aqueous sulfuric acid with thiourea and chloride additives**." ecs transactions 2, no. 3 (2006): 329.

1496. Kim, do-hyung, yong-hwan kim, and won-sub chung. "**The effect of arsenic on copper electrodeposition in copper-sulfate solutions in copper-electrorefining**." journal of the korean institute of surface engineering 42, no. 3 (2009): 103-108.

1497. Woo, tae-gyu, kyeong-won seol, hyun-woo lee, il-song park, young-min yoon, jeong-mo yoon, and kyeong-nyong woo. "**The effect of additives and current density on the copper electrodeposition using galvanostatic mode**." journal of the korean institute of metals and materials 44, no. 8 (2006): 575-580.

1498. Buckley, d. N., mairead breathnach, shafaat ahmed, and shohei nakahara. "**In situ afm study of the effect of additives on the morphology of electrodeposited copper**." ecs transactions 2, no. 6 (2007): 157.

1499. Pradhan, n., p. G. Krishna, and s. C. Das. "**Influence of chloride ion on electrocrystallization of copper**." plating and surface finishing 83, no. 3 (1996): 56-63.

1500. Kelly, james j., chunyan tian, and alan c. West. "**Leveling and microstructural effects of additives for copper electrodeposition**." journal of the electrochemical society 146, no. 7 (1999): 2540.

1501. Schrebler arratia, r., h. Aros meneses, r. Schrebler guzman, and c. Carlesi jara. "**Use of polyethylene glycol as organic additive in copper electrodeposition over stainless steel cathodes**." latin american applied research 42, no. 4 (2012): 371-376.

1502. Fabricius, gunilla, and g. Sundholm. "**The effect of additives on the electrodeposition of copper studied by the impedance technique**." journal of applied electrochemistry 14 (1984): 797-801.

1503. Araneda-hernández, eugenia, froilán vergara-gutierrez, and antonio pagliero-neira. "**Effect of additives on diffusion coefficient for cupric ions and kinematics viscosity in H_2SO_4-$CuSO_4$ solution at 60 c**." dyna 81, no. 188 (2014): 209-215.

1504. Nkuna, e. H., and a. P. I. Popoola. "**Effect of chloride electrolyte additive on the quality of electrorefined copper cathode**." procedia manufacturing 35 (2019): 789-794.

1505. Mirkova, l., n. Petkova, and i. Popova. "**The effect of some surface active additives upon the quality of cathodic copper deposits during the electro-refining process**." hydrometallurgy 36, no. 2 (1994): 201-213.

1506. Tadesse, bogale, michael horne, and jonas addai-mensah. "**The effect of thiourea, l (−) cysteine and glycine additives on the mechanisms and kinetics of copper electrodeposition**." journal of applied electrochemistry 43 (2013): 1185-1195.

1507. Collins, dale wade. "**Additive monitoring and interactions during copper electroprocessing**." phd diss., the university of arizona, 2001.

1508. Suzuki, atsuhiro, satoshi oue, and hiroaki nakano. "**Synergistic effects of additives on the deposition behavior, throwing power and surface roughness of cu obtained from electrorefining solution**." materials transactions 61, no. 5 (2020): 972-979.

1509. Mendez, s., gustavo andreasen, p. Schilardi, m. Figueroa, li vazquez, roberto carlos salvarezza, and alejandro jorge arvia. "**Dynamic scaling exponents of copper electrodeposits from scanning force microscopy imaging. Influence of a thiourea additive on the kinetics of roughening and brightening**." langmuir 14, no. 9 (1998): 2515-2524.

1510. Brown, g. M., g. A. Hope, d. P. Schweinsberg, and p. M. Fredericks. "**SERS study of the interaction of thiourea with a copper electrode in sulphuric acid solution**." journal of electroanalytical chemistry 380, no. 1-2 (1995): 161-166.

1511. Chang, jo, and chin an huang. "**The electrocrystallization behavior of the copper deposit plated in sulfuric acid bath with various concentrations of thiourea and chloride ions**." in ecs meeting abstracts, no. 26, p. 925. Iop publishing, 2006.

1512. Huang, ching an, jo hsuan chang, fu-yung hsu, and chih wei chen. "**Electropolishing behaviour and microstructures of copper deposits electroplated in an acidic copper-sulphuric bath with different thiourea contents**." surface and coatings technology 238 (2014): 87-92.

1513. Tarallo, a., and l. Heerman. "**Influence of thiourea on the nucleation of copper on polycrystalline platinum**." journal of applied electrochemistry 29 (1999): 585-591.

1514. Fabricius, g., k. Kontturi, and g. Sundholm. "**Influence of thiourea on the nucleation of copper from acid sulphate solutions**." electrochimica acta 39, no. 16 (1994): 2353-2357.

1515. Schab, d., h. Beyer, and k. Hein. "**einfluss der stromdichte...(effect of current density on the reaction of 35 s-labelled thiourea during electrolytic refining of copper)**." neue huette 24, no. 11 (1979): 410-414.

1516. Stanković, z. D., and m. Vuković. "**The influence of thiourea on kinetic parameters on the cathodic and anodic reaction at different metals in H2SO4 solution**." electrochimica acta 41, no. 16 (1996): 2529-2535.

1517. Jin, shize, and edward ghali. "**Effect of thiourea on the copper cathode polarization behavior in acidic copper sulfate at 65° c**." metallurgical and materials transactions b 32 (2001): 887-893.

1518. Pedre, ignacio, l. Méndez deleo, maria guadalupe sánchez-loredo, fernando battaglini, and graciela alicia gonzález. "**Electrochemical sensor for thiourea focused on metallurgical applications of copper**." sensors and actuators b: chemical 232 (2016): 383-389.

1519. Pedre, ignacio, fernando battaglini, gladis judith labrada delgado, maría guadalupe sánchez-loredo, and graciela a. González. "**Detection of thiourea from electrorefining baths using silver nanoparticles-based sensors**." sensors and actuators b: chemical 211 (2015): 515-522.

1520. Collet, thomas, benny wouters, sebastiaan eeltink, philipp schmidt, kristof ramharter, and annick hubin. "**An ex situ and operando analysis of thiourea consumption and activity during a simulated copper electrorefining process**." journal of electroanalytical chemistry 920 (2022): 116581.

1521. Gauvin, w. H., and c. A. Winkler. "**The effect of chloride ions on copper deposition**." journal of the electrochemical society 99, no. 2 (1952): 71.

1522. Zheng, zhimin. "**Fundamental studies of the anodic behavior of thiourea in copper electrorefining**." phd diss., university of british columbia, 2001.

1523. Quinet, magali, fabrice lallemand, laurence ricq, jean-yves hihn, and patrick delobelle. "**Adsorption of thiourea on polycrystalline platinum: influence on electrodeposition of copper**." surface and coatings technology 204, no. 20 (2010): 3108-3117.

1524. Ngandu, franklin. "**Investigating the effects of selenium and thiourea concentration on copper electrowinning**." phd diss., stellenbosch: stellenbosch university, 2016.

1525. Tantavichet, nisit, and mark d. Pritzker. "**Effect of plating mode, thiourea and chloride on the morphology of copper deposits produced in acidic sulphate solutions**." electrochimica acta 50, no. 9 (2005): 1849-1861.

1526. Chen, guo-liang, heng lin, jiang-hong lu, li wen, jian-zhang zhou, and zhong-hua lin. "**SERS and eqcm studies on the effect of allyl thiourea on copper dissolution and deposition in aqueous sulfuric acid**." journal of applied electrochemistry 38 (2008): 1501-1508.

1527. Fabbri, lorenzo, walter giurlani, giulia mencherini, antonio de luca, maurizio passaponti, emanuele piciollo, claudio fontanesi, andrea caneschi, and massimo innocenti. "**Optimisation of thiourea concentration in a decorative copper plating acid bath based on methanesulfonic electrolyte**." coatings 12, no. 3 (2022): 376.

1528. Tantavichet, nisit, somsak damronglerd, and orawan chailapakul. "**Influence of the interaction between chloride and thiourea on copper electrodeposition**." electrochimica acta 55, no. 1 (2009): 240-249.

1529. Safizadeh, fariba, anne-marie lafront, edward ghali, and georges houlachi. "**Monitoring the influence of gelatin and thiourea on copper electrodeposition employing electrochemical noise technique**." canadian metallurgical quarterly 49, no. 1 (2010): 21-28.

1530. Peeters, fabienne. **The influence of thiourea on copper electrodeposition in sulfate solutions**. Columbia university, 1995.

1531. Hatefi-mehrjardi, abdolhamid, mohammad ali karimi, and hojat kor. "**Application of electrochemical impedance spectroscopy for thiourea determination**."

1532. Bozzini, benedetto, lucia d'urzo, and claudio mele. "**A novel polymeric leveller for the electrodeposition of copper from acidic sulphate bath: a spectroelectrochemical investigation**." electrochimica acta 52, no. 14 (2007): 4767-4777.

1533. Oniciu, l., and l. Mureşan. "**Some fundamental aspects of levelling and brightening in metal electrodeposition**." journal of applied electrochemistry 21, no. 7 (1991): 565-574.

1534. El-batouti, mervette, soad h. Salaam, abdel-moneim m. Ahmed, and h. A. M. D. Y. El-shamy. "**Effect of some organic compounds on electrodeposition of copper metal in copper cathode**." asian journal of chemistry 28, no. 5 (2016).

2.4.4 Electrolyte temperature

1535. Tolibayev, yerlan, atabay jienbaev, and zamir dauletbayev. "**In metallurgical process modeling system high temperature copper refining processes**." models and methods in modern science 2, no. 3 (2023): 12-22.

1536. Pino, esteban j., roberto lópez valenzuela, eduardo p. Wiechmann, francisco saavedra rodríguez, anibal s. Morales, and pablo aqueveque. "**Temperature monitoring and flow estimation in electrolytic cells using wireless harsh environment sensors**." (2018).

1537. Aqueveque, pablo, anibal s. Morales, francisco saavedra, esteban pino, and eduardo p. Wiechmann. "**Temperature monitoring of electrolytic cells using wireless battery-free harsh environment sensors**." in 2016 ieee industry applications society annual meeting, pp. 1-8. Ieee, 2016.

1538. Hong, zhiying, and qingling wang. "**A new processing method of infrared temperature images in copper electrolysis**." in iecon 2017-43rd annual conference of the ieee industrial electronics society, pp. 5681-5684. Ieee, 2017.

1539. Aqueveque, pablo, anibal s. Morales, roberto lopez valenzuela, francisco saavedra rodriguez, esteban j. Pino, and eduardo p. Wiechmann. "**Temperature monitoring and flow estimation in electrolytic cells using wireless harsh environment sensors**." ieee transactions on industry applications 54, no. 4 (2018): 3982-3990.

1540. Gladysz, o., p. Los, and e. Krzyzak. "**Influence of concentrations of copper, levelling agents and temperature on the diffusion coefficient of cupric ions in industrial electro-refining electrolytes**." journal of applied electrochemistry 37 (2007): 1093-1097.

1541. Moats, michael s., j. Brent hiskey, and dale w. Collins. "**The effect of copper, acid, and temperature on the diffusion coefficient of cupric ions in simulated electrorefining electrolytes**." hydrometallurgy 56, no. 3 (2000): 255-268.

2.4.5 Electrolyte purification

1542. González de las torres, ana i., michael s. Moats, guillermo ríos, ana rodríguez almansa, and daniel sánchez-rodas. "**Removal of sb impurities in copper electrolyte and evaluation of as and fe species in an electrorefining plant**." metals 11, no. 6 (2021): 902.

1543. Shen, yukun, shenghang xu, tanna yu, wenyu feng, huibin zhang, huazhen cao, and guoqu zheng. "**Selective recovery of bismuth in copper electrolyte through coprecipitation method and its mechanism**." metallurgical and materials transactions b 52, no. 4 (2021): 2551-2562.

1544. Navarro, patricio, and francisco josé alguacil. "**Adsorption of antimony and arsenic from a copper electrorefining solution onto activated carbon**." hydrometallurgy 66, no. 1-3 (2002): 101-105.

1545. Salari, katereh, saeedeh hashemian, and mohammad taghi baei. "**Sb (v) removal from copper electrorefining electrolyte: comparative study by different sorbents**." transactions of nonferrous metals society of china 27, no. 2 (2017): 440-449.

1546. Monhemius, a. J., and p. M. Swash. "**Removing and stabilizing As from copper refining circuits by hydrothermal processing**." jom 51, no. 9 (1999): 30-33.

1547. Institution of mining and metallurgy, g. A. Riveros, r. I. Salas, j. A. Zúñiga, and o. H. Jiménez. "**Arsenic removal in anode refining by flux injection**." mining latin america/minería latinoamericana: challenges in the mining industry/desafíos para la industria minera (1994): 391-404.

1548. Xiao, fa-xin, jian-wei mao, dao cao, xiao-ni shen, and feng-zhang ren. "**Formation of antimonate in co-precipitation reaction of As, Sb and Bi in copper electrolytes**." minerals engineering 35 (2012): 9-15.

1549. Dreisinger, david b., and brenna jy scholey. "**ion exchange removal of antimony and bismuth from copper refinery electrolytes, paper from copper 95, volume iii, electrorefining and hydrometallurgy of copper, international conference held in santiago, chile, november 26-29, 1995**." papers (1995): 305-314.

1550. Cifuentes, gerardo, jaime simpson, cesar zúñiga, leoncio briones, and alejandro morales. "**Model and simulation of an ion exchange process for the extraction of antimony**." journal of metallurgical engineering oct 1, no. 3 (2012): 75-80.

1551. Hernández-pérez, l., j. Carrillo-abad, e. M. Ortega, v. Pérez-herranz, m. T. Montañés, and m. C. Martí-calatayud. "**Voltammetric and electrodeposition study for the recovery of antimony from effluents generated in the copper electrorefining process**." journal of environmental chemical engineering 11, no. 1 (2023): 109139.

1552. Riveros, p. A., j. E. Dutrizac, and r. Lastra. "**A study of the ion exchange removal of antimony (iii) and antimony (v) from copper electrolytes**." canadian metallurgical quarterly 47, no. 3 (2008): 307-316.

1553. Navarro, patricio, j. Simpson, and francisco josé alguacil. "**Removal of antimony (iii) from copper in sulphuric acid solutions by solvent extraction with lix 1104sm**." hydrometallurgy 53, no. 2 (1999): 121-131.

1554. Kowalik, patrycja, dorota kopyto, mateusz ciszewski, michał drzazga, and katarzyna leszczyńska-sejda. "**Purification of industrial copper electrolyte from bismuth impurity**." minerals 12, no. 1 (2022): 36.

1555. Lundström, m., p. Hannula, violeta barranco, k. Yliniemi, b. P. Wilson, d. Janas, and a. Hubin. "**Solution purification of copper electrorefining electrolyte-a novel way to recover precious metals**." (2019).

1556. Meymandi, abolfazl yazdi. "**Purification of copper metal in series cells and ways to increase efficiency**."

1557. Cifuentes, gerardo, jaime simpson, and cristián vargas. "**New process of precipitation of Sb and Bi from copper electrolytes with PbO_2.**" in tt chen honorary symposium on hydrometallurgy, electrometallurgy and materials characterization, pp. 125-130. Tms, john wiley & sons, inc. Hoboken, new jersey, 2012.

1558. Davidson, robert a., edward b. Walker, craig r. Barrow, and charles f. Davidson. "**On-line radioisotope xrf analysis of copper, arsenic, and sulfur in copper electrolyte purification solutions**." applied spectroscopy 48, no. 7 (1994): 796-800.

1559. Liu, y. "**silver removal in copper electrolyte purification for making high purity copper**." in ichm'98: third international conference on hydrometallurgy, pp. 386-391. 1998.

1560. Hoffmann, james e. "**the purification of copper refinery electrolyte**." jom 56, no. 7 (2004): 30-33.

1561. Ruitenberg, r., j. Boonstra, r. Jm van lier, and c. Jn buisman. "**Copper electrolyte purification with biogenic sulfide**." (2001).

1562. Qin, songyan, xin meng, yuqian fang, and lixin zhao. "**Deep electrochemical purification of high arsenic-bearing copper refined electrolyte**." journal of sustainable metallurgy (2023): 1-10.

1563. Juhasz, iozsef, ion constantin, vasile hotea, elena pop, and mihaela podariu. "**Researches on the electrolyte purification and the useful elements recovery in the copper electrolytic refining process**." revue roumaine de chimie 53, no. 5 (2008): 369-377.

1564. Peng, ying-lin, ya-jie zheng, wen-ke zhou, and wen-mi chen. "**Separation and recovery of Cu and As during purification of copper electrolyte**." transactions of nonferrous metals society of china 22, no. 9 (2012): 2268-2273.

1565. Bravo, j. L. R. "**studies for changes in the electrolyte purification plant at caraiba metais, brazil, paper from copper 95, volume iii, electrorefining and hydrometallurgy of copper, international conference held in santiago, chile, november 26-29, 1995**." papers (1995): 315-324.

1566. Shibayama, r., and t. Nagai. "**On application of solvent extraction and chelating ion-exchange resin for purification if copper electrolytes**." in process metallurgy, vol. 7, pp. 1193-1198. Elsevier, 1992.

1567. Wang, xingming, xuewen wang, biao liu, mingyu wang, huaguang wang, xuehui liu, and shengfan zhou. "**Promotion of copper electrolyte self-purification with antimonic oxides**." hydrometallurgy 175 (2018): 28-34.

1568. Wang, jin-liang, and hua-zhou hu. "**The use of antimony trioxide in copper electrolyte purification and its subsequent regeneration: an experimental and mechanistic study**." russian journal of non-ferrous metals 59 (2018): 237-249.

1569. Zheng, ya-jie, fa-xin xiao, yong wang, chun-hua li, wei xu, hong-sheng jian, and yu-tian ma. "**Industrial experiment of copper electrolyte purification by copper arsenite**." journal of central south university of technology 15 (2008): 204-208.

1570. Xiao, fa-xin, ya-jie zheng, w. A. N. G. Yong, x. U. Wei, chun-hua li, and hong-sheng jian. "**Novel technology of purification of copper electrolyte**." transactions of nonferrous metals society of china 17, no. 5 (2007): 1069-1074.

1571. Xiao, fa-xin, ya-jie zheng, w. A. N. G. Yong, hong-sheng jian, and xing-guan huang. "**Purification mechanism of copper electrolyte by As (iii)**." transactions of nonferrous metals society of china 18, no. 5 (2008): 1275-1279.

1572. Xiao, fa-xin, ya-jie zheng, w. A. N. G. Yong, hong-sheng jian, chun-hua li, and x. U. Wei. "**Preparation of copper arsenite and its application in purification of copper electrolyte**." transactions of nonferrous metals society of china 18, no. 2 (2008): 474-479.

1573. Gargul, krzysztof. "**Review of the copper electrolyte purification technologies in terms of the production of high purity copper cathodes**."

1574. Petrescu, n., l. Ganovici, and m. Britchi. "**Progress in copper electrolytical refining by the use of organic electrolytes and by the electrolyte purification used in conventional electrolysis**." metalurgia(bucharest) 36, no. 12 (1984): 636-639.

1575. Forsén, olof, antero pehkonen, lin zhu, and jari aromaa. "**Behaviour of dissolved arsenic in the electrolyte purification process in the electrorefining of copper**." in copper 2003-cobre 2003, santiago, chile, 30.11.-3.12. 2003, pp. 607-622. 2003.

1576. Koo, ja-kyung, heung-ki hong, and jae-ho lee. "**Recovery of Bi and Sb from copper spent electrolytes by electrowinning method**." journal of nanoscience and nanotechnology 15, no. 11 (2015): 8943-8946.

2.4.6 Electrolyte circulation&filtration

1577. Fukunaka, yasuhiro. "**Electrolyte circulation in copper refinery**." in electrochemical society meeting abstracts 226, no. 16, pp. 864-864. The electrochemical society, inc., 2014.

1578. Yang, jianguang, shan liu, weizhi zeng, bo li, ken li, hui hu, and wenjie ding. "**Experimental analysis of the performance of innovative circulation configurations for cleaner copper electrolysis**." hydrometallurgy 189 (2019): 105145.

1579. Rawling, j. R., and l. D. Costello. "**Mixing characteristics of a copper refinery tankhouse cell**." jom 21 (1969): 49-52.

1580. Gajowski, p., z. Szota, and p. Keyha. "**Use of installations measuring the suspended matter content of the electrolyte, in the control of the filtration in the copper electrorefining process**." in copper metallurgy'88/metalurgia miedzi'88--proceedings, pp. 153-158. 1988.

2.5 Transport phenomena

1581. Wang, zerui, yi meng, chun li, jun tie, and rentao zhao. "**Effect of nodules on electrolyte flow and cu2+ concentration distribution in copper electrolytic refining**." in advances in energy, environment and chemical engineering volume 1, pp. 309-313. Crc press, 2022.

1582. Blanc, agustín tomás escobar. "**nernst-planck equation for electrolytes in the context of copper electro-refinement**." phd diss., pontificia universidad catolica de chile (chile), 2019.

1583. Gray, nb, and jm floyd. "**some heat and mass transfer challenges in smelting and refining of metals**." in third australasian conference on heat and mass transfer, university of melbourne, 13-15 may 1985, p. 193. Brookfield publishing company, 1985.

1584. Kemminger, andreas, and andreas ludwig. "**Minutes of the sponsor group meeting of the research project: characterisation and optimisation of the electrolyte flow in conventional tankhouse cells**." (2013).

1585. Kemminger, a., and a. Ludwig. "**Modelling the electrolyte flow in a full-scale copper electrorefining tankhouse cell. European metallurgical conference,(2), 795-806**." (2013).

1586. Kim, k. R., s. Y. Choi, s. Paek, j. Y. Park, i. S. Hwang, and y. Jung. "**Electrochemical hydrodynamics modeling approach for a copper electrowinning cell**." international journal of electrochemical science 8, no. 11 (2013): 12333-12347.

1587. Enriquez, a., colin nexhip, g. Poplar, and a. Deneys. "**An update on praxair coherent jet technology in anode refining at kennecott Utah copper**." proceedings of copper 2010 (2010): 2327-2339.

1588. Eriksson, richard. "**Experimental determinations of concentration fields in the copper and silver refining systems using probe-beam deflection**." electrochimica acta 40, no. 6 (1995): 725-732.

1589. Laitinen, ilkka s., and juha t. Tanttu. "**Modelling and simulation of a copper electrolysis cell group**." simulation modelling practice and theory 16, no. 8 (2008): 900-909.

1590. Konishi, y., y. Nakamura, y. Fukunaka, k. Tsukada, and k. Hanasaki. "**Anodic dissolution phenomena accompanying supersaturation of copper sulfate along a vertical plane copper anode**." electrochimica acta 48, no. 18 (2003): 2615-2624.

1591. Kemminger, Andreas, and andreas ludwig. "**Annual report: characterisation and optimisation of the electrolyte flow in conventional tankhouse cells**." (2013).

1592. Konishi, y., y. Nakamura, y. Fukunaka, k. Tsukada, and k. Hanasaki. "**Anodic dissolution phenomena accompanying supersaturation of copper sulfate along a vertical plane copper anode**." electrochimica acta 48, no. 18 (2003): 2615-2624.

1593. Zhang, fangping, zheng xiang, and yu cao. "**Numerical simulation of vertical mold casting temperature field of copper anode plates**." engineering research express 2, no. 4 (2020): 045010.

1594. Kemminger, andreas. "**Characterization and optimization of the electrolyte flow in a conventional tankhouse cell**." phd diss., university of leoben, 2015.

1595. Holgate, daniel, and gregory j. Griffin. "**Comparison of experimental and computational fluid dynamics analysis of velocity patterns in industrial scale copper electrorefining cells**."

1596. Kemminger, andreas, and andreas ludwig. "**Optimization and modelling of the electrolyte flow in a conventional copper electrorefining cell**." (2013).

1597. Laitinen, ilkka s., and juha t. Tanttu. "**FEM modeling of an industrial scale electrolysis cell**." in proceedings of the nordic comsol conference, pp. 29-34. 2006.

1598. Kalliomäki, taina, benjamin p. Wilson, jari aromaa, and mari lundström. "**Diffusion coefficient of cupric ion in a copper electrorefining electrolyte containing nickel and arsenic**." minerals engineering 134 (2019): 381-389.

1599. Bauer, joseph, and michael moats. "**Effective copper diffusion coefficients in CuSO4–H2SO4 electrowinning electrolytes**." in tms 2020 149th annual meeting & exhibition supplemental proceedings, pp. 1237-1247. Springer international publishing, 2020.

1600. Feng, wenyu, huazhen cao, yukun shen, shenghang xu, huibin zhang, and guoqu zheng. "**A theoretical model for metal cation reduction in the flow field and its application to copper electrorefining**." int. J. Electrochem. Sci 17, no. 220236 (2022): 2.

1601. Kawai, s., and t. Miyazawa. "**CFD modelling and simulation of industrial-scale copper electrorefining process**." minerals engineering 63 (2014): 81-90.

1602. Zeng, weizhi, shijie wang, and michael l. Free. "**Experimental and simulation studies of electrolyte flow and slime particle transport in a pilot scale copper electrorefining cell**." journal of the electrochemical society 163, no. 5 (2016): e111.

1603. Novev, javor k., and richard g. Compton. "**Natural convection effects in electrochemical systems**." current opinion in electrochemistry 7 (2018): 118-129.

1604. Zeng, weizhi, shijie wang, and michael l. Free. "**A comparative study of electrolyte flow and slime particle transport in a newly designed copper electrolytic cell and a laboratory-scale conventional electrolytic cell**." jom 69, no. 10 (2017): 1876-1887.

1605. Zeng, weizhi, gaosong yi, shijie wang, and michael l. Free. "**Design and analysis of direct side inflows in copper electrolytic cells by a computational method**." hydrometallurgy 169 (2017): 612-620.

1606. Zeng, weizhi, shijie wang, and michael l. Free. "**Two-phase flow modeling of copper electrorefining involving impurity particles**." journal of the electrochemical society 164, no. 9 (2017): e233.

1607. Zeng, weizhi, michael l. Free, and shijie wang. "**Innovations and insights in fluid flow and slime adhesion for improved copper electrorefining**." in applications of process engineering principles in materials processing, energy and environmental technologies: an epd symposium in honor of professor ramana g. Reddy, pp. 25-33. Springer international publishing, 2017.

1608. Wang, hongdan, qian wang, wentang xia, and bingzhi ren. "**Effect of jet flow between electrodes on the cathode quality in copper electrorefining with high current density**." metals 8, no. 10 (2018): 833.

1609. Ping, z. H. O. U., zi-wei xie, and hong-jie yan. "**Evaluation of flow behavior in copper electro-refining cell with different inlet arrangements**." transactions of nonferrous metals society of china 27, no. 10 (2017): 2282-2290.

1610. Brunner, daniel, marlon boldrini, and gernot kurt boiger. "**Model based analysis of forced and natural convection effects in an electrochemical cell**." the international journal of multiphysics 11, no. 1 (2017): 97-111.

1611. Jennings, herbert s., and frank e. Rizzo. "**Diffusion layer interpretation of the interaction of electrorefining addition agents**." metallurgical transactions 4 (1973): 921-926.

1612. Ehrl, andreas, georg bauer, volker gravemeier, and wolfgang a. Wall. "**A computational approach for the simulation of natural convection in electrochemical cells**." journal of computational physics 235 (2013): 764-785.

1613. Sedahmed, g. H., and i. Nirdosh. "**Intensification of rate of diffusion controlled reactions in a parallel plate electrochemical reactor stirred by a curtain of electrochemically generated gas bubbles**." chemical engineering & technology: industrial chemistry-plant equipment-process engineering-biotechnology 30, no. 10 (2007): 1406-1411.

1614. Sedahmed, g. H. "**effect of anodically evolved gas bubbles on the rate of cathodic mass transfer in a vertical cylinder cell**." journal of applied electrochemistry 14, no. 6 (1984): 693-700.

1615. Subbaiah, t., p. Venkateswarlu, r. P. Das, and g. J. V. J. Raju. "**mass-transfer conditions at a cathode support plate in an electrochemical cell**." chemical engineering and processing: process intensification 34, no. 6 (1995): 495-501.

1616. Ibrahim, marwa h., and sarmad t. Najim. "**Determination of mass transfer coefficient for copper electrodeposition by limiting current technique**." al-nahrain journal for engineering sciences 20, no. 3 (2017): 666-672.

1617. Leahy, martin j., and m. Philip schwarz. "**Experimental validation of a computational fluid dynamics model of copper electrowinning**." metallurgical and materials transactions b 41, no. 6 (2010): 1247-1260.

1618. Subbaiah, tondepu, ponnam vijetha, barsha marandi, kali sanjay, and manickam minakshi. "**Ionic mass transfer at point electrodes located at cathode support plate in an**

electrorefining cell in presence of rectangular turbulent promoters." sustainability 14, no. 2 (2022): 880.

1619. Gendron, a. S., and v. A. Ettel. "**Hydrodynamic studies in natural and forced convection electrowinning cells**." the canadian journal of chemical engineering 53, no. 1 (1975): 36-40.

1620. Leahy, martin j., and m. Phillip schwarz. "**Modeling natural convection in copper electrorefining: describing turbulence behavior for industrial-sized systems**." metallurgical and materials transactions b 42 (2011): 875-890.

1621. Leahy, m. J., and m. P. Schwarz. "**Computational fluid dynamics modelling of natural convection in copper electrorefining**." (2007): 112-116.

1622. Leahy, martin j., and m. Philip schwarz. "**Flow and mass transfer modelling for copper electrowinning: development of instabilities along electrodes**." hydrometallurgy 147 (2014): 41-53.

1623. Miyamoto, masayuki, atsushi kitada, kazuhiro fukami, and kuniaki murase. "**Growth of nodules in copper electrorefining: numerical simulation of natural convection**." in electrochemical society meeting abstracts prime2020, no. 18, pp. 1520-1520. The electrochemical society, inc., 2020.

1624. Eklund, a., f. Alavyoon, d. Simonsson, r. I. Karlsson, and f. H. Bark. "**Theoretical and experimental studies of free convection and stratification of electrolyte in a copper refining cell--i.**" electrochimica acta 36, no. 8 (1991): 1345-1354.

1625. Eklund, a., f. Alavyoon, and r. I. Karlsson. "**Theoretical and experimental studies of free convection and stratification of electrolyte in a copper refining cell—ii. Influence of the supporting electrolyte**." electrochimica acta 37, no. 4 (1992): 695-704.

1626. Kawai, s., y. Fukunaka, and s. Kida. "**Numerical simulation of transient natural convection along vertical plane electrodes caused by electrolytic current modulation**." journal of the electrochemical society 155, no. 5 (2008): f75.

1627. Fukunaka, y., t. Minegishi, n. Nishioka, and y. Kondo. "**Transient natural convection near a plane vertical electrode surface after reversing the electrolytic current**." journal of the electrochemical society 128, no. 6 (1981): 1274.

1628. Kawai, s., y. Fukunaka, and s. Kida. "**Numerical simulation of ionic mass-transfer rates with natural convection in $CuSO_4$–H_2SO_4 solution: i. Numerical study on the developments of secondary flow and electrolyte stratification phenomena**." journal of the electrochemical society 156, no. 9 (2009): f99.

1629. Kawai, s., y. Fukunaka, and s. Kida. "**Numerical simulation of ionic mass-transfer rates with natural convection in $CuSO_4$–H_2SO_4 solution: ii. Comparisons between**

numerical calculations and optical measurements." journal of the electrochemical society 156, no. 9 (2009): f109.

1630. Kawai, shunsuke. "**Numerical analysis on free convection and mass transfer**." mmg 2: 2.

1631. Ahmed, a. M. "**effect of natural convection mass transfer on the rate of electrorefining of copper at inclined electrodes**." j. Electrochem. Soc. India 37, no. 1 (1988): 79-80.

1632. Holgate, daniel, and gregory j. Griffin. "**The role of natural convection in the contamination of cathodes by anode slimes during industrial copper electrorefining**." in chemeca 2000: opportunities and challenges for the resource and processing industries, pp. 539-544. Barton, act: institution of engineers, australia, 2000.

1633. Sedzimir, j. **"dependence of the passivation time on current density in the process of copper electrorefining. Diffusion, migration and gravitational convection contributions in the Cu exp 2+ transport**." archives of metallurgy(poland) 38, no. 4 (1993): 419-433.

1634. Torgashov, a. G., e. M. Solov'ev, and l. V. Volkov. "**Role of natural convection in mechanism of leveling effect of inhibitory additives sas during copper electrolytic refining**." khim. Tekhnol. 8 (2004): 32-34.

1635. Cooke, a. V., j. P. Chilton, and d. J. Fray. "**Electrode mass transfer under conditions of natural and forced convection**." metallurgical transactions b 20 (1989): 21-29.

1636. Eklund, anders. "**Mass transfer and free convection in electrochemical cells**." (1994): 0269-0269.

1637. Denpo, k., s. Teruta, y. Fukunaka, and y. Kondo. "**Turbulent natural convection along a vertical electrode**." metallurgical transactions b 14 (1983): 633-643.

1638. Alavyoon, farid. "**Unsteady natural convection and mass transfer in copper electrolysis with a supporting electrolyte**." electrochimica acta 37, no. 2 (1992): 333-344.

1639. Hemmati, helen, ali mohebbi, ataallah soltani, and shahram daneshpajouh. "**CFD modeling of the electrolyte flow in the copper electrorefining cell of sarcheshmeh copper complex**." hydrometallurgy 139 (2013): 54-63.

1640. Filzwieser, a., k. Hein, and g. Mori. "**Current density limitation and diffusion boundary layer calculation using CFD method**." jom 54 (2002): 28-31.

1641. Najmi, noori m., a. Mohebbi, a. Soltani, h. Hemmati, and arabi b. Ghadami. "**CFD modeling of the electrolyte flow in the copper electrowinning cell of sarcheshmeh copper complex**." (2014).

1642. O'keefe, thomas j., j. S. Cuzmar, and s. F. Chen. "**Calculation of mass transfer coefficients in metal deposition using electrochemical tracer techniques**." journal of the electrochemical society 134, no. 3 (1987): 547.

1643. Subbaiah, t., and r. P. Das. "**Mass transfer studies in an electrochemical cell during electrodeposition of copper**." mineral procesing and extractive metallurgy review 12, no. 2-4 (1993): 291-306.

1644. Najim, sarmad talib. "**Estimation of mass transfer coefficient for copper electrowinning process**." journal of engineering 22, no. 4 (2016): 158-168.

1645. Su, junling, xiao lin, shili zheng, rui ning, wenbo lou, and wei jin. "**Mass transport-enhanced electrodeposition for the efficient recovery of copper and selenium from sulfuric acid solution**." separation and purification technology 182 (2017): 160-165.

1646. Kawai, s., m. Ogawa, k. Ishibashi, y. Kondo, t. Matsuoka, t. Homma, y. Fukunaka, and s. Kida. "**Transient mass transfer rate of Cu2+ ion caused by copper electrodeposition with alternating electrolytic current**." electrochimica acta 55, no. 12 (2010): 3987-3994.

1647. Mohanta, s., and t. Z. Fahidy. "**The effect of a uniform magnetic field on mass transfer in electrolysis**." the canadian journal of chemical engineering 50, no. 2 (1972): 248-253.

1648. Fahidy, thomas z. "**augmentation of natural convective mass transfer via magnetoelectrolysis**." the chemical engineering journal 7, no. 1 (1974): 21-27.

1649. Schab, dietmar, and klaus hein. "**Problems of anodic and cathodic mass transfer in copper refining electrolysis with increased current density**." canadian metallurgical quarterly 31, no. 3 (1992): 173-179.

1650. Sedahmed, g. H. "**a model for correlating mass transfer data in parallel plate gas sparged electrochemical reactors**." journal of applied electrochemistry 15, no. 5 (1985): 777-780.

1651. Wendt, hartmut, gerhard kreysa, hartmut wendt, and gerhard kreysa. "**Mass transfer by fluid flow, convective diffusion and ionic electricity transport in electrolytes and cells**." electrochemical engineering: science and technology in chemical and other industries (1999): 81-127.

1652. Roy, shimul kanti. "**Effect of fluidization on mass transfer behaviour in the electrodeposition on parallel plate electrode**." (1997).

1653. Rao, d. Subba, and p. Venkateswarlu. "**Ionic mass transfer studies in an open cell in the presence of circular cylindrical promoters**." chemical engineering and processing: process intensification 43, no. 1 (2004): 35-41.

1654. Subbaiah, t., p. Venkateswarlu, s. C. Das, r. P. Das, and g. J. V. J. Raju. "**Mass transfer conditions in an electrochemical cell in the presence of turbulence promoters**." plating and surface finishing 86, no. 1 (1999): 94-98.

1655. Subbaiah, t., and r. P. Das. "**Mass transfer studies in an electrochemical cell during electrodeposition of copper**." mineral procesing and extractive metallurgy review 12, no. 2-4 (1993): 291-306.

1656. Wang, h. M., s. F. Chen, t. J. O'keefe, marc degrez, and rené winand. "**Evaluation of mass transport in copper and zinc electrodeposition using tracer methods**." journal of applied electrochemistry 19 (1989): 174-182.

1657. Ziegler, donald paul. **A study of electrowinning and electrorefining cell hydrodynamics**. University of california, berkeley, 1984.

1658. Fabian, cesimiro p., philippe mandin, michael ridd, and madoc sheehan. "**Hydrodynamic modeling of copper electrodeposition at a vertical rotating cylinder electrode**." ecs transactions 2, no. 3 (2006): 303.

1659. Liu, chang, guangqiang li, lifeng zhang, qiang wang, and qiang wang. "**A three-dimensional comprehensive numerical model of ion transport during electro-refining process for scrap-metal recycling**." materials 15, no. 8 (2022): 2789.

1660. Schab, d., and k. Hein. "**Problems of material transport in copper refining electrolysis, especially of copper ions approaching the cathode**." freib. Forschungsh. B, metall. Werkstofftech. (1985): 66-82.

1661. Ibl, n. "**fundamentals of electrochemical engineering: the role of transport phenomena**." plenary and main section lectures presented at Hamburg, federal republic of germany, 2-8 september, 1973: applied electrochemistry 5 (1974): 31.

1662. Zeng, weizhi. "**Experimental and validated modeling studies of electrolyte flow and anode slime behavior and transport in copper electrorefining**." phd diss., the university of utah, 2016.

2.6 Cathode copper purity and physical quality

2.6.1 Cathode copper purity

1663. Sahlman, mika, jari aromaa, and mari lundström. "**Copper cathode contamination by nickel in copper electrorefining**." metals 11, no. 11 (2021): 1758.

1664. Cardinal, a. L., j. T. Farraro, and g. Montes. **An analysis of variance of impurity distributions in electrolytically refined copper cathodes**. Astm international, 1984.

1665. Anzalone, j. C., r. J. Chesher, and t. F. Krusmark. "**Occurrence of bismuth in cathode at the bhp San Manuel refinery**." aqueous electrotechnologies: progress in theory and practice (1997): 1997.

1666. Baltazar, v., and p. L. Claessens. "**Factors affecting cathode purity during copper electrorefining**." the metallurgical society/aime, (1984): 12.

2.6.2 Crystalography, Morphology and Nodulation Growth

1667. Shojaei, mohammad reza, gholam reza khayati, seyed mohammad javad korasani, and roya kafi harnashki. "**Investigating the nodulation mechanism of copper cathode based on microscopic approach: as a punch failure factor**." engineering failure analysis 133 (2022): 105970.

1668. González, felipe javier garrido. **Design of solar pond for water preheating used in the copper cathodes washing process at spence mine**. Pontificia universidad catolica de chile (chile), 2012.

1669. Mubarok, m. Zaki, iris filzwieser, and peter paschen. "**Dendritic cathode growth during copper electrorefining in the presence of solid particles**." erzmetall 58, no. 6 (2005): 315.

1670. Ahmadi, a., saeed sheibani, m. Mokmeli, s. M. J. Khorasani, and n. S. Yaghoobi. "**Factors affecting the cathode edge nodulation in copper electrorefining process**." international journal of engineering 35, no. 12 (2022): 2370-2376.

1671. Miyamoto, masayuki, shohei mitsuno, atsushi kitada, kazuhiro fukami, and kuniaki murase. "**Mechanism of nodular growth in copper electrorefining with the inclusion of impurity particles under natural convection**." hydrometallurgy 216 (2023): 106013.

1672. Bauer, joseph, and michael moats. "**Nodule formation on copper electrodeposits in the rotating cylinder hull cell**." metallurgical and materials transactions b (2022): 1-10.

1673. Pourgharibshahi, mohammad, seyed mohammad javad khorasani, nahid yaghoobi, and paul lambert. "**A descriptive model for twin-textured growth and nodulation of copper cathodes**." electrocatalysis (2022): 1-10.

1674. Li, yansong, yang hongying, and dawei wang. "**Study on the preparation of spectral standard samples for cathode copper**." biomedical research (0970-938x) 28, no. 8 (2017).

1675. Guerra, eduard, and jeffrey shepherd. "**Cathode guides for conventional copper electrorefining reactors employing starter sheet cathodes**." ecs transactions 2, no. 3 (2006): 345.

1676. Hiskey, j. Brent, and y. Maeda. "**A study of copper deposition in the presence of group-15 elements by cyclic voltammetry and auger-electron spectroscopy**." journal of applied electrochemistry 33 (2003): 393-401.

1677. Gauvin, W., and C. A. Winkler. "**Effect of surface on cathode polarization during the electrodeposition of copper**." Canadian Journal of Research 21, no. 4 (1943): 37-50.

1678. Shreir, l. L., and j. W. Smith. "**Cathode polarization potential during the electrodeposition of copper: iii. Effect of the cathode base upon the cathode polarization potential and the crystal structure of the deposit**." journal of the electrochemical society 99, no. 11 (1952): 450.

1679. Moats, michael s., and alexander derrick. "**Investigation of nucleation and plating overpotentials during copper electrowinning using the galvanostatic staircase method**." electrometallurgy 2012 (2012): 125-137.

1680. Abel, r., m. Contreras, w. Guiachetti, g. Zarate, and e. Altamirano. "**measurement of physical properties of electrorefined cathode melt samples**, paper from copper 87, volume 3, hydrometallurgy and electrometallurgy of copper, international conference held in vina del mar, chile, november 30-december 3, 1987." books (1988).

1681. Delplancke, j -l., m. Ongaro, and rené winand. "**Growth of electrodeposited copper on anodized titanium**." journal of applied electrochemistry 22 (1992): 843-851.

1682. Kao, y. L., g. C. Tu, c. A. Huang, and j. H. Chang. "**The annealing behavior of copper deposit electroplated in sulfuric acid bath with various concentrations of thiourea**." materials science and engineering: a 382, no. 1-2 (2004): 104-111.

1683. Sharma, akshdeep, sumit kumar khandelwal, deepak bansal, kamaljit rangra, and dinesh kumar. "**Experimental study on sheet resistivity and thickness measurement in copper electroplating**." (2013).

1684. Fraser, kevin s., and w. Charles cooper. "**The nature and strippability of copper electrodeposits on different film-covered surfaces**." surface technology 8, no. 5 (1979): 385-398.

1685. Butts, allison, and vittorio de nora. "**Structure and grain size of electrodeposited copper**." transactions of the electrochemical society 79, no. 1 (1941): 163.

1686. Laezza, j. "**copper cathode quality improvement at the kidd refinery**." copper'90. Refining, fabrication (1990): 198-207.

1687. Cifuentes, l., and m. Mella. "**On the physical quality of copper electrodeposits obtained on mesh cathodes**." canadian metallurgical quarterly 45, no. 1 (2006): 9-16.

1688. Majuste, daniel, natanael almeida, virginia sampaio teixeira ciminelli, and paulo roberto cetlin. "**Cathode stripping behavior: simulation by the finite element method and experimental effect of cathode surface roughness and its repeated use**." available at ssrn 4408280.

1689. Olgac, zafer. **The macrostructure of copper electrodeposits**. The university of texas at el paso, 1973.

1690. Čadjenović, branislav, radmila marković, and aleksandra milosavljević. "**Influence of some elements from anode copper on cathode copper quality**."

1691. Safizadeh, f., a-m. Lafront, e. Ghali, and g. Houlachi. "**Monitoring the quality of copper deposition by statistical and frequency analyses of electrochemical noise**." hydrometallurgy 100, no. 3-4 (2010): 87-94.

1692. Isa, nn che, yusairie mohd, mh mohd zaki, and sa syed mohamad. "**Characterization of copper coating electrodeposited on stainless steel substrate**." int. J. Electrochem. Sci 12 (2017): 6010-6021.

1693. Serrano, john r., dennis berger, and bill bridges jr. "**using quality control to limit bismuth in copper cathodes**." jom 46, no. 10 (1994): 12-14.

1694. Suarez, d. F., and f. Olson. "**Nodulation of copper cathodes by electrorefining addition agents thiourea, glue and chloride ion**." the electrorefining and winning of copper (1987): 145-170.

1695. Adachi, ken, yuya nakai, atsushi kitada, kazuhiro fukami, and kuniaki murase. "**FEM simulation of nodulation in copper electro-refining**." in rare metal technology 2018, pp. 215-222. Springer international publishing, 2018.

1696. Filzwieser, zaki mubarok iris, and peter paschen. "**Analysis of nodulated cathodes from atlantic copper and new boliden**."

1697. Nakai, yuya, ken adachi, atsushi kitada, kazuhiro fukami, and kuniaki murase. "**Experimental modeling of nodulation in copper electrorefining**." in rare metal technology 2018, pp. 319-323. Springer international publishing, 2018.

1698. Veilleux, b., a-m. Lafront, and e. Ghali. "**Computerized scaled cells to study the effect of additive ratios and concentrations on nodulation during copper electrorefining**." journal of applied electrochemistry 31 (2001): 1017-1024.

1699. Veilleux, b., a-m. Lafront, and e. Ghali. "**Effect of thiourea on nodulation during copper electrorefining using scaled industrial cells**." canadian metallurgical quarterly 40, no. 3 (2001): 343-354.

1700. Lafront, a. M., b. Veilleux, and e. Ghali. "**Galvanostatic and microscopic studies of nodulation during copper electrolysis**." journal of applied electrochemistry 32 (2002): 329-337.

1701. Suarez, d. F., and f. A. Olson. "**Nodulation of electrodeposited copper in the presence of thiourea**." journal of applied electrochemistry 22, no. 11 (1992): 1002-1010.

2.6.3 Physical factors affecting cathode purity

1702. Cifuentes, g., c. Vargas, and j. Simpson. "**Analysis of the process main variables influence in the rejection of the cathodes during copper electrorefining**." revista de metalurgia 45, no. 3 (2009): 228-236.

1703. Cifuentes, gerardo, cristian vargas, and jaime simpson. "**Analysis of the main variables that influence in the cathodic rejection in copper electrorefining**." in proceedings of the seminar first meeting on minor contaminants in copper metallurgy. Concepción, chile, pp. 37-43. 2007.

1704. Correa, pedro pablo, aldo cipriano, felipe nunez, juan carlos salas, and hans lobel. "**Forecasting copper electrorefining cathode rejection by means of recurrent neural networks with attention mechanism**." ieee access 9 (2021): 79080-79088.

2.7 Anode Casting - Physical and chemical Quality

1705. Shojaei, mohammad reza, gholam reza khayati, seyed mohammad javad khorasani, and nahid assadat yaghubi. "**Study the failure of casted copper anode: the formation of bumps defects on the surface of the anode during casting**." engineering failure analysis 138 (2022): 106426.

1706. Oudiz, j. J. "**poling processes for copper refining**." jom 25, no. 12 (1973): 35-38.

1707. Zeng, weizhi, shijie wang, and michael l. Free. "**experimental studies of the effects of anode composition and process parameters on anode slime adhesion and cathode copper purity by performing copper electrorefining in a pilot-scale cell**." metallurgical and materials transactions b 47 (2016): 3178-3191.

1708. Markovic, radmila, vesna krstic, bernd friedrich, srecko stopic, jasmina stevanovic, zoran stevanovic, and vesna marjanovic. "**Electrorefining process of the non-commercial copper anodes**." metals 11, no. 8 (2021): 1187.

1709. Owais, ashour, mohamed abdel hady gepreel, and essam ahmed. "**Effect of thermal treatment of copper anodes on electrorefining process**." hydrometallurgy 152 (2015): 55-60.

1710. Lee, yong-hyuk, hyun-jin ju, sa-kyun rha, seung-hee lee, byoungju kang, and youn-seoung lee. "**Behavior of soluble and insoluble anodes in Cu electroplating**." in ecs meeting abstracts, no. 28, p. 1616. Iop publishing, 2011.

1711. Kucharska-giziewicz, e. A., and d. J. Mackinnon. "**Factors affecting the electrochemical behaviour of copper anodes under simulated electrorefining conditions**." journal of applied electrochemistry 24 (1994): 953-964.

1712. Mokmeli, mohammad, and masoumeh torabi parizi. "**The effect of copper smelting technology on the dissolution of anodes at the sarcheshmeh copper electrorefining plant**." metallurgical engineering 23, no. 2 (2020): 90-101.

1713. Wenzl, christine. "**Structure and casting technology of anodes in copper metallurgy**." phd diss., university of leoben, 2008.

1714. Wenzl, christine, helmut antrekowitsch, iris filzwieser, josef pesl, and montanwerke brixlegg ag. "**Anode casting-chemical anode quality**." in proc. Of copper/cobre v, pp. 91-110. 2007.

1715. Wenzl, dipl-ing christine, i. Filzwieser, and a. Filzwieser. "**Anode casting-physical anode quality**." in proceedings of emc, p. 1. 2007.

1716. Wenzl, christine, iris filzwieser, gregor mori, and josef pesl. "**Investigations on anode quality in copper electrorefining**." bhm berg-und hüttenmännische monatshefte 153, no. 3 (2008): 91-96.

1717. Edens, torben, and dirk hannemann. "**New casting moulds for anode copper**." converter and fire refining practices, tms (2005): 159-165.

1718. Safizadeh, f., and e. Ghali. "**Electrochemical noise of copper anode behaviour in industrial electrolyte using wavelet analysis**." transactions of nonferrous metals society of china 23, no. 6 (2013): 1854-1862.

1719. Dompas, j. M., and j. De keyser. "**Continuous casting of anodes with integral lugs for electrolytic copper refining**." pr. Inst. Met. Niezelaz. 12, no. 1 (1983): 127-142.

1720. Regan, p. C., and j. M. Dompas. "**The hazelett continuous cast anode efficiency in handling and processing in the tankhouse**." copper 91(cobre 91) (1991).

1721. Dragulovic, suzana, zdenka stanojevic-simsic, silvana dimitrijevic, aleksandra ivanovic, and zorica ljubomirovic. "**Comparative view of copper electrolytic refining by using standard and non-standard electrodes**." international multidisciplinary scientific geoconference: sgem 3 (2011): 821.

1722. Leckie, h. P. "**the anodic polarization behavior of copper**." journal of the electrochemical society 117, no. 12 (1970): 1478.

1723. Sahoo, m., g. Morin, d. Cousineau, and d. J. Kemp. "**tundish modification to improve the quality of hazelett-cast copper anodes, paper from copper 95, volume iii, electrorefining and hydrometallurgy of copper, international conference held in santiago, chile, november 26-29, 1995**." papers (1995): 175-187.

1724. Hoey, dw, tc hunter, and ks robertson. "**eldomet anode casting experience at copper refineries pty. Ltd**." insulation(london) (1978).

1725. Roberti, r. "**inco's procedure for controlling warpage in copper moulds used for anode casting**." the electrorefining and winning of copper (1987): 21-32.

1726. Cheng, x., j. B. Hiskey, and t. F. Krusmark. "**characterization of copper anode surfaces during different stages of polarization, paper from copper 95, volume iii, electrorefining and hydrometallurgy of copper, international conference held in santiago, chile, november 26-29, 1995**." papers (1995): 225-240.

1727. Cifuentes, gerardo, josé hernández, and nicolás guajardo. "**Recovering scrap anode copper using reactive electrodialysis**." american journal of analytical chemistry 5, no. 15 (2014): 1020.

1728. Guy, p. C. L. "**operating experience with the contilanod process for continuously cast copper anodes**." copper'90. Refining, fabrication (1990): 66-73.

1729. Romero, jorge sebastian, marcela andrea cruchaga, and diego javier celentano. "**Evaluation of formation and evolution of microporosity in anodic copper solidification processes: simulation and experimental validation**." metallurgical and materials transactions b 44 (2013): 624-652.

1730. Ding, lifeng, jun cheng, tong wang, junliang zhao, chongyan chen, and yulan niu. "**Continuous electrolytic refining process of cathode copper with non-dissolving anode**." minerals engineering 135 (2019): 21-28.

2.8 Cathode blank

1731. Rostamzadeh, f., g. R. Khayati, s. M. J. Khorasani, and n. Assadat yaghubi. "**Failure analysis of the handle of stainless steel cathode blank in copper electroforming process: cu core connection to 316l stainless steel sheath**." journal of failure analysis and prevention (2023): 1-12.

1732. Xu, youwei, xuqian hou, yu shi, wenzhu zhang, yufen gu, changgen feng, and korzhyk volodymyr. "**Correlation between the microstructure and corrosion behaviour of copper/316 l stainless-steel dissimilar-metal welded joints**." corrosion science 191 (2021): 109729.

1733. Filzwieser, i., a. Filzwieser, and r. Ofner. "**Geometric surface inspection for stainless steel cathode plates and copper cathodes**." bhm berg-und hüttenmännische monatshefte 155, no. 1 (2010): 7-11.

1734. Zhang, chi, and junyi wu. "**Selection of stainless steel for cathode plate in hydrometallurgical process**." world journal of engineering and technology 3, no. 3 (2015): 348-353.

1735. Eastwood, k. L., g. W. Whebell, and hunter street. "**Developments in permanent stainless steel cathodes within the copper industry**." proc. Cu2007 5 (2007): 35-46.

1736. Kemp, d. J., d. G. Shane, and r. Sutherland. "**improvements in the application of permanent cathode technology, paper from copper 95, volume iii, electrorefining and hydrometallurgy of copper, international conference held in santiago, chile, november 26-29, 1995**." papers (1995): 255-266.

1737. Nordlund, l., and h. Virtanen. "**Development of permanent cathode technology and related lifecycle solutions**." in proc. Base metals conf., pp. 89-98. 2013.

1738. Wiechmann, eduardo p., anibal s. Morales, pablo aqueveque, jorge a. Henriquez, esteban j. Pino, and leonardo g. Aburto. "**On the design robustness and long-term performance of the most used electrodes in the copper electrowinning industry**." ieee transactions on industry applications 52, no. 5 (2016): 4460-4469.

1739. Taylor, alan. "**The use of stainless and other high performance alloys in hydrometallurgical process plants for the recovery of metals**." presentation at the assda eighth national stainless steel conference, october, 2000.

1740. Pranowo, a., n. J. Aslin, p. O. Eriksson, and g. J. Heferen. "**Stainless steel "permanent" cathode plates-fixed assets or consumables?**."

1741. Aromaa, jari, antti kekki, and olof forsén. "**Corrosion of stainless steel cathode blanks in copper electrorefining**." in copper-cobre 2013, santiago, chile, 1-4.12. 2013. The chilean institute of mining engineers, 2013.

1742. Shojaei, mohammadreza, gholam reza khayati, seyed mohammad javad khorasani, and roya kafi hernashki. "**investigation of spring back phenomenon in the 316l stainless steel cathode blank based on the changes in electrical resistivity and magnetic properties due to the residual stress and martensite phase formation: an industrial failure**." engineering failure analysis 126 (2021): 105473.

1743. Zhou, z., and t. J. O'keefe. "**Electrodeposition of copper on thermally oxidized 316 l stainless steel substrates**." journal of applied electrochemistry 28 (1998): 461-469.

1744. Verbruggen, florian, erika fiset, luiza bonin, antonin prévoteau, michael s. Moats, tom hennebel, and korneel rabaey. "**Stainless steel substrate pretreatment effects on copper nucleation and stripping during copper electrowinning**." journal of applied electrochemistry 51 (2021): 219-233.

1745. Aromaa, jari, antti kekki, anna stefanova, and olof forsén. "**Copper nucleation and growth patterns on stainless steel cathode blanks in copper electrorefining**." journal of solid state electrochemistry 16 (2012): 3529-3537.

1746. Gladysz, o., and p. Los. "**The electrochemical nucleation of copper on disc-shaped ultramicroelectrode in industrial electrolyte**." electrochimica acta 54, no. 2 (2008): 801-807.

1747. Aromaa, jari, olof forsen, and antti kekki. "**Nucleation and growth of copper on stainless steel cathode blanks in electrorefining**." electrometallurgy 2012 (2012): 139-146.

1748. Teng, kuo-shi. **Electrolyte and substrate effects on copper nucleation**. University of missouri-rolla, 1995.

1749. Emekli, ugur, and alan c. West. "**Electrochemical nucleation of copper: the effect of poly (ethylene glycol)**." journal of the electrochemical society 157, no. 5 (2010): d257.

1750. Kim, s. B., k. T. Kim, c. J. Park, and hyuk-sang kwon. "**Electrochemical nucleation and growth of copper on chromium-plated electrodes**." journal of applied electrochemistry 32 (2002): 1247-1255.

1751. Dutra, a. J. B., and t. J. O'keefe. "**Copper nucleation on titanium for thin film applications**." journal of applied electrochemistry 29 (1999): 1217-1227.

1752. Marsden, t., and j. Jickling. "**The next generation of permanent cathode and lead anode technology**." in hydrometallurgy conference, pp. 249-256. 2009.

1753. Aromaa, jari, olof forsén, and antti kekki. "**Cathode blanks in electrorefining**." electrometallurgy 2012 (2012): 139.

1754. Zhu, hongqiu, lei peng, can zhou, yusi dai, and tianyu peng. "**An attention-based long short-term memory prediction model for working conditions of copper electrolytic plates**." measurement science and technology 34, no. 6 (2023): 065202.

1755. Donaldson, p. E., and p. J. Murphy. "**Kidd process permanent cathode technology advancements**." copper 99- cobre 99 (1999): 301-310.

1756. Milton, dafydd. "**Sampling refined copper cathode using a slotted punch system-a statistical evaluation**." in proceedings of emc, p. 1. 2001.

2.9 Cells

1757. Zeng, weizhi, shijie wang, michael l. Free, chong-jian tang, ruiyang xiao, and yanjie liang. "**design and modeling of an innovative copper electrolytic cell**." journal of the electrochemical society 165, no. 14 (2018): e798.

1758. Laitinen, ilkka. "**Modelling, simulation and optimization of a copper electrolysis cell group**." (2009).

2.10 Busbar

1759. Wiechmann, eduardo p., anibal s. Morales, pablo aqueveque, jorge a. Henríquez, and luis muñoz. "**3d FEM thermal and electrical analysis of copper electrowining intercell bars**." in 2015 ieee industry applications society annual meeting, pp. 1-7. Ieee, 2015.

1760. Boon, chris, rob fraser, tim johnston, and douglas robinson. "**Comparison of intercell contact bars for electrowinning plants**." ni-co 2013 (2016): 177-189.

1761. Vidal, g. A., e. P. Wiechmann, and a. J. Pagliero. "**Technological improvement in copper electrometallurgy: optibar segmented intercell bars (patent pending)**." canadian metallurgical quarterly 44, no. 2 (2005): 147-154.

1762. Wiechmann, eduardo, pablo aqueveque, jorge a. Henriquez, anibal s. Morales, and luis g. Munoz. "**An intercell busbar topology to surpass anomalies of copper electrorefining processes**." ieee transactions on industry applications 54, no. 5 (2018): 4977-4982.

1763. Wiechmann, eduardo p., pablo aqueveque, jorge a. Henríquez, and anibal morales. "**An intercell busbar topology to improve resilience to anomalies of copper electrorefining process**." in 2016 ieee industry applications society annual meeting, pp. 1-6. Ieee, 2016.

1764. Pohjoranta, antti, alexander mendelson, and robert tenno. "**A copper electrolysis cell model including effects of the ohmic potential loss in the cell**." electrochimica acta 55, no. 3 (2010): 1001-1012.

2.11 Minimizing energy consumption and maximizing current efficiency

1765. Shakibania, sina, mohammad mokmeli, and seyyed mohammad javad khorasani. "**Statistical analysis of factors affecting the anode scrap rate at the khatoon abad copper refinery plant**." metallurgical and materials transactions b (2022): 1-16.

1766. Mansouri, najme, gholam reza khayati, behnam mohammad hasani zade, seyed mohammad javad khorasani, and roya kafi hernashki. "**A new feature extraction technique based on improved owl search algorithm: a case study in copper electrorefining plant**." neural computing and applications 34, no. 10 (2022): 7749-7814.

1767. Moats, michael s. "**energy efficiency of electrowinning**." energy efficiency in the minerals industry: best practices and research directions (2018): 213-232.

1768. Burdett, ben w., and young c. Kim. "**Electrical network analysis in an electrolytic copper refinery**." metallurgical and materials transactions b 6 (1975): 19-29.

1769. Braun, t. B. "**Energy balances in the electrorefining and electrowinning of copper**." jom 33, no. 2 (1981): 59-67.

1770. Moats, m. "**How to evaluate current efficiency in copper electrowinning**." separation technologies for minerals, coal, and earth resources (2012): 333-339.

1771. Zhao, jingya, yi meng, chun li, and jun tie. "**The effect of nodulation on the distribution of concentration and current density during copper electrolytic refining**." in journal of physics: conference series, vol. 2285, no. 1, p. 012015. Iop publishing, 2022.

1772. Bauer, joseph, and michael moats. "**Analytical and approximate current distributions in the rotating cylinder hull cell**." journal of the electrochemical society 169, no. 12 (2022): 123504.

1773. Kim, s. K. "**control metallurgist copper refineries pty. Ltd. Townsville, north queensland 4810**." in energy reduction techniques in metal electrochemical processes: proceedings of a symposium, p. 365. American society of civil engineers, 1985.

1774. Zhou, s. "**copper electrolytic refining technology operating at high current density**." in proceedings of copper, vol. 5, pp. 333-344. 2013.

1775. Krusmark, timothy f. "**impact of anode chemistry on high current density operation at magma copper's electrolytic refinery**." in proc. Copper 95-cobre int. Conf. Vol. Iii-electrorefining and hydrometallurgy of copper, pp. 189-206. Cim, 1995.

1776. Choku, imai. "**Experiments on the process of anodic dissolution in electrolytic refining of copper-studies on electrolytic refining of copper at high current densities (2nd report)**." j. Mining and metallurgical inst. Japan 85, no. 974 (1969): 423-429.

1777. Morinaga, t. "**electrolytic refining of copper at high current density**." bull res inst miner dressing metall 25, no. 2 (1970): 151-158.

1778. Petrov, d. "**electrolytic copper refining at high current densities in copper refinery damianov g zlatitsa-pirdop-bulgaria**." in journal of metals, vol. 22, no. 12, p. A23. 420 commonwealth dr, warrendale, pa 15086: minerals metals materials soc, 1970.

1779. Petrov, d. A., l. T. Lachev, and j. D. Popov. "**Method for electrolytic refining of copper at high current densities (300–700 a/m2)**." bulgarian patent 10 (1963): 188.

1780. Badt, f. B. "**practical notes on the electrolytic refining of copper**." transactions of the american institute of electrical engineers 9, no. 1 (1892): 508-524.

1781. Furuta, m., and k. Haiki. "**Study of high current density copper electrolysis and the application to tamno refinery**." journal-mining and materials processing institute of japan 117, no. 5 (2001): 424-427.

1782. Kaltenboeck, fj, h. Woerz, and h. Woebking. "**On the influence of the current density on the cost structure of electrolytic copper refining: comparison between 330 a/m2 pcr electrolysis and 200 a/m2 direct current electrolysis**." metall (berlin, west) 38, no. 11 (1984): 1112-1116.

1783. Sedzimir, j. "**influence of current density on current efficiency of the electrochemical copper refining**." (1975).

1784. Kupfer, robert r. "**the casting of anodes for the series system of electrolytic copper refining**." (1949).

1785. Rodyushkin, v. V., a. G. Titarenko, and g. Serebrakov. "**Current efficiency prediction for copper electrolytic refining at increased current densities**." tsvetn. Metall. Nauchno-tekh. Sb. 5 (1980): 19-21.

1786. Krzysztofowicz, k. "**electrolytic refining of copper using high current densities**." rudy metale niezel 10, no. 5 (1965): 241-250.

1787. Fuentes, jc. "**operation with high current densities in the ventanas refinery**." in proc. Copper 95-cobre 95 int. Conf. Vol. Iii-electrorefining and hydrometallurgy of copper, pp. 287-292. Cim, 1995.

1788. Filzwieser, a., i. Filzwieser, s. Konetschnik, and a. Anzinger. "**Economic benefits of operating a copper electro-refining tankhouse at high current density using the mettop-**

brx technology." in proceedings of the conference of metallurgists (com 2014), vancouver, bc, canada, vol. 28. 2014.

1789. Petrescu, n., l. Ganovici, and m. Britchi. "**Research on the copper refining by periodically reversed current electrolysis**." metalurgia(bucharest) 37, no. 7 (1985): 343-348.

1790. Shreir, l. L., and j. W. Smith. "**Cathode polarization potential during electrodeposition of copper: ii. Variation of the cathode polarization potentials with current density and electrolyte concentration**." journal of the electrochemical society 99, no. 2 (1952): 64.

1791. Wobking, h. "**electrolytic copper refining with reversed currents (pcr process)**." extrolysis of nonferrous metals (1981): 201-213.

1792. Nielson, m. C. "**high current density operations at magma copper company's electrolytic refinery, paper from copper 91, volume 3, hydrometallurgy and electrometallurgy of copper, an international symposium held in ottawa, ontario, canada, august 18-21, 1991**." papers (1991): 509-515.

1793. Kubasov, v. L., a. D. Kaminskaya, and g. P. Miroevskii. "**Limiting currents for the separation of copper under the conditions of electro-refining**." tsvetn. Met. 2 (1990): 16-17.

1794. Wagner, mary-elizabeth, rodrigo valenzuela, tomás vargas, melanie colet-lagrille, and antoine allanore. "**Copper electrodeposition kinetics measured by alternating current voltammetry and the role of ferrous species**." journal of the electrochemical society 163, no. 2 (2015): d17.

1795. Titarenko, a. G., e. N. Smirnova, and b. N. Smirnov. "**Choice of the optimum electrolyte composition for the electrolytic refining of copper at high current densities**." tsvetn. Met. 9 (1979): 27-29.

1796. Nielson, m. C. "**high current density operations at magma copper company's electrolytic refinery**." copper 91(cobre 91) (1991).

1797. Dabroś, t., and m. Jaskuła. "**Current density optimization in the copper electrorefining process**." journal of applied electrochemistry 8, no. 6 (1978): 483-490.

1798. Aqueveque, pablo e., eduardo p. Wiechmann, and rolando p. Burgos. "**on the efficiency and reliability of high-current rectifiers**." in conference record of the 2006 ieee industry applications conference forty-first ias annual meeting, vol. 3, pp. 1290-1297. Ieee, 2006.

1799. Takasu, tomio, takashi nakamura, hideyuki ito, fumio noguchi, and jun'ichiro murabe. "**Effect of fluid motion of electrolyte on the behaviors of v group elements (as,**

sb, bi) in copper electrorefining under high current density." 資源と素材 115, no. 11 (1999): 841-846.

1800. Wiechmann, eduardo p., anibal a. Morales, pablo e. Aqueveque, and rolando p. Burgos. "**Measurement of cathodic currents in equipotential inter-cell bars for copper electrowinning and electrorefining plants**." in 2007 ieee industry applications annual meeting, pp. 2074-2079. Ieee, 2007.

1801. Granato, m., and pe praes. **"the effect of pulsating currents on the electrorefining of copper**, paper from copper 87, volume 3, hydrometallurgy and electrometallurgy of copper, international conference held in vina del mar, chile, november 30-december 3, 1987." books (1988).

1802. Aqueveque, pablo, eduardo p. Wiechmann, and anibal s. Morales. "**Measurement system of cathodic currents in electrorefining processes with multicircuital technology**." in 2009 ieee industry applications society annual meeting, pp. 1-5. Ieee, 2009.

1803. Fraser, rob, tim johnston, john yesberg, sebastien nolet, and chris boon. "**HELM tracker™ cathode current sensing technology**." ni-co 2013 (2016): 201-209.

1804. Wiechmann, eduardo p., luis g. Muñoz, pablo e. Aqueveque, guillermo a. Vidal, and jorge a. Henríquez. "**Introducing a bypass-backup connection system for current-mode copper electrowinning intercell bars**." ieee transactions on industry applications 50, no. 2 (2013): 1490-1495.

1805. Wiechmann, eduardo p., guillermo a. Vidal, and antonio j. Pagliero. "**Current-source connection of electrolytic cell electrodes: an improvement for electrowinning and electrorefinery**." ieee transactions on industry applications 42, no. 3 (2006): 851-855.

1806. Aqueveque, pablo e., eduardo p. Wiechmann, and aníbal s. Morales. "**System for the measurement of cathodic currents in electrorefining processes that employ multicircuital technology**." ieee transactions on industry applications 46, no. 5 (2010): 1764-1768.

1807. Stanković, v. D. "**limiting current density and specific energy consumption in electrochemical cells with inert turbulence promoters**." journal of applied electrochemistry 24, no. 6 (1994): 525-530.

1808. Tuddenham, wd, d. M. Lewis, j. M. Lebrizzi, w. A. Wood, and j. Brenza. "**Increased current density in electrorefining operati ons**." in electrometallurgy, tms extractive metallurgy division symposium proceedings, cleveland, ohio. 1968.

1809. Winand, r., and ph harlet. "**high-current density copper electrorefining**." transactions of the institution of mining and metallurgy section c-mineral processing and extractive metallurgy 101 (1992): c33-c44.

1810. Smith, gerald r. **Electrorefining copper at high current densities**. Vol. 8397. Department of the interior, bureau of mines, 1979.

1811. Jaskua, marian j. "**some remarks of the problem of current density optimization in copper electrorefining process**." electrochimica acta 28, no. 10 (1983): 1395-1406.

1812. Mccririck, a. "**the relative merits of periodic current reversal or direct current for new copper electrorefining tankhouses**." in 110 th aime meeting, p. 1981. 1981.

1813. Harvey, w. W. "**material balance and current efficiency in electrowinning**." hydrometallurgy 2, no. 1 (1976): 35-50.

1814. Werner, joshua m., w. Zeng, m. L. Free, z. Zhang, and j. Cho. "**Modeling and validation of local electrowinning electrode current density using two phase flow and nernst–planck equations**." journal of the electrochemical society 165, no. 5 (2018): e190.

1815. Jaskula, m. "**determination of the optimum current density in the process of copper electrorefining.(retroactive coverage)**." rudy met. Niezelaz. 28, no. 7 (1983): 250-255.

1816. Jaskula, m. "**the current density optimization in pcr copper electrorefining**." metall (internationale zeitschrift fuer technik und wirtschaft);(germany, fr) 44, no. 2 (1990).

1817. Gürmen, sebahattin, gökhan orhan, cüneyt arslan, and servet timur. "**Copper refining electrolysis at high current densities**." itu ari bulletin of istanbul technical university 54, no. 02 (2004): 40-44.

1818. Deconinck, johan. **Current distributions and electrode shape changes in electrochemical systems**. Vol. 75. Springer science & business media, 2012.

1819. Harvey, w. W., m. R. Randlett, and k. I. Bangerskis. "**High current density copper electrorefining and electrowinning in a series cell part i—electroretining**." jom 27, no. 7 (1975): 19-25.

1820. Meyer, edwin m. "**direct current requirements at carteret copper refinery supplied by three units**." jom 6, no. 7 (1954): 811-813.

1821. Kawai, s., y. Fukunaka, and s. Kida. "**Numerical calculation of transient current density distribution along vertical plane electrode in cuso4–h2so4 electrolyte solution**." journal of the electrochemical society 157, no. 3 (2010): f40.

1822. Denoiseux, r. F. "**energy saving in nonferrous tankhouses and electrorefining plants by infrared detection of short circuits**." extrolysis of nonferrous metals (1981): 437-453.

1823. Moreno-leiva, simón, felipe valencia, jannik haas, dimitrij chudinzow, and ludger eltrop. "**Solar energy alternatives for copper production**." in aip conference proceedings, vol. 2033, no. 1, p. 020006. Aip publishing llc, 2018.

1824. . Moreno-leiva, simón, gustavo díaz-ferrán, jannik haas, thomas telsnig, felipe a. Díaz-alvarado, rodrigo palma-behnke, willy kracht, roberto román, dimitrij chudinzow, and ludger eltrop. "**Towards solar power supply for copper production in chile: assessment of global warming potential using a life-cycle approach**." journal of cleaner production 164 (2017): 242-249.

2.12 Interelectrode short-circuit

1825. Zeng, qingyu, chun li, yi meng, jun tie, rentao zhao, and zhifang zhang. "**Analysis of interelectrode short-circuit current in industrial copper electrorefining cells**." measurement 164 (2020): 108015.

1826. Makipaa, esa, juha t. Tanttu, and henri virtanen. "**Ir-based system for short-circuit detection during copper electrorefining process**." in machine vision applications in industrial inspection vii, vol. 3652, pp. 2-9. Spie, 1999.

1827. Makipaa, esa, juha t. Tanttu, and henri virtanen. "**Ir-based method for copper electrolysis short circuit detection**." in thermosense xix: an international conference on thermal sensing and imaging diagnostic applications, vol. 3056, pp. 100-109. Spie, 1997.

1828. Titarenko, a. G., s. I. Korishch, and a. V. Pomosov. "**Means of preventing short circuits during electro-refining of copper**." tsvetn. Met. 1 (1981): 25-28.

1829. Mäkipää, esa. "**Comparison of the short-circuit measurement methods of the copper electrorefining process**." master's thesis (in finnish), tampere university of technology (1996).

1830. Jia, r. M., x. L. Ma, and w. Q. He. "**Infrared short-circuit detection for electrolytic copper refining**." in 2016 international conference on advanced electronic science and technology (aest 2016), pp. 844-851. Atlantis press, 2016.

1831. Li, xin, yonggang li, hongqiu zhu, and xiaoxu hu. "**An infrared image-based copper electrolysis short-circuit detection method using improved dog filter**." ifac-papersonline 51, no. 21 (2018): 82-87.

1832. Aqueveque, pablo e., eduardo p. Wiechmann, and rolando p. Burgos. "**Short-circuit detection for electrolytic processes employing optibar intercell bars**." ieee transactions on industry applications 45, no. 4 (2009): 1225-1231.

1833. Morales, anibal s., eduardo p. Wiechmann, pablo aqueveque, and esteban pino. "**Sliding window trend analysis: a method for short and open circuit detection in copper**

electrorefining." in 2010 ieee industry applications society annual meeting, pp. 1-5. Ieee, 2010.

1834. Hine, fumio. "**Voltage balance and energy balance in an electrolytic cell**." in electrode processes and electrochemical engineering, pp. 73-107. Boston, ma: springer us, 1985.

1835. Bautista, renato g., and Douglas s. Flett. **Energy considerations in electrohydrometallurgy**. No. Is-m-83; conf-761109-12. Warren spring lab., stevenage (uk), 1976.

1836. Somers, w. E., l. Kurylko, j. R. Stone, and m. L. Hughen. "**Energy use and energy conservation opportunities in copper refining-- a case study**." metallurgical society aime, (1981): 20.

1837. Pitt, charles h., and milton e. Wadsworth. "**Current energy requirements in the copper producing industries**." jom 33 (1981): 25-34.

1838. Somers, william e., lubomyr kurylko, john r. Stone, and marvin l. Hughen. "**A case study of energy conservation opportunities in copper refining**." jom 34, no. 7 (1982): 41-49.

1839. Moreno-leiva, simón, jannik haas, tobias junne, felipe valencia, hélène godin, willy kracht, wolfgang nowak, and ludger eltrop. "**Renewable energy in copper production: a review on systems design and methodological approaches**." journal of cleaner production 246 (2020): 118978.

1840. Li, xin, yonggang li, hongqiu zhu, renchao wu, and can zhou. "**Short circuit fault detection against high thermal background using a two-level scheme based on dog filter**." complexity 2021 (2021): 1-13.

1841. Li, xin, yonggang li, renchao wu, can zhou, and hongqiu zhu. "**Short circuit recognition for metal electrorefining using an improved faster r-cnn with synthetic infrared images**." frontiers in neurorobotics 15 (2021): 751037.

2.13 Treatment of electrolyte bleed

1842. Shojaei, mohammad reza, gholam reza khayati, and mohammad javad korasani. "**A sustainable approach to replace bleed stream in electrical refining of copper**." materials letters: x 16 (2022): 100169.

1843. Yi, w. A. N. G., l. I. U. Biao, xue-wen wang, yu-qi meng, xing-ming wang, and ming-yu wang. "**Separation and recovery of Ni from copper electrolyte by crystallization of nickel ammonium sulfate double salt**." transactions of nonferrous metals society of china 32, no. 11 (2022): 3780-3789.

1844. Ando, k., and n. Tsuchida. "**Recovering Bi and Sb from electrolyte in copper electrorefining**." jom 49, no. 12 (1997): 49-51.

1845. Jin, wei, paul i. Laforest, alex luyima, weldon read, luis navarro, and michael s. Moats. "**Electrolytic recovery of bismuth and copper as a powder from acidic sulfate effluents using an emew® cell**." rsc advances 5, no. 62 (2015): 50372-50378.

1846. Shojaei, m. R., g. R. Khayati, n. Assadat yaghubi, f. Bagheri sharebabaki, and s. M. J. Khorasani. "**Removing of sb and as from electrolyte in copper electrorefining process: a green approach**." international journal of engineering 34, no. 3 (2021): 700-705.

1847. Marković, radmila, jasmina s. Stevanović, milica m. Gvozdenović, branimir jugović, aleksandar grujić, dragutin nedeljković, and jasna stajić trošić. "**Treatment of waste copper electrolytes using insoluble and soluble anodes**." international journal of electrochemical science 8 (2013): 7357-7370.

1848. Marković, radmila, jasmina stevanović, milica gvozdenović, branimir jugović, and radojka jonović. "**Decopperization process of waste solutions from conventional copper electrolysis**." in proceedings of the 39th international conference of slovak society of chemical engineering, pp. 292-297. Tatranské matliare: slovak society of chemical engineering, 2012.

1849. Jarjoura, g., m. Muinonen, and g. J. Kipouros. "**Physicochemical properties of nickel copper sulfate solutions**." canadian metallurgical quarterly 42, no. 3 (2003): 281-288.

1850. Zheng, ya-jie, ying-lin peng, k. E. Lang, and wen-mi chen. "**Separation and recovery of Cu and As from copper electrolyte through electrowinning and SO2 reduction**." transactions of nonferrous metals society of china 23, no. 7 (2013): 2166-2173.

1851. Meshram, pratima, abhilash, and banshi dhar pandey. "**Advanced review on extraction of nickel from primary and secondary sources**." mineral processing and extractive metallurgy review 40, no. 3 (2019): 157-193.

1852. Cole, p. M., and a. M. Feather. **"a solvent-extraction process to recover copper and nickel from a tankhouse effluent, paper from copper 95, volume iii, electrorefining and hydrometallurgy of copper, international conference held in santiago, chile, november 26-29, 1995**." papers (1995): 607-616.

1853. Baradel, a., r. Guerriero, l. Meregalli, and i. Vittadini. "**Extraction of As from copper refining electrolyte**." jom 38, no. 2 (1986): 32-37.

1854. Arroyo-torralvo, f., a. Rodríguez-almansa, i. Ruiz, i. González, g. Ríos, c. Fernández-pereira, and l. F. Vilches-arenas. "**Optimizing operating conditions in an ion-exchange**

column treatment applied to the removal of sb and bi impurities from an electrolyte of a copper electro-refining plant." hydrometallurgy 171 (2017): 285-297.

1855. Moghimi nejad, fereshteh, abdolhamid jafari, hossein yoozbashi zadeh, and masood askari. "**An investigation on the adsorption behavior of sb (iii) on a cationic ion exchange resin in fixed-bed column: experimental design and breakthrough curves modeling**." journal of advanced materials and processing 8, no. 1 (2020): 30-45.

1856. Artzer, andrew, michael moats, and jack bender. "**Removal of antimony and bismuth from copper electrorefining electrolyte: part i—a review**." jom 70 (2018): 2033-2040.

1857. Hernández-pérez, l., j. Carrillo-abad, v. Pérez-herranz, m. T. Montañés, and m. C. Martí-calatayud. "**Effluents from the copper electrorefining as a secondary source of antimony: role of mass transfer on the recovery by electrodeposition**." desalination 549 (2023): 116322.

1858. Barros, kayo santana, andré luiz vargas machado, vicente schaeffer vielmo, svetlozar velizarov, jane zoppas ferreira, valentín pérez–herranz, and andréa moura bernardes. "**Membrane electrolysis for recovering sb and bi from elution solutions of ion-exchange resins used in copper electrorefining: a cyclic voltammetric study**." journal of electroanalytical chemistry 924 (2022): 116867.

1859. Díaz, eduardo, josé a. Maldonado calvo, j. M. Gallardo, and a. Paúl. "**Extraction of antimony from hydrochloric acid side stream of copper electrorefining by hydrolysis**." available at ssrn 4161829.

1860. Lagno, felipe, iván garcia, claudio ledesma, andrés reghezza, george p. Demopoulos, levente becze, mario gomez, and lydia katsarou. "**Fixation of arsenic and antimony from copper smelter flue dust and electrorefinery bleed-off as crystalline scorodite**." in proceedings of hydrocopper 2009 conference, antofagasta, chile, pp. 13-15. 2009.

1861. Agrawal, archana, d. Bagchi, s. Kumari, and b. D. Pandey. "**An overview of process options and behavioral aspects of the copper values recovered from the copper bleed stream of a copper smelter developed at the national metallurgical laboratory**." mineral processing & extractive metallurgy review 30, no. 2 (2009): 136-162.

1862. Agrawal, archana, m. K. Manoj, s. Kumari, d. Bagchi, vinay kumar, and b. D. Pandey. "**Extractive separation of copper and nickel from copper bleed stream by solvent extraction route**." minerals engineering 21, no. 15 (2008): 1126-1130.

1863. Nyirenda, r. L., and w. S. Phiri. "**The removal of nickel from copper electrorefining bleed-off electrolyte**." minerals engineering 11, no. 1 (1998): 23-37.

2.14 Treatment of slimes

1864. Furuzono, takahiro, atsushi fujimoto, tomohisa takeuchi, and kazuaki takebayashi. "**Unique hydrometallurgical process for copper-anode slime treatment at saganoseki smelter and refinery**." in extraction 2018: proceedings of the first global conference on extractive metallurgy, pp. 2075-2083. Springer international publishing, 2018.

1865. Xu, liang, dong yao, jindong he, xiaofeng zhang, yanhang xiong, zhongsheng hua, yongpan tian, and zhuo zhao. "**An efficient process for recycling of copper telluride residue out of copper anode slime**." journal of environmental chemical engineering 10, no. 3 (2022): 107987.

1866. Wang, shijie. "**An innovative hydrometallurgical process for recovery of critical and rare metals from copper anode slimes**." in rare metal technology 2023, pp. 53-59. Cham: springer nature switzerland, 2023.

1867. Wang, shixing, wei cui, gengwei zhang, libo zhang, and jinhui peng. "**Ultra fast ultrasound-assisted decopperization from copper anode slime**." ultrasonics sonochemistry 36 (2017): 20-26.

1868. Liu, jian, shixing wang, chenhui liu, libo zhang, and desong kong. "**Decopperization mechanism of copper anode slime enhanced by ozone**." journal of materials research and technology 15 (2021): 531-541.

1869. Li, zhangdi, fengxian qiu, qiong tian, xuejie yue, and tao zhang. "**Production and recovery of tellurium from metallurgical intermediates and electronic waste-a comprehensive review**." journal of cleaner production (2022): 132796.

1870. Ludvigsson, bjorn m., and stig r. Larsson. "**Anode slimes treatment: the boliden experience**." jom 55, no. 4 (2003): 41-44.

1871. Clark, c. W., and a. A. Heimrod. "**Recovery of precious metals from electrolytic copper refining: at the canadian copper refiners plant, montreal east, quebec**." transactions of the electrochemical society 61, no. 1 (1932): 77.

1872. Van lier, roy jm. "**Analysis of the first-stage leach process at inco ltd.'s copper refinery**." PhD diss., university of british columbia, 1996.

1873. Gabb, p. J., d. L. Howe, d. J. Purdie, and h. J. Woerner. **"the kennecott smelter hydrometallurgical impurities process, paper from copper 95, volume iii, electrorefining and hydrometallurgy of copper, international conference held in santiago, chile, november 26-29, 1995**." papers (1995): 591-606.

1874. Hoffmann, j. E., k. E. Sutliff, and b. Wells. "**hydrometallurgical processing of kennecott refinery slimes, paper from copper 95, volume iii, electrorefining and**

hydrometallurgy of copper, international conference held in santiago, chile, november 26-29, 1995." papers (1995): 41-57.

1875. Abdollahy, m., and n. M. Rice. "**Removal of barite from sar-cheshmeh copper anode slimes**."

1876. Zha, guozheng, bin yang, chongfang yang, xinyu guo, and wenlong jiang. "**Selective separation and recovery of valuable metals by vacuum distillation of copper anode slime flotation tailings**." jom 71 (2019): 2413-2419.

1877. Dehghanpoor, m. H., m. Zivdar, and m. Torabi. "**Extraction of copper and gold from anode slime of sarcheshmeh copper complex**." journal of the southern african institute of mining and metallurgy 116, no. 12 (2016): 1153-1157.

1878. Chen, t. T., and j. E. Dutrizac. "**Mineralogical overview of the behavior of gold in conventional copper electrorefinery anode slimes processing circuits**." mining, metallurgy & exploration 25, no. 3 (2008): 156-164.

1879. Chen, t. T., and j. E. Dutrizac. "**Mineralogical overview of the behavior of gold in conventional copper electrorefinery anode slimes processing circuits**." mining, metallurgy & exploration 25, no. 3 (2008): 156-164.

1880. Bard, gabrielle n., and luis gs sobral. "**Extraction of gold, silver and copper from the copper electrorefining anode slime: separation of the metals**." in global symposium on recycling, waste treatment and clean technology, pp. 141-148. 2008.

1881. Anderson, corby g., and todd s. Fayram. "**Recycle of precious metals utilizing copper based industrial pyrometallurgy and electrorefining**." journal of solid waste technology & management 40, no. 4 (2014).

1882. Abdollahy, m. "**the recovery of silver from sarcheshmeh copper anode slimes using hydrometallurgical method**." (2001).

1883. Cooper, w. Charles. "**The treatment of copper refinery anode slimes**." jom 42, no. 8 (1990): 45-49.

1884. Institution of mining and metallurgy and the society of chemical industry, j. E. Hoffmann, and bradford wesstrom. "**hydrometallurgical processing of refinery slimes at phelps dodge: theory to practice**." in hydrometallurgy'94: papers presented at the international symposium 'hydrometallurgy'94'organized by the institution of mining and metallurgy and the society of chemical industry, and held in cambridge, england, from 11 to 15 july, 1994, pp. 69-105. Springer netherlands, 1994.

1885. Kanari, ndue, eric allain, seit shallari, frédéric diot, sébastien diliberto, fabrice patisson, and jacques yvon. "**Thermochemical route for extraction and recycling of critical, strategic and high-value elements from by-products and end-of-life materials,**

part ii: processing in presence of halogenated atmosphere." materials 13, no. 18 (2020): 4203.

1886. Dönmez, bünyamin, cafer celik, sabri colak, and ahmet yartaşi. "**Dissolution optimization of copper from anode slime in H_2SO_4 solutions**." industrial & engineering chemistry research 37, no. 8 (1998): 3382-3387.

1887. Khanlarian, misagh, fereshteh rashchi, and mojtaba saba. "**A modified sulfation-roasting-leaching process for recovering se, cu, and ag from copper anode slimes at a lower temperature**." journal of environmental management 235 (2019): 303-309.

1888. Mahmoudi, alireza, sina shakibania, mohammad mokmeli, and fereshteh rashchi. "**Tellurium, from copper anode slime to high purity product: a review paper**." metallurgical and materials transactions b 51 (2020): 2555-2575.

1889. Shi, mei-qing, xiao-bo min, s. H. E. N. Chen, li-yuan chai, k. E. Yong, y. A. N. Xu, and yan-jie liang. "**Separation and recovery of copper in cu− as-bearing copper electrorefining black slime by oxidation acid leaching and sulfide precipitation**." transactions of nonferrous metals society of china 31, no. 4 (2021): 1103-1112.

1890. Xing, wei dong, seong ho sohn, and man seung lee. "**A review on the recovery of noble metals from anode slimes**." mineral processing and extractive metallurgy review 41, no. 2 (2020): 130-143.

1891. Li, baole, juhai deng, wenlong jiang, guozheng zha, and bin yang. "**Removal of arsenic, lead and bismuth from copper anode slime by a one-step sustainable vacuum carbothermal reduction process**." separation and purification technology 310 (2023): 123059.

1892. Chen, ailiang, zhiwei peng, jiann-yang hwang, yutian ma, xuheng liu, and xingyu chen. "**Recovery of silver and gold from copper anode slimes**." jom 67 (2015): 493-502.

1893. Dönmez, bünyamin, zafer ekinci, cafer celik, and sabri çolak. "**Optimisation of the chlorination of gold in decopperized anode slime in aqueous medium**." hydrometallurgy 52, no. 1 (1999): 81-90.

1894. Lee, jae-chun, kurniawan kurniawan, kyeong woo chung, and sookyung kim. "**Metallurgical process for total recovery of all constituent metals from copper anode slimes: a review of established technologies and current progress**." metals and materials international 27 (2021): 2160-2187.

1895. Zhu, wen, nengwu zhu, jinchan xian, yunhao xi, fei li, pingxiao wu, and yijun chen. "**A green process for simultaneously efficient base metals removal and precious metals enrichment from copper anode slime**." resources, conservation and recycling 180 (2022): 106200.

1896. Kurniawan, kurniawan, jae-chun lee, jonghyun kim, ha bich trinh, and sookyung kim. "**Augmenting metal leaching from copper anode slime by sulfuric acid in the presence of manganese (iv) oxide and graphite**." hydrometallurgy 205 (2021): 105745.

1897. Yang, hong-ying, xue-jiao li, lin-lin tong, zhe-nan jin, y. I. N. Lu, and guo-bao chen. "**Leaching kinetics of selenium from copper anode slimes by nitric acid-sulfuric acid mixture**." transactions of nonferrous metals society of china 28, no. 1 (2018): 186-192.

1898. Wen, xiaochun, pinqiang dai, jinliang wang, lei guo, and zhancheng guo. "**An environmentally-friendly method to recover silver, copper and lead from copper anode slime by carbothermal reduction and super-gravity**." minerals engineering 180 (2022): 107515.

1899. Li, xue-jiao, hong-ying yang, zhe-nan jin, lin-lin tong, and fa-xin xiao. "**Selenium leaching from copper anode slimes using a nitric acid–sulfuric acid mixture**." metallurgist 61 (2017): 348-356.

1900. Virolainen, sami. "**Hydrometallurgical recovery of valuable metals from secondary raw materials**." (2013).

1901. Li, xue jiao, hong ying yang, zhe nan jin, guo bao chen, and lin lin tong. "**Transformation of selenium-containing phases in copper anode slimes during leaching**." jom 69 (2017): 1932-1938.

1902. Zhen, tiantian, huan luo, lang liu, guozheng zha, bin yang, wenlong jiang, and baoqiang xu. "**Selective recovery of valuable metals (se, te, cu) from the selenium distillation residue by sulfuric acid oxidative leaching**." journal of sustainable metallurgy 8, no. 3 (2022): 1191-1203.

1903. Lei, l. I., song wang, guodong wu, heng wang, and shiding wang. "**extraction of platinum and gold from copper anode slimes by a process of chlorinating roasting first and chlorinating leaching followed**." journal of mining and metallurgy, section b: metallurgy 56, no. 2 (2020): 193-202.

1904. Bäckström, jonas. "**Copper, nickel and tellurium yields during leaching of anode slime**." (2010).

1905. Rüşen, aydin, s. A. Yildizel, and mehmet ali topçu. "**Metal recovery prediction of elements from anode slime**." international journal of environmental science and technology 16 (2019): 6797-6804.

1906. Navarro, luis, tracy morris, and weldon read. "**Detellurization process of copper anodic slimes leach liquor by cementation of tellurium using elemental copper**." in tt chen honorary symposium on hydrometallurgy, electrometallurgy and materials characterization, pp. 141-149. Hoboken, nj, usa: john wiley & sons, inc., 2012.

1907. Li, zhichao, dachun liu, guozheng zha, wenlong jiang, daxin huang, baoqiang xu, and bin yang. "**Efficient separation and recovery of tellurium and copper from copper telluride slag by an innovative process**." available at ssrn 4062568.

1908. Liu, gongqi, yufeng wu, aijun tang, and bin li. "**recovery of scattered and precious metals from copper anode slime by hydrometallurgy: a review**." hydrometallurgy 197 (2020): 105460.

1909. Liu, shuo, zijian su, yujuan cai, tao jiang, and yuanbo zhang. "**An efficient and clean method for the selective separation of arsenic from scrap copper anode slime containing high arsenic and tin**." journal of cleaner production 354 (2022): 131640.

1910. Xian, jinchan, nengwu zhu, wen zhu, jing wang, and pingxiao wu. "**A green and economical process for resource recovery from precious metals enriched residue of copper anode slime**." journal of cleaner production 369 (2022): 133341.

2.15 Recent developments and emerging trends in copper electrorefining

1911. Olper, m., m. Maccagni, r. Matusewicz, and m. A. Reuter. "**Simplified copper production from primary concentrates: the direct electrorefining of white metal/copper matte**." canadian metallurgical quarterly 47, no. 3 (2008): 369-376.

1912. Gana, r., m. Figueroa, l. Kattan, and s. Castro. "*Direct electrorefining of copper scrap using an anode-support system in a bipolar cell*." journal of applied electrochemistry 23 (1993): 813-818.

1913. Filzwieser, andreas, m. B. Hanel, i. Filzwieser, and s. Wallner. "**FAQS with regards to operating a cu er tankhouse above 400 a/m2 using mettop-brx technology**." in conference proceedings of copper cobre, vol. 2016. 2016.

1914. Bond, a. M., h. A. Hudson, p. A. Van den bosch, f. L. Walter, and h. R. A. Exelby. "**On-line monitoring with an ion-selective electrode in a high-volume flow-through cell**." analytica chimica acta 136 (1982): 51-59.

1915. Hidalgo-fort, eduardo, juan antonio gómez-galán, ramón gonzález-carvajal, pedro sánchez-cárdenas, and carlos clemente-maya. "**Battery-less industrial wireless monitoring and control system for improved operational efficiency**." sensors 23, no. 5 (2023): 2517.

1916. Atkinson, w. J., i. Auranen, d. J. Barratt, p. Berry, g. Pantaleoni, p. Piga, o. Sammarco et al. "**operation of an industrial pilot plant for copper electrorefining with the 'support-anode'system**." mining latin america/minería latinoamericana (1986): 131-134.

1917. Laezza, j., r. Box, and j. D. Scott. "**The kidd creek copper refinery**." in proceedings of the international symposium on electrometallurigical plant practice, pp. 3-19. Pergamon, 1990.

1918. Dinani, hossein t., enrique muñoz, and jeronimo r. Maze. "**Sensing electrochemical signals using a nitrogen-vacancy center in diamond**." nanomaterials 11, no. 2 (2021): 358.

1919. Muir, d. M., and g. Senanayake. "**Refining copper by the acetonitrile process**." hydrometallurgy 14, no. 3 (1985): 279-293.

1920. Vivero, enrique o., and avelino l. Castillo. "**Application of a continuous improvement focus on the operational**." in proceedings of the copper 95-cobre 95 international conference: november 26-29, 1995, santiago, chile. Electrorefining and hydrometallurgy of copper, vol. 3, p. 121. Canadian institute of mining, metallurgy and petroleum, 1995.

1921. Rantala, a., d. Kim, and s. Ko. "**Advanced wireless monitoring system for electrolytic cells**." ifac proceedings volumes 40, no. 11 (2007): 477-482.

1922. Castillo, paz, samir kouro, christian a. Rojas, and nicolás muller. "**Photovoltaic dc-dc converter for direct power interface to copper electrorefining process**." in iecon 2015-41st annual conference of the ieee industrial electronics society, pp. 004388-004393. Ieee, 2015.

1923. Andersen, t. N., r. C. Kerby, and t. J. O'keefe. "**Control techniques for industrial electrodeposition from aqueous solutions**." jom 37, no. 1 (1985): 36-43.

1924. Gładysz, olimpia, and przemysław łoś. "**Impedance studies of copper electro-reduction on a disc-shaped ultramicroelectrode in industrial electrolytes**." journal of applied electrochemistry 41 (2011): 713-719.

1925. Wheeler, archer e., and henry y. Eagle. "**The nkana copper refinery of rhokana corporation limited**." transactions of the electrochemical society 74, no. 1 (1938): 375.

1926. Barrios, p., a. Alonso, and c. Ortiz. "**productivity and quality improvements in the rio tinto minera(huelva) copper refinery, paper from copper 95, volume iii, electrorefining and hydrometallurgy of copper, international conference held in santiago, chile, november 26-29, 1995**." papers (1995): 93-102.

1927. Ajima, shun-ichi. "**Copper smelting and refining at naoshima smelter**." 資源と素材 (shigen-to-sozai) 109 (1993): 959-963.

1928. Navarro, luis g., tracy morris, weldon read, and krishna parameswaran. "**Metal sustainability from a manufacturing perspective: initiatives at asarco llc amarillo copper**

refinery." metal sustainability: global challenges, consequences, and prospects (2016): 397-423.

1929. Leigh, arthur h. "**kennecott copper corporation, utah refinery salt lake city, utah 84111**." in international symposium on hydrometallurgy, chicago, illinois, february 25-march 1, 1973: editors: dji evans and rs shoemaker, p. 95. American institute of mining, metallurgical, & petroleum engineers, 1972.

1930. O'rourke, brendan. "**Tank house expansion and modernisation of copper refineries ltd, townsville, australia**." in proceedings of alta conference 2000. 2000.

1931. Armstrong, wayne, and copper refineries. "**The isa process and its contribution to electrolytic copper**." rautomead coference, scotland (1999).

1932. Wilson, r., k. Perez, n. Toro, r. Parra, p. J. Mackey, and a. Navarra. "**Mine-to-smelter integration framework for regional development of porphyry copper deposits within the chilean context**." canadian metallurgical quarterly 61, no. 1 (2022): 48-62.

1933. Zen, hideki, tatsuo ishida, and makoto takagi. "**increase production and quality improvement of electrolytic copper at tank house in naoshima smelter & refinery**." minerals, metals and materials society/aime, 420 commonwealth dr., p. O. Box 430 warrendale pa 15086 usa.[np]. 14-18 feb (2010).

1934. Navarro, luis, roberto navarro-tovar, ronald bruening, and reed izatt. "**The application of green chemistry superlig® molecular recognition technology and other sustainable processes at copper electrorefineries**." in 2019-sustainable industrial processing summit, vol. 6, pp. 72-77. Flogen star outreach, 2019.

1935. Vivero, e. O., and a. L. Castillo. "**application of a continuous improvement focus on the operational management of the potrerillos refinery, paper from copper 95, volume iii, electrorefining and hydrometallurgy of copper, international conference held in santiago, chile, november 26-29, 1995**." papers (1995): 121-130.

1936. Coursol, pascal, tony leggett, and bill quesnel. "**Development of a mass balance model for the xstrata copper kidd refinery**." in hydrometallurgy 2008: proceedings of the sixth international symposium, honoring robert s. Shoemaker, p. 367. Sme, 2008.

1937. Agrawal, archana, and k. K. Sahu. "**Problems, prospects and current trends of copper recycling in india: an overview**." resources, conservation and recycling 54, no. 7 (2010): 401-416.

1938. Gana, r., m. Figueroa, l. Kattan, j. M. Sanchez, and m. A. Esteso. "**Anode-support system for the direct electrorefining of cement copper part i: process conditions using horizontal rotary cathodes**." journal of applied electrochemistry 25 (1995): 240-246.

1939. Barrios, p., a. Alonso, and c. Ortiz. "**Productivity and quality improvements in the rio tinto minera (huelva) copper refinery**." in proceedings of the copper 95-cobre 95 international conference: november 26-29, 1995, santiago, chile. Electrorefining and hydrometallurgy of copper, vol. 3, p. 93. Canadian institute of mining, metallurgy and petroleum, 1995.

1940. Jordan, t. L. "**process improvements at magma metals copper refinery, paper from copper 95, volume iii, electrorefining and hydrometallurgy of copper, international conference held in santiago, chile, november 26-29, 1995**." papers (1995): 113-117.

1941. Yamagiwa, masayuki. "**Copper smelting and refining at sumitomo toyo smelter and refinery**." journal of mmij 123, no. 12 (2007): 620-625.

1942. Acharya, sridhara. "**Copper refining electrolyte and slime processing-emerging techniques**." advanced materials research 828 (2014): 93-115.

1943. Forsén, olof, jari aromaa, and mari lundström. "**Primary copper smelter and refinery as a recycling plant—a system integrated approach to estimate secondary raw material tolerance**." recycling 2, no. 4 (2017): 19.

1944. Chooye[1], maambo, rakesh patel[1], addin pranowo, and brendan o'rourke. "**Copper refinery modernisation, mopani copper mines plc, mufulira, zambia**."

1945. Elena, pop, vasile hotea, and jozsef juhasz. "**Improvements to the technology for copper electrolysis**." scientific bulletin series d: mining, mineral processing, non-ferrous metallurgy, geology & environmental engineering 26, no. 1 (2012).

1946. Traulsen, h., b. Ruhl, and a. Shulte. "**Comparison of modern electrolytic copper refining concepts**." erzmetall 38, no. 12 (1985): 581-587.

1947. Stone, d. R., and j. P. Tuggle. "**process, productivity and quality improvements at the copper division of southwire, paper from copper 95, volume iii, electrorefining and hydrometallurgy of copper, international conference held in santiago, chile, november 26-29, 1995**." papers (1995): 103-111.

1948. Bosscher, j., and w. Berends. "**Advances in copper tankhouse automation**." in proceedings of the international symposium on electrometallurigical plant practice, pp. 271-279. Pergamon, 1990.

1949. Filzwieser, i., a. Filzwieser, j. Pesl, a. Anzinger, r. Stibich, and montanwerke brixlegg ag. "**Tankhous optimization by mettop GMBH**." in proceedings of emc, p. 1. 2007.

1950. Filzwieser, andreas, iris filzwieser, and stefan konetschnik. "**New technology for electrorefining of copper**." jom 64, no. 11 (2012): 1290-1295.

1951. Aslin, n. J., o. Eriksson, g. J. Heferen, and g. Sue yek. "**Developments in cathode stripping machines-an integrated approach for improved efficiency**." proceedings of cu (2010): 1.

1952. Harvey, w. W., m. R. Randlett, and k. I. Bangerskis. "**Exploratory development of air-agitation copper electrorefining**." jom 30, no. 7 (1978): 32-41.

1953. Thiriar, j., r. J. Geren, and h. Persson. "**Tankhouse modernization at CCR**." in proceedings of the international symposium on electrometallurigical plant practice, pp. 21-30. Pergamon, 1990.

1954. Fu, chen zhen. "**Improvements and technical process developments in cathode copper production at the yunnan smelter**." in proceedings of the international symposium on electrometallurigical plant practice, pp. 73-82. Pergamon, 1990.

1955. Amsden, m. P., r. M. Sweetin, and d. G. Treilhard. "**Selection and design of texasgulf canada's copper smelter and refinery**." jom 30, no. 7 (1978): 16-26.

1956. Wenzl, christine, andreas filzwieser, and stefan konetschnik. "**Mettop-BRX-technology—industrial application**." in tt chen honorary symposium on hydrometallurgy, electrometallurgy and materials characterization, pp. 63-76. John wiley & sons, inc. Hoboken, nj, 2012.

1957. Parada, r., l. Urrutia, and r. Weishaupt. "**improvements at the chuquicamata refinery tankhouses, paper from copper 95, volume iii, electrorefining and hydrometallurgy of copper, international conference held in santiago, chile, november 26-29, 1995**." papers (1995): 71-79.

1958. Gao, mingwei, philip arthur, and nigel aslin. "**Proven technologies from xstrata and their applications for copper smelting and refining in china**." in hainan conference, china, pp. 1-11. 2004.

1959. Filzwieser, a., i. Filzwieser, s. Wallner, and m. B. Hanel. "**METTOP-BRX technology—eliminating concerns and highlight potentials of the concept of tankhouse optimization**." in applications of process engineering principles in materials processing, energy and environmental technologies: an epd symposium in honor of professor ramana g. Reddy, pp. 115-127. Springer international publishing, 2017.

1960. Cruthers, a. L., and e. W. Hodkin. "**Mechanization of inco's copper cliff copper refinery tankhouse**." in proceedings of the international symposium on electrometallurigical plant practice, pp. 31-40. Pergamon, 1990.

1961. Sutliff, k. E., and t. I. Probert. "**kennecott utah copper refinery modernization, paper from copper 95, volume iii, electrorefining and hydrometallurgy of copper,**

international conference held in santiago, chile, november 26-29, 1995." papers (1995): 27-39.

1962. Cheng, xuan, and j. Brent hiskey. "**Characterization of copper anode surfaces**." in proceedings of the copper 95-cobre 95 international conference: november 26-29, 1995, santiago, chile. Electrorefining and hydrometallurgy of copper, vol. 3, p. 225. Canadian institute of mining, metallurgy and petroleum, 1995.

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Chapter 3

3 Dust recovery

3.1 Chemical and minerallogical characterization

1963. Okanigbe, Daniel Ogochukwu, A. P. I. Popoola, and Abraham A. Adeleke. "**Characterization of copper smelter dust for copper recovery**." Procedia Manufacturing 7 (2017): 121-126.

1964. Wang, Ling, Chen Yu, Xin Fu, Weijiao Yang, Baozhong Ma, Chengyan Wang, Chenchen Zhou, and Qing Zhang. "**Quantitative characterization of secondary copper flue dust and guidance for separating valuable and toxic elements via low-temperature roasting and selective leaching**." Minerals Engineering 189 (2022): 107871.

1965. Ettler, Vojtěch, Zdenek Johan, Bohdan Kříbek, František Veselovský, Martin Mihaljevič, Aleš Vaněk, Vít Penížek et al. "**Composition and fate of mine-and smelter-derived particles in soils of humid subtropical and hot semi-arid areas**." Science of the Total Environment 563 (2016): 329-339.

1966. Grudinsky, P. I., V. G. Dyubanov, and P. A. Kozlov. "**Copper smelter dust is a promising material for the recovery of nonferrous metals by the Waelz process**." Inorganic Materials: Applied Research 10 (2019): 496-501.

1967. Li, Xiang, Xueqian Wang, Bing Cai, Langlang Wang, Li Yuan, and Ping Ning. "**Investigation of heavy metal flows in a copper pyrometallurgical process of a typical smelter**." Process Safety and Environmental Protection 174 (2023): 214-222.

1968. González, A., O. Font, N. Moreno, X. Querol, N. Arancibia, and R. Navia. "**Copper flash smelting flue dust as a source of germanium**." Waste and Biomass Valorization 8 (2017): 2121-2129.

1969. Paz-Gómez, D. C., Silvia María Pérez-Moreno, I. Ruiz-Oria, G. Rios, and J. P. Bolivar. "**Characterization of Two Sludges from a Pyrometallurgical Copper Smelting Complex for Designing a Se and Pb Recovery Proposal**." Waste and Biomass Valorization 12 (2021): 2739-2755.

1970. Alguacil, Francisco José, Irene García-Díaz, Felix López, and Olga Rodríguez. "**Management of a copper smelter dust for copper profitability**."

1971. Sethurajan, Manivannan, Eric D. van Hullebusch, and Yarlagadda V. Nancharaiah. "**Biotechnology in the management and resource recovery from metal bearing solid wastes: Recent advances**." Journal of Environmental Management 211 (2018): 138-153.

1972. Ettler, Vojtěch, Ladislav Konečný, Lucie Kovářová, Martin Mihaljevič, Ondřej Šebek, Bohdan Kříbek, Vladimír Majer et al. "**Surprisingly contrasting metal distribution and fractionation patterns in copper smelter-affected tropical soils in forested and grassland areas (Mufulira, Zambian Copperbelt)**." Science of the total environment 473 (2014): 117-124.

1973. Potysz, Anna, Jakub Kierczak, Anna Pietranik, and Katarzyna Kądziołka. "**Mineralogical, geochemical, and leaching study of historical Cu-slags issued from processing of the Zechstein formation (Old Copper Basin, southwestern Poland)**." Applied Geochemistry 98 (2018): 22-35.

1974. Lanzerstorfer, Christof. "**Size Dependence of the Filter Dust Composition of a Secondary Copper Smelting Furnace**."

1975. ETTLER, Vojtech, Martina VITKOVA, Bohdan KRIBEK, and Martin MIHALJEVIC. "**Dust from metal smelters: mineralogy, leaching and contaminant bioaccessibility**." In XXth Anniversary Meeting of the Petrology Group of the Mineralogical Society of Poland, p. 39.

1976. Eatough, Delbert J., Norman L. Eatough, Max W. Hill, Nolan F. Mangelson, John Ryder, Lee D. Hansen, Robert G. Meisenheimer, and James W. Fischer. "**The chemical composition of smelter flue dusts**." Atmospheric Environment (1967) 13, no. 4 (1979): 489-506.

3.2 Copper extraction

1977. Morales, A., M. Cruells, A. Roca, and R. Bergó. "**Treatment of copper flash smelter flue dusts for copper and zinc extraction and arsenic stabilization**." Hydrometallurgy 105, no. 1-2 (2010): 148-154.

1978. Vítková, Martina, Vojtěch Ettler, Jiri Hyks, Thomas Astrup, and Bohdan Kříbek. "**Leaching of metals from copper smelter flue dust (Mufulira, Zambian Copperbelt)**." Applied Geochemistry 26 (2011): S263-S266.

1979. Ke, Jia-Jun, Rui-Yun Qiu, and Chia-Yung Chen. "**Recovery of metal values from copper smelter flue dust**." Hydrometallurgy 12, no. 2 (1984): 217-224.

1980. Gao, Wei, Bin Xu, Junkui Yang, Yongbin Yang, Qian Li, Bangsheng Zhang, Guiqing Liu, Yongpeng Ma, and Tao Jiang. "**Comprehensive recovery of valuable metals from copper smelting open-circuit dust with a clean and economical hydrometallurgical process**." Chemical Engineering Journal 424 (2021): 130411.

1981. Xu, Bin, Yongpeng Ma, Wei Gao, Junkui Yang, Yongbin Yang, Qian Li, and Tao Jiang. "**A review of the comprehensive recovery of valuable elements from copper smelting open-circuit dust and arsenic treatment**." Jom 72 (2020): 3860-3875.

1982. Liu, Wei-feng, Xin-xin Fu, Tian-zu Yang, Du-chao Zhang, and C. H. E. N. Lin. "**Oxidation leaching of copper smelting dust by controlling potential**." Transactions of Nonferrous Metals Society of China 28, no. 9 (2018): 1854-1861.

1983. Zhang, Yuhui, Bingjie Jin, Yinghong Huang, Qinghe Song, and Chengyan Wang. "**Two-stage leaching of zinc and copper from arsenic-rich copper smelting hazardous dusts after alkali leaching of arsenic**." Separation and Purification Technology 220 (2019): 250-258.

1984. Zhang, Yuhui, Xiaoyan Feng, Long Qian, Jin Luan, and Bingjie Jin. "**Separation of arsenic and extraction of zinc and copper from high-arsenic copper smelting dusts by alkali leaching followed by sulfuric acid leaching**." Journal of Environmental Chemical Engineering 9, no. 5 (2021): 105997.

1985. Yang, Tianzu, Xinxin Fu, Weifeng Liu, Lin Chen, and Duchao Zhang. "**Hydrometallurgical treatment of copper smelting dust by oxidation leaching and fractional precipitation technology**." JoM 69 (2017): 1982-1986.

1986. Ke, Yong, Chen Shen, Xiao-Bo Min, Mei-Qing Shi, and Li-Yuan Chai. "**Separation of Cu and As in Cu-As-containing filter cakes by Cu2+-assisted acid leaching**." Hydrometallurgy 172 (2017): 45-50.

1987. Caplan, Michael, Joseph Trouba, Corby Anderson, and Shijie Wang. "**Hydrometallurgical leaching of copper flash furnace electrostatic precipitator dust for the separation of copper from bismuth and arsenic**." Metals 11, no. 2 (2021): 371.

1988. Ríos, G., I. Ruiz, O. Rius, M. Cruells, and Antonio Roca. "**Leaching of copper from a flash furnace dust using sulfuric acid**." Mineral Processing and Extractive Metallurgy Review 43, no. 4 (2022): 411-421.

1989. Alguacil, Francisco Jose, Irene Garcia-Diaz, Felix Lopez, and Olga Rodriguez. "**Recycling of copper flue dust via leaching-solvent extraction processing**." Desalination and Water Treatment 56, no. 5 (2015): 1202-1207.

1990. Oráč, Dušan, Jakub Klimko, Dušan Klein, Jana Pirošková, Pavol Liptai, Tomáš Vindt, and Andrea Miškufová. "**Hydrometallurgical Recycling of Copper Anode Furnace Dust for a Complete Recovery of Metal Values**." Metals 12, no. 1 (2022): 36.

1991. Matkarimov, Sokhibjon Turdalievich, Dilfuza Odilovna Yavkochiva, Bahriddin Tilovkabulovich Berdiyarov, and Fakhriddin Djailolovich Nosirov. "**Hydrometallurgical processing of copper-smelting dust**." International Journal 8, no. 7 (2020).

1992. Lucheva, Biserka, Peter Iliev, and Dimitar Kolev. "**Hydro-pyrometallurgical treatment of copper converter flue dust**." Journal of Chemical Technology and Metallurgy 52, no. 2 (2017): 320-325.

1993. Zhang, Erjun, Kanggen Zhou, Xuekai Zhang, Yehuizi Wu, Jiajian Liu, Wei Chen, and Changhong Peng. "**Selective separation of copper and zinc from high acid leaching solution of copper dust using a sulfide precipitation-pickling approach**." Process Safety and Environmental Protection 156 (2021): 100-108.

1994. Ebrahimpour, Shahram, Hadi Abdollahi, Mahdi Gharabaghi, Zahra Manafi, and Olli H. Tuovinen. "**Acid bioleaching of copper from smelter dust at incremental temperatures**." Mineral Processing and Extractive Metallurgy Review 43, no. 2 (2022): 233-242.

1995. Adrados, Aitziber, Mikel Merchán, Alejandro Obregón, Antxon Artola, Jon Ander Iparraguirre, Maider García de Cortázar, David Eguizabal, and Hary Demey. "**Development of a Sustainable Metallurgical Process to Valorize Copper Smelting Wastes with Olive Stones-Based Biochar**." Metals 12, no. 10 (2022): 1756.

1996. Alguacil, Francisco Jose, and Magdalena Regel-Rosocka. "**Hydrometallurgical treatment of hazardous copper Cottrell dusts to recover copper**." Physicochemical Problems of Mineral Processing 54, no. 3 (2018): 771-780.

1997. Lee, Hyunju, Mooki Bae, Eunkyung Lee, and Brajendra Mishra. "**Copper extraction from flue dust of electronic waste by electrowinning and ion exchange process**." Jom 71 (2019): 2360-2367.

1998. Okanigbe, D. O., A. P. I. Popoola, and A. A. Adeleke. "**Hydrometallurgical processing of copper smelter dust for copper recovery as nano-particles: A review**." Energy Technology 2017: Carbon Dioxide Management and Other Technologies (2017): 205-226.

1999. Sahu, N. K., Barsha Dash, Suchismita Sahu, I. N. Bhattacharya, and T. Subbaiah. "**Extraction of copper by leaching of electrostatic precipitator dust and two step removal of arsenic from the leach liquor**." Korean Journal of Chemical Engineering 29 (2012): 1638-1642.

2000. Mamyachenkov, S. V., N. A. Khanzhin, O. S. Anisimova, and K. A. Karimov. "**Extraction of Nonferrous Metals and Arsenic from Thin Dusts of Copper Fuel Production by Combined Technology**." Russian Journal of Non-Ferrous Metals 62 (2021): 648-658.

2001. Okanigbe, D. O., A. P. I. Popoola, A. A. Adeleke, and O. M. Popoola. "**Upgrading the copper value in a waste copper smelter dust with the falcon gravity concentrator**." In Energy Technology 2018: Carbon Dioxide Management and Other Technologies, pp. 283-295. Springer International Publishing, 2018.

2002. Okanigbe, Daniel O., Michael K. Ayomoh, Olawale M. Popoola, Patricia A. Popoola, and Victor S. Aigbodion. "**Oxidative roasting experimentation and optimum predictive model development for copper and iron recovery from a copper smelter dust**." Results in Engineering 7 (2020): 100125.

2003. Okanigbe, Daniel, Popoola Olawale, Abimbola Popoola, Adeleke Abraham, Ayomoh Michael, and Kolesnikov Andrei. "**Centrifugal separation experimentation and optimum predictive model development for copper recovery from waste copper smelter dust**." Cogent Engineering 5, no. 1 (2018): 1551175.

2004. Okanigbe, Daniel Ogochukwu, Abimbola Patricia Popoola, and Abraham Adewale Adeleke. "**Pre-treatment of Waste Copper Dust (I): Potential of Oxidative Roasting–Density Separation–Sulphuric Acid Leaching Technology for Copper Recovery**." In Resource Recovery and Recycling from Waste Metal Dust, pp. 31-51. Cham: Springer International Publishing, 2023.

2005. Magwanyana, Zenzele, Daniel Ogochukwu Okanigbe, Abimbola Patricia Popoola, and Abraham Adewale Adeleke. "**Extraction of Copper Oxide (I): Purified CuSO4 Solution**." In Resource Recovery and Recycling from Waste Metal Dust, pp. 79-105. Cham: Springer International Publishing, 2023.

2006. Okanigbe, D. O., A. P. I. Popoola, A. A. Adeleke, I. O. Otunniyi, and O. M. Popoola. "**Investigating the impact of pretreating a waste copper smelter dust for likely higher recovery of copper**." Procedia Manufacturing 35 (2019): 430-435.

2007. Li, Xuepeng, Juan Wang, and Jun Chang. "**Selective Separation of Arsenic from Arsenic-bearing Copper Dust by Vulcanization Reduction**." In Journal of Physics: Conference Series, vol. 2437, no. 1, p. 012032. IOP Publishing, 2023.

2008. Ivšić-Bajčeta, Dragana, Željko Kamberović, Jelena Rogan, Milorad Ćirković, and Toplica Pavlović. "**Analysis of copper losses throughout weak acid effluent flows generated during off-gas treatment in the New Copper Smelter RTB Bor**." Metallurgical & Materials Engineering 19, no. 3 (2013): 217-231.

2009. Alguacil, Francisco José, Irene García-Díaz, Félix Antonio López Gómez, O. Rodriguez, and Manuel Alonso Gámez. "**Recycling of a copper flue dust via leaching-solvent extraction processing**." (2013).

2010. Wen, Yan. "**Study on Leaching of Dust of Copper Flash Smelting Furnace**." (2015).

2011. He, Xuwen, Zhen Chai, Jingjing Shi, Yan Li, Zengqiang Fang, and Fuping Li. "**Leaching of elements from flue dust produced in copper scrap smelting process**." Toxicological & Environmental Chemistry 95, no. 6 (2013): 932-941.

2012. Xu, Zhi-feng, L. I. Qiang, and Hua-ping Nie. "**Pressure leaching technique of smelter dust with high-copper and high-arsenic**." Transactions of nonferrous metals society of China 20 (2010): s176-s181.

2013. Zhang, xing-fei, y. U. A. N. Jia, t. I. A. N. Jia, hai-sheng han, s. U. N. Wei, y. U. E. Tong, y. A. N. G. Yue, w. A. N. G. Li, xue-feng cao, and cheng-long lu. "**Ultrasonic-enhanced selective sulfide precipitation of copper ions from copper smelting dust using monoclinic pyrrhotite**." transactions of nonferrous metals society of china 32, no. 2 (2022): 682-695.

2014. Gonzalez-Montero, Pablo, Nieves Iglesias-Gonzalez, Rafael Romero, Alfonso Mazuelos, and Francisco Carranza. "**Recovery of zinc and copper from copper smelter flue dust. Optimisation of sulphuric acid leaching**." Environmental technology 41, no. 9 (2020): 1093-1100.

3.3 Arsenic removal

2015. Zhang, Wenjuan, Jianyong Che, Liu Xia, Peicheng Wen, Jun Chen, Baozhong Ma, and Chengyan Wang. "**Efficient removal and recovery of arsenic from copper smelting flue dust by a roasting method: Process optimization, phase transformation and mechanism investigation**." Journal of Hazardous Materials 412 (2021): 125232.

2016. Henao, Hector, Ignacio Paredes, Rodrigo Diaz, and Javier Ortiz. "**Pyrometallurgical Removal of Arsenic from Electrostatic Precipitators Dusts of Copper Smelting**." Journal of Minerals and Materials Characterization and Engineering 9, no. 06 (2021): 545.

2017. Henao, Hector, Ignacio Paredes, Rodrigo Diaz, and Javier Ortiz. "**Pyrometallurgical Removal of Arsenic from Dusts Collected in Electrostatic Precipitators of Copper, Part I-Dust from a Flash Smelting Furnace**." (2020).

2018. Zheng, Guangya, Jupei Xia, Hailang Liu, and Zhengjie Chen. "**Arsenic removal from acid extraction solutions of copper smelting flue dust**." Journal of Cleaner Production 283 (2021): 125384.

2019. Guo, Li, Jirong Lan, Yaguang Du, Tian C. Zhang, and Dongyun Du. "**Microwave-enhanced selective leaching of arsenic from copper smelting flue dusts**." Journal of hazardous materials 386 (2020): 121964.

2020. Jarošíková, Alice, Vojtěch Ettler, Martin Mihaljevič, Petr Drahota, Adam Culka, and Martin Racek. "**Characterization and pH-dependent environmental stability of arsenic trioxide-containing copper smelter flue dust**." Journal of environmental management 209 (2018): 71-80.

2021. Chen, Ya, Ting Liao, Gaibian Li, Baizhen Chen, and Xichang Shi. "**Recovery of bismuth and arsenic from copper smelter flue dusts after copper and zinc extraction**." Minerals Engineering 39 (2012): 23-28.

2022. Guo, Li, Zhongqiu Hu, Yaguang Du, Tian C. Zhang, and Dongyun Du. "**Mechanochemical activation on selective leaching of arsenic from copper smelting flue dusts**." Journal of Hazardous Materials 414 (2021): 125436.

2023. Zhang, Wenjuan, Jianyong Che, Peicheng Wen, Liu Xia, Baozhong Ma, Jun Chen, and Chengyan Wang. "**Co-treatment of copper smelting flue dust and arsenic sulfide residue by a pyrometallurgical approach for simultaneous removal and recovery of arsenic**." Journal of Hazardous Materials 416 (2021): 126149.

2024. Ha, Tae Kyung, Bok Hyun Kwon, Kye Sun Park, and Debasish Mohapatra. "**Selective leaching and recovery of bismuth as Bi2O3 from copper smelter converter dust**." Separation and Purification Technology 142 (2015): 116-122.

2025. Shi, Tengteng, Jilin He, Rongbo Zhu, Bin Yang, and Baoqiang Xu. "**Arsenic removal from arsenic–containing copper dust by vacuum carbothermal reduction–vulcanization roasting**." Vacuum 189 (2021): 110213.

2026. Chen, Yujie, Shun Zhu, Pekka Taskinen, Ning Peng, Bing Peng, Ari Jokilaakso, Hui Liu, Yanjie Liang, Zongwen Zhao, and Zhongbing Wang. "**Treatment of high-arsenic copper smelting flue dust with high copper sulfate: Arsenic separation by low temperature roasting**." Minerals Engineering 164 (2021): 106796.

2027. Kritskii, Aleksei, and Stanislav Naboichenko. "**Hydrothermal treatment of arsenopyrite particles with $CuSO_4$ solution**." Materials 14, no. 23 (2021): 7472.

2028. Zhang, Yuhui, Xiaoyan Feng, and Bingjie Jin. "**An effective separation process of arsenic, lead, and zinc from high arsenic-containing copper smelting ashes by alkali leaching followed by sulfide precipitation**." Waste Management & Research 38, no. 11 (2020): 1214-1221.

2029. Li, Lei, Fuyou Wang, Dapeng Zhong, Cheng Tan, and Yong Yu. "**Separation and recovery of antimony from high arsenic-bearing flue dusts through selective oxidation using MnO_2.**" ISIJ International 57, no. 3 (2017): 581-586.

2030. Li, Xuepeng, Dachun Liu, Juan Wang, and Jianxun Song. "**Selective removal of arsenic from arsenic-containing copper dust by low-temperature carbothermal reduction**." Separation Science and Technology 55, no. 1 (2020): 88-97.

2031. Li, Qingzhu, Xinting Lai, Zhenxing Liu, Fei Chai, Fei-ping Zhao, Cong Peng, and Yanjie Liang. "**Selective Removal of Arsenic from Copper Smelting Flue Dusts by Alkaline Thiourea Leaching**." Available at SSRN 4231145.

2032. Xie, Rongsheng, Tingting Xu, Ni Yang, and Lin Tian. "**Study on Existence Speciation and Distribution Characteristics of Arsenic and Mercury in Smelting Dust**." (2019).

2033. Qian, W. A. N. G., G. U. O. Li, W. U. Chenjie, and D. U. Dongyun. "**Arsenic removal from copper smelting ash assisted by microwave induced oxidation process**." Chinese Journal of Environmental Engineering 11, no. 11 (2017): 6072-6077.

2034. Suarez Garcia, Carlos. "**Immobilization of arsenic from copper smelter waste**." Master's thesis, 2016.

2035. Yurkevich, Nataliya V., Olga P. Saeva, and Nadezhda A. Pal'chik. "**Arsenic mobility in two mine tailings drainage systems and its removal from solution by natural geochemical barriers**." Applied geochemistry 27, no. 11 (2012): 2260-2270.

2036. Siyar, R., F. Doulati Ardejani, M. Farahbakhsh, M. Yavarzadeh, and S. Maghsoudy. "**Application of Phytoremediation to Reduce Environmental Pollution of Copper Smelting and Refinery Factories: a Review**." Journal of Mining and Environment 11, no. 2 (2020): 517-537.

2037. Li, Xiang, Xingwang Zhang, Ruixin Ma, Shina Li, Xiaoyong Zhang, Fan Yang, and Weishuang Zhao. "**Study on Process for Preparing High Purity Bismuth Oxide from Copper Converter Dust**." (2016).

2038. WANG, Qin-meng, Xue-yi GUO, Qing-hua TIAN, Sheng-li QU, W. A. N. G. Zhi, and Ming-xing HUANG. "**Thermodynamic modeling of antimony removal from complex resources in copper smelting process**." Transactions of Nonferrous Metals Society of China 32, no. 12 (2022): 4113-4128.

2039. stoyanova, verka, eduard stefanov, bogomila planska, radina dimitrova, irina valtcheva, milen kadiyski, and vanya stoyanova. "**Arsenic removal in a stable form from industrial wastewater in the copper industry**." journal of chemical technology & metallurgy 57, no. 5 (2022).

2040. Dalewski, Frank. "**Removing arsenic from copper smelter gases**." Jom 51, no. 9 (1999): 24-26.

2041. Li, Yongkui, Xing Zhu, Xianjin Qi, Bo Shu, Xin Zhang, Kongzhai Li, Yonggang Wei, Fengyan Hao, and Hua Wang. "**Efficient removal of arsenic from copper smelting wastewater in form of scorodite using copper slag**." Journal of Cleaner Production 270 (2020): 122428.

2042. Li, Cong, Rong Liang Zhang, Jia Zeng, Chao Fan Tang, Wei Zhang, Rui-Xiang Yang, Jin-Tao Cao et al. "**Leaching and Removal of Arsenic with Waste Acids from Arsenic Pre-Removed Dusts Discharged from Furnaces for Pyrometallurgical Refining of Copper**."

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Chapter 4

4 Slag treatment

4.1 Pyro or Hydrometallurgy

2043. Zhang, Changda, Bin Hu, Minge Yang, Guiqing Zhang, Shijie Zhao, Zhiqin Liao, Qiuxiang Liu, and Mingyu Wang. "**Comprehensive Utilization of Copper Slag in a Pyro-Hydrometallurgical Process for Iron Phase Reconstruction and Valuable Metals Recovery**." In New Directions in Mineral Processing, Extractive Metallurgy, Recycling and Waste Minimization: An EPD Symposium in Honor of Patrick R. Taylor, pp. 275-283. Cham: Springer Nature Switzerland, 2023.

2044. Phiri, Tina Chanda, Pritam Singh, and Aleksandar N. Nikoloski. "**The potential for copper slag waste as a resource for a circular economy: A review–Part I**." Minerals Engineering 180 (2022): 107474.

2045. Phiri, Tina Chanda, Pritam Singh, and Aleksandar N. Nikoloski. "**The potential for copper slag waste as a resource for a circular economy: A review–Part II**." Minerals Engineering 172 (2021): 107150.

2046. Habib, Aqsa, Haq Nawaz Bhatti, and Munawar Iqbal. "**Metallurgical processing strategies for metals recovery from industrial slags**." Zeitschrift für Physikalische Chemie 234, no. 2 (2020): 201-231.

2047. Guo, Zhengqi, Deqing Zhu, Jian Pan, Tengjiao Wu, and Feng Zhang. "**Improving beneficiation of copper and iron from copper slag by modifying the molten copper slag**." Metals 6, no. 4 (2016): 86.

2048. Zhou, Wentao, Xiao Liu, Xianjun Lyu, Wenhao Gao, Huili Su, and Chuanming Li. "**Extraction and separation of copper and iron from copper smelting slag: A review**." Journal of Cleaner Production (2022): 133095.

2049. Klaffenbach, Eric, Victor Montenegro, Muxing Guo, and Bart Blanpain. "**Sustainable and Comprehensive Utilization of Copper Slag: A Review and Critical Analysis**." Journal of Sustainable Metallurgy (2023): 1-29.

2050. Gabasiane, Tlotlo Solomon, Gwiranai Danha, Tirivaviri Mamvura, Tebogo Mashifana, and Vusumuzi Sibanda. "**Application of Attainable Region Technique to Optimize Copper Slag's Desired Size Class**." Minerals 13, no. 1 (2023): 19.

2051. Zhao, Zongwen, Zhongbing Wang, Ning Peng, Bing Peng, Yanjie Liang, Shengli Qu, Zhunqing Dong, and Weizhi Zeng. "**Copper behavior and fayalite microstructure changes influenced by Cu_2O dissolution**." JOM 71 (2019): 2891-2898.

2052. Guo, Zhengqi, Jian Pan, Deqing Zhu, and Yang Congcong. "**Mechanism of composite additive in promoting reduction of copper slag to produce direct reduction iron for weathering resistant steel**." Powder Technology 329 (2018): 55-64.

4.2 Hydrometallurgical Treatment

2053. Urosevic, Daniela M., Mile D. Dimitrijevic, Zoran D. Jankovic, and Dejan V. Antic. "**Recovery of copper from copper slag and copper slag flotation tailings by oxidative leaching**." Physicochemical Problems of Mineral Processing 51 (2015).

2054. Carranza, F., N. Iglesias, A. Mazuelos, R. Romero, and O. Forcat. "**Ferric leaching of copper slag flotation tailings**." Minerals Engineering 22, no. 1 (2009): 107-110.

2055. Potysz, Anna, Eric D. van Hullebusch, and Jakub Kierczak. "**Perspectives regarding the use of metallurgical slags as secondary metal resources–a review of bioleaching approaches**." Journal of environmental management 219 (2018): 138-152.

2056. Potysz, Anna, and Jakub Kierczak. "**Prospective (bio) leaching of historical copper slags as an alternative to their disposal**." Minerals 9, no. 9 (2019): 542.

2057. Dimitrijevic, Mile D., Daniela M. Urosevic, Zoran D. Jankovic, and Snezana M. Milic. "**Recovery of copper from smelting slag by sulphation roasting and water leaching**." Physicochemical problems of mineral processing 52 (2016).

2058. Kaksonen, Anna H., Silja Särkijärvi, Esa Peuraniemi, Saku Junnikkala, Jaakko A. Puhakka, and Olli H. Tuovinen. "**Metal biorecovery in acid solutions from a copper smelter slag**." Hydrometallurgy 168 (2017): 135-140.

2059. Kaksonen, Anna H., Silja Särkijärvi, Jaakko A. Puhakka, Esa Peuraniemi, Saku Junnikkala, and Olli H. Tuovinen. "**Chemical and bacterial leaching of metals from a smelter slag in acid solutions**." Hydrometallurgy 159 (2016): 46-53.

2060. Seyrankaya, Abdullah. "**Pressure leaching of copper slag flotation tailings in oxygenated sulfuric acid media**." ACS omega 7, no. 40 (2022): 35562-35574.

2061. Zhang, Hui-bin, Yu-zheng He, Jing-jing Hu, Ya-nan Wang, Hua-zhen Cao, Z. H. O. U. Jun, and Guo-qu Zheng. "**Assessment of selective sequential extraction procedure for determining arsenic partitioning in copper slag**." Transactions of Nonferrous Metals Society of China 30, no. 10 (2020): 2823-2835.

2062. Tao, Lei, Langlang Wang, Kanghuai Yang, Xueqian Wang, Lu Chen, and Ping Ning. "**Leaching of iron from copper tailings by sulfuric acid: behavior, kinetics and mechanism**." RSC advances 11, no. 10 (2021): 5741-5752.

2063. Dimitrijevic, Mile D., Daniela M. Urošević, Snežana M. Milić, Miroslav D. Sokić, and Radmila T. Marković. "**Dissolution of copper from smelting slag by leaching in chloride media**." Journal of Mining and Metallurgy, Section B: Metallurgy 53, no. 3 (2017): 407-407.

2064. Faghihi, A., M. Gholinejad, E. Rahimi, and A. Adib. "**Investigation of the Leaching of Sarcheshmeh Reverberatory Furnace Slag Using Hydrogen Peroxide and Hematite Nano Particles**." Journal of Mineral Resources Engineering 6, no. 4 (2021): 141-154.

2065. Mussapyrova, Lyazzat, Rashid Nadirov, Peter Baláž, Michal Rajňák, Radovan Bureš, and Matej Baláž. "**Selective room-temperature leaching of copper from mechanically activated copper smelter slag**." Journal of Materials Research and Technology 12 (2021): 2011-2025.

2066. Mikoda, Bartosz, Anna Potysz, and Ewa Kmiecik. "**Bacterial leaching of critical metal values from Polish copper metallurgical slags using Acidithiobacillus thiooxidans**." Journal of environmental management 236 (2019): 436-445.

2067. Kart, Elif Uzun, Zeynep Hazal Yazğan, and Aleyna Gümüşsoy. "**Investigation of iron selectivity behavior of copper smelter slag flotation tailing with hematitization baking and base metals leaching methods**." Physicochemical Problems of Mineral Processing 57, no. 5 (2021).

2068. Behera, Sunil Kumar, Sandeep Kumar Panda, and Antoine-Floribert Mulaba-Bafubiandi. "**Valorization of copper smelter slag through the recovery of metal values by a synergistic bioprocess system of bio-flotation and bio-leaching**." Environmental Quality Management 32, no. 1 (2022): 233-241.

4.3 Slag flotation

2069. Alp, İ. B. R. A. H. İ. M., H. A. C. I. Deveci, and H. Süngün. "**Utilization of flotation wastes of copper slag as raw material in cement production**." Journal of hazardous materials 159, no. 2-3 (2008): 390-395.

2070. Roy, Subrata, Amlan Datta, and Sandeep Rehani. "**Flotation of copper sulphide from copper smelter slag using multiple collectors and their mixtures**." International Journal of Mineral Processing 143 (2015): 43-49.

2071. Stanojlovic, Rodoljub D., and Jovica M. Sokolovic. "**A study of the optimal model of the flotation kinetics of copper slag from copper mine Bor**." Archives of Mining Sciences 59, no. 3 (2014).

2072. Sarrafi, A., B. Rahmati, H. R. Hassani, and H. H. A. Shirazi. "**Recovery of copper from reverberatory furnace slag by flotation**." Minerals Engineering 17, no. 3 (2004): 457-459.

2073. Linsong, Wang, Gao Zhiyong, Tang Honghu, Wang Li, Han Haisheng, Sun Wei, Qu Yongbao, and Yang Yue. "**Copper recovery from copper slags through flotation enhanced by sodium carbonate synergistic mechanical activation**." Journal of Environmental Chemical Engineering 10, no. 3 (2022): 107671.

2074. Li, Siwei, Jian Pan, Deqing Zhu, Zhengqi Guo, Jiwei Xu, and Jianlei Chou. "**A novel process to upgrade the copper slag by direct reduction-magnetic separation with the addition of Na_2CO_3 and CaO**." Powder Technology 347 (2019): 159-169.

2075. Gabasiane, Tlotlo S., Gwiranai Danha, Tirivaviri Augustine Mamvura, Tebogo Mashifana, and Godfrey Dzinomwa. "**Characterization of copper slag for beneficiation of iron and copper**." Heliyon 7, no. 4 (2021): e06757.

2076. Guo, Zhengqi, Deqing Zhu, Jian Pan, Weijie Yao, Wuqi Xu, and Jinan Chen. "**Effect of Na_2CO_3 addition on carbothermic reduction of copper smelting slag to prepare crude Fe-Cu alloy**." Jom 69 (2017): 1688-1695.

2077. Guo, Zhengqi, Deqing Zhu, Jan Pan, and Feng Zhang. "**Mechanism of mineral phase reconstruction for improving the beneficiation of copper and iron from copper slag**." JOM 68 (2016): 2341-2348.

2078. Piatak, Nadine M., Vojtěch Ettler, and Darryl Hoppe. "**Geochemistry and mineralogy of slags**." In Metallurgical Slags, pp. 59-124. 2021.

2079. Gümüşsoy, Aleyna, Mikail Başyiğit, and Elif Uzun Kart. "**Economic potential and environmental impact of metal recovery from copper slag flotation tailings**." Resources Policy 80 (2023): 103232.

2080. Gao, Xiang, Zhuo Chen, Junjie Shi, Pekka Taskinen, and Ari Jokilaakso. "**Effect of cooling rate and slag modification on the copper matte in smelting slag.**" Mining, Metallurgy & Exploration 37, no. 5 (2020): 1593-1601.

2081. Grudinsky, P. I., E. S. Podjelnikova, and V. G. Dyubanov. "**Research on the process of sulphatizing roasting of copper slag flotation tailings using iron sulphates**." In IOP Conference Series: Earth and Environmental Science, vol. 459, no. 4, p. 042004. IOP Publishing, 2020.

2082. Sit'ko, Ye A., B. M. Sukurov, G. S. Ruzakhunova, B. A. Omirzakov, and A. E. Bajduisenova. "**Comprehensive processing of converter slag**." Kompleksnoe Ispolzovanie Mineralnogo Syra 305, no. 2 (2018): 45-57.

2083. Kapobe, Jackson, Charles Mazala, and Richard Phiri. "**Kitwe Black Mountain-Is Zambia realising the true value from it?**." Journal of Natural and Applied Sciences 3, no. 1 (2019): 62-72.

2084. Park, Jayhyun, Uikyu Choi, Hongil Choe, and Shunghan Shin. "**Characteristic of flotation for recovery of copper from copper slag in Kazakhstan**." Resources Recycling 24, no. 4 (2015): 12-21.

2085. Matkarimov, S. T., B. T. Berdiyarov, S. K. Nosirkhujayev, K. T. Ochildiyev, and B. L. Marjorie. "**Processing of slags of copper manufacturing with the use of ideal mixing equipment**." Technical science and innovation 2020, no. 3 (2020): 227-234.

2086. Aatach, Mohamed, Kadiyski Milen, Viktor Stoilov, Evgeni Visariev, and Stoyan Gaydardzhiev. "**Process Oriented Characterisation of Copper Slag Processed by Flotation in View Metals Recovery**." In 7th International Slag Valorisation Symposium. 2021.

2087. Mahdi, Bahaa Sami, and Asaad Hasan Lafta. "**Recovery of Copper from Copper Slag by Hydrometallurgy Method, from Iraqi Factories Waste**." Journal of University of Babylon for Pure and Applied Sciences 26, no. 7 (2018): 179-199.

2088. Zhou, Huihui, Guijian Liu, Liqun Zhang, and Chuncai Zhou. "**Mineralogical and morphological factors affecting the separation of copper and arsenic in flash copper smelting slag flotation beneficiation process**." Journal of Hazardous Materials 401 (2021): 123293.

2089. Guo, Zhengqi, Jian Pan, Deqing Zhu, and Feng Zhang. "**Green and efficient utilization of waste ferric-oxide desulfurizer to clean waste copper slag by the smelting reduction-sulfurizing process**." Journal of Cleaner Production 199 (2018): 891-899.

2090. Xia, Longgong, Shuheng Cao, Qihou Li, Xingwu Lu, and Zhihong Liu. "**Co-treatment of copper smelting slag and gypsum residue for valuable metals and sulfur recovery**." Resources, Conservation and Recycling 183 (2022): 106360.

2091. Nuorivaara, Ted, Anna Klemettinen, and Rodrigo Serna-Guerrero. "**Improving the flotation recovery of Cu from flash smelting slags by utilizing cellulose-based frother formulationss**." Minerals Engineering 181 (2022): 107522.

2092. Liu, Runqing, Qilin Zhai, Chen Wang, Xiong Li, and Wei Sun. "**Optimizing the crystalline state of Cu slag by Na2CO3 to improve Cu recovery by flotation**." Minerals 10, no. 9 (2020): 820.

2093. Wang, Qikai, Hongwen Ma, Meitang Liu, Ruoyu Guo, and Ge Liu. "**A new method of full resource utilization of copper slag**." Hydrometallurgy 212 (2022): 105899.

2094. Liu, Xiaomin, Bin Li, and Yufeng Wu. "**The pretreatment of non-ferrous metallurgical waste slag and its research progress in the preparation of glass-ceramics**." Journal of Cleaner Production (2023): 136930.

2095. Hagiri, Masahide, and Kazufumi Honda. "**Preparation and evaluation of gypsum plaster composited with copper smelter slag**." Cleaner Engineering and Technology 2 (2021): 100084.

2096. Xu, Lei, Dongye Zhang, Yang Liu, and Min Chen. "**Iron Recovery from Waste Copper Slag by Using Coal and Secondary Aluminum Dross as Co-Reductants**." JOM 74, no. 5 (2022): 2029-2036.

2097. Wang, Da-wei, Yan-jie Liang, Zhang Lin, Cong Peng, and Bing Peng. "**Comprehensive recovery of zinc, iron and copper from copper slag by co-roasting with SO2–O2**." Journal of Materials Research and Technology 19 (2022): 2546-2555.

2098. Li, Jialei, Yalong Liao, Haifei Ma, Qingfeng Liu, and Yue Wu. "**Review on Comprehensive Recovery Valuable Metals and Utilization of Copper Slag**." Journal of Sustainable Metallurgy (2023): 1-20.

2099. Tsunazawa, Yuki, Changzhi Liu, Ryutaro Toi, Takahiko Okura, and Chiharu Tokoro. "**Crystal formation and growth by slow cooling for recovery of magnetite particles from copper smelting slag**." Mineral Processing and Extractive Metallurgy 128, no. 4 (2019): 248-255.

2100. Štirbanović, Zoran, Daniela Urošević, Milica Đorđević, Jovica Sokolović, Nemanja Aksić, Novka Živadinović, and Sandra Milutinović. "**Application of Thionocarbamates in Copper Slag Flotation**." Metals 12, no. 5 (2022): 832.

2101. Pan, Qing-qing, and Hui-qing Peng. "**Effect of copper and iron ions on the sulphidizing flotation of copper oxide in copper smelting slag**." Advances in Materials Science and Engineering 2018 (2018).

2102. Cao, Shuheng, Zhihong Liu, Xingwu Lu, Leru Zhang, Qihou Li, and Longgong Xia. "**The Phase Transition and Element Distribution of Copper Smelting Slag in the Cooling—Sulfidation Process**." Metallurgical and Materials Transactions B 54, no. 2 (2023): 969-979.

2103. XIE, Renqi, Run HUANG, Shifan ZHAO, Jingpiao YANG, and Jinzhu ZHANG. "**Research progress on resource utilization of copper slag**." Conservation and Utilization of Mineral Resources 40, no. 6 (2020): 149-154.

2104. Jordaan, Thomas Ignatius. "**Investigating the role of dithiophosphate in the flotation of base metal sulfides**." Master's thesis, University of Cape Town, 2018.

2105. Pan, Qing-Qing, and Hui-Qing Peng. "**Effect of copper and iron ions on the sulphidizing floatation of copper in copper smelting slag**." In IOP Conference Series: Earth and Environmental Science, vol. 186, no. 3, p. 012011. IOP Publishing, 2018.

2106. Sabanova, m. N., n. N. Orekhova, o. E. Gorlova, and i. V. Glagoleva. "**The effect of dialkyldithiophosphate reagents on copper flotation from pyritic slags**." izvestiya vuzov. Tsvetnaya metallurgiya (izvestiya. Non-ferrous metallurgy) 4 (2018): 4-14.

2107. Stanojlovic, rodoljub, jovica sokolovic, marko gusevac, ivan anđelovic, goran stojic, and novka zivadinovic. "**Sustainability of copper slag processing from new flash copper smelter in rtb bor**." quaestus 9 (2016): 42.

2108. Sarfo, Prince, Avimanyu Das, Gary Wyss, and Courtney Young. "**Recovery of metal values from copper slag and reuse of residual secondary slag**." Waste Management 70 (2017): 272-281.

2109. Zuo, Zongliang, Yan Feng, Xinjiang Dong, Siyi Luo, Dongdong Ren, Wenhao Wang, Yuxi Wu, Qingbo Yu, Huan Lin, and Xiaoqing Lin. "**Advances in recovery of valuable metals and waste heat from copper slag**." Fuel Processing Technology 235 (2022): 107361.

2110. Das, Bisweswar, Barada Kanta Mishra, Shivakumar Angadi, Siddharth Kumar Pradhan, Sandur Prakash, and Jayakrushna Mohanty. "**Characterization and recovery of copper values from discarded slag**." Waste Management & Research 28, no. 6 (2010): 561-567.

2111. Ashelford, Michael, and Damian B. Gore. "**Elemental and mineralogical constraints on environmental contamination from slag at Gulf Creek copper mine**." Minerals Engineering 154 (2020): 106407.

2112. Bulut, Gülay. "**Recovery of copper and cobalt from ancient slag**." Waste management & research 24, no. 2 (2006): 118-124.

2113. Shamsi, Mostafa, Mohammad Noaparast, Seied Ziadin Shafaie, and Mahdi Gharabaghi. "**Synergism effect of collectors on copper recovery in flotation of copper smelting slags**." Geosystem Engineering 19, no. 2 (2016): 57-68.

2114. Dong, Haidong, Yonggang Wei, Shiwei Zhou, Bo Li, and Hua Wang. "**Cracking of waste cooking oil in the presence of copper slag**." Sustainable Chemistry and Pharmacy 22 (2021): 100482.

2115. Bulut, Gülay, K. T. Perek, Alim Gül, Fatma Arslan, and Güven Önal. "**Recovery of metal values from copper slags by flotation and roasting with pyrite**." Mining, Metallurgy & Exploration 24 (2007): 13-18.

2116. Stirbanovic, Zoran M., and Zoran S. Markovic. "**The effect of copper bearing particles liberation on copper recovery from smelter slag by flotation**." Separation Science and Technology 46, no. 16 (2011): 2496-2500.

2117. Yang, Xu, Jialiang Zhang, Jiankun Zhang, Juntao Hu, Jiangtao Li, Lifeng Zhang, Yongqiang Chen, and Chengyan Wang. "**Efficient recovery of copper and cobalt from the matte–slag mixture of ISA furnace by injection of coke and pyrite**." Metallurgical and Materials Transactions B 49 (2018): 3118-3126.

2118. Živković, Ž., N. Mitevska, I. Mihajlović, and Đ. Nikolić. "**Copper losses in sulfide concentrate smelting slag are dependent on slag composition**." Mining, Metallurgy & Exploration 27 (2010): 141-147.

2119. Selivanov, E. N., R. I. Gulyaeva, L. Yu Udoeva, V. V. Belyaev, and A. A. Pankratov. "**Effect of the cooling rate on the phase composition and structure of copper matte converting slags**." Russian Metallurgy 2009, no. 4 (2009): 281.

2120. Markovic, Zoran, Zoran Stirbanovic, Dragan Milanovic, Daniela Urosevic, and Florian Kongoli. "**Microscopy analysis of copper slag and its processing by flotation**." Proceedings of the 2014—Sustainable Industrial Processing Summit, Paphos, Cyprus 29 (2014): 231-236.

2121. Dordevic, Predrag, Zivan Zivkovic, Ivan Mihajlovic, and Nada Strbac. "**Statistical modeling of the copper losses in the reverberatory furnace slag**." Metalurgia International 16, no. 10 (2011): 120.

2122. Voisin, Leandro, Camila Pizarro, and Julio Ossandón. "**Determination of the behaviour of valuable metals during the controlled cooling of copper smelting slags to clarify their recovery by grinding and flotation**." In 5th International Slag Valorisation Symposium. https://cutt. ly/BzBJ7TM. 2017.

2123. Nikolić, Ivica P., Isidora M. Milošević, Nenad N. Milijić, and Ivan N. Mihajlović. "**Cleaner production and technical effectiveness: Multi-criteria analysis of copper smelting facilities**." Journal of Cleaner Production 215 (2019): 423-432.

2124. Murari, Krishna, Rafat Siddique, and K. K. Jain. "**Use of waste copper slag, a sustainable material**." Journal of Material Cycles and Waste Management 17 (2015): 13-26.

4.4 copper slag as replacement material

2125. Rashad, Alaa M. "**A Brief Review on Blast-Furnace Slag and Copper Slag as Fine Aggregate in Mortar and Concrete Based on Portland Cement**." Reviews on Advanced Materials Science 44, no. 3 (2016).

2126. Madheswaran, C. K., P. S. Ambily, J. K. Dattatreya, and N. P. Rajamane. "**Studies on use of copper slag as replacement material for river sand in building constructions**." Journal of the Institution of Engineers (India): Series A 95 (2014): 169-177.

2127. Hwang, Chao-Lung, and Jaw-Chang Laiw. "**Properties of concrete using copper slag as a substitute for fine aggregate**." Special Publication 114 (1989): 1677-1696.

2128. Sharma, Rahul, and Rizwan A. Khan. "**Durability assessment of self compacting concrete incorporating copper slag as fine aggregates**." Construction and Building Materials 155 (2017): 617-629.

2129. Ali, Mohammad M., Satish K. Agarwal, and Ashwani Pahuja. "**Potentials of copper slag utilisation in the manufacture of ordinary Portland cement**." Advances in cement research 25, no. 4 (2013): 208-216.

2130. Kubissa, Wojciech, Roman Jaskulski, Pui-Lam Ng, and Jiajian Chen. "**Utilisation of copper slag waste and heavy-weight aggregates for production of pre-cast shielding concrete elements**." Journal of Sustainable Architecture and Civil Engineering 22, no. 1 (2018): 39-48.

2131. Tandel, Yogendra K., and Jignesh B. Patel. "**Review of utilisation of copper slag in highway construction**." Australian Geomechanics 44, no. 3 (2009): 71.

2132. Al-Jabri, Khalifa S., Makoto Hisada, Salem K. Al-Oraimi, and Abdullah H. Al-Saidy. "**Copper slag as sand replacement for high performance concrete**." Cement and Concrete Composites 31, no. 7 (2009): 483-488.

2133. Wu, Wei, Weide Zhang, and Guowei Ma. "**Optimum content of copper slag as a fine aggregate in high strength concrete**." Materials & Design 31, no. 6 (2010): 2878-2883.

2134. Ayano, Toshiki, and Kenji Sakata. "**Durability of concrete with copper slag fine aggregate**." In 5th International CanMET/ACI Conference on Durability of Concrete 2000, pp. 141-157. American Concrete Institute, 2000.

2135. Al-Jabri, Khalifa S., Abdullah H. Al-Saidy, and Ramzi Taha. "**Effect of copper slag as a fine aggregate on the properties of cement mortars and concrete**." Construction and Building Materials 25, no. 2 (2011): 933-938.

2136. Ambily, P. S., C. Umarani, K. Ravisankar, Prabhat Ranjan Prem, B. H. Bharatkumar, and Nagesh R. Iyer. "**Studies on ultra high performance concrete incorporating copper slag as fine aggregate**." Construction and Building Materials 77 (2015): 233-240.

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