मुंबई विद्यापीठ

UNIVERSITY OF MUMBAI

आम्ही मुंबई विद्यापीठाचे कुलपती, कुलगुरू आणि व्यवस्थापन परिषदेचे सदस्य असे प्रमाणित करतो की युनिव्हर्सिटी डिपार्टमेंट ऑफ केमिकल टेकनॉलॉजीचे अमोल अरविंदराव कुलकर्णी, हे मे १९९८ मध्ये घेण्यात आलेली रासायनिक अभियांत्रिकी स्नातक परीक्षा प्रथम श्रेणीत उत्तीर्ण झाले असून दिनांक २ डिसेंबर १९९८ रोजी मुंबई येथे झालेल्या दीक्षांत समारंभात त्यांना रासायनिक अभियांत्रिकी स्नातक ही पदवी प्रदान करण्यात आली आहे.

विद्यापीठाची मुद्रा व कुलपतींची स्वाक्षरी यांसह साक्षीने अंकित.

We, the Chancellor, Vice-Chancellor and Members of the Management Council of the University of Mumbai certify that ***Amol Arvindrao Kulkarni*** *of the* ***University Department of Chemical Technology*** *having passed the* ***Bachelor of Chemical Engineering*** *degree examination held in May 1998 in the* ***First Class****, the degree of* ***Bachelor of Chemical Engineering*** *has been conferred on him at the Convocation held in Mumbai on 2nd December, 1998.*

In testimony whereof are set the Seal of the said University and the signature of the said Chancellor.

कुलपती CHANCELLOR

98-BCHE-31

मुंबई विद्यापीठ

UNIVERSITY OF MUMBAI

आम्ही मुंबई विद्यापीठाचे कुलपती, कुलगुरू आणि व्यवस्थापन परिषदेचे सदस्य असे प्रमाणित करतो की **युनिव्हर्सिटी डिपार्टमेंट ऑफ केमिकल टेकनॉलॉजीचे अमोल अरविंदराव कुलकर्णी,** हे जून २००० मध्ये घेण्यात आलेली **रासायनिक अभियांत्रिकी अधिस्नातक** परीक्षा **प्रथम श्रेणीत विशेष** प्राविण्यासह **गुणवत्तापूर्वक** उत्तीर्ण झाले असून दिनांक २२ डिसेंबर २००० रोजी मुंबई येथे झालेल्या दीक्षांत समारंभात त्यांना **रासायनिक अभियांत्रिकी अधिस्नातक** ही पदवी प्रदान करण्यात आली आहे.

विद्यापीठाची मुद्रा व कुलगुरूंची स्वाक्षरी यांसह साक्षीने अंकित.

We, the Chancellor, Vice-Chancellor and Members of the Management Council of the University of Mumbai certify that ***Amol Arvindrao Kulkarni of the University Department of Chemical Technology*** *having passed the* ***Master of Chemical Engineering*** *degree examination held in June 2000 with* ***Honours in the First Class with Distinction,*** *the degree of* ***Master of Chemical Engineering*** *has been conferred on him at the Convocation held in Mumbai on 22nd December, 2000.*

In testimony whereof are set the Seal of the said University and the signature of the said Vice-Chancellor.

कुलगुरू VICE-CHANCELLOR

2000-MCHE-6

मुंबई विद्यापीठ

UNIVERSITY OF MUMBAI

आम्ही मुंबई विद्यापीठाचे कुलपती, कुलगुरू आणि व्यवस्थापन परिषदेचे सदस्य असे प्रमाणित करतो की **मुंबई विद्यापीठ - इन्स्टिटयूट ऑफ केमिकल टेकनॉलॉजीचे अमोल अरविंदराव कुलकर्णी** यांनी ऑक्टोबर २००३ मध्ये **विद्यावाचस्पती (तंत्रविद्या)** पदवीसाठी **रसायन अभियांत्रिकी** या विषयात सादर केलेला प्रबंध परीक्षकांनी तपासून स्वीकृत केला असून दिनांक १८ डिसेंबर २००४ रोजी मुंबई येथे झालेल्या दीक्षांत समारंभात त्यांना **विद्यावाचस्पती (तंत्रविद्या)** ही पदवी प्रदान करण्यात आली आहे.

विद्यापीठाची मुद्रा व कुलगुरूंची स्वाक्षरी यांसह साक्षीने अंकित.

We, the Chancellor, Vice-Chancellor and Members of the Management Council of the University of Mumbai certify that ***Amol Arvindrao Kulkarni*** *of* ***University of Mumbai - Institute of Chemical Technology*** *having presented in October 2003, a Thesis for the degree of* ***Doctor of Philosophy (Technology) in Chemical Engineering****, which has been accepted by the Examiners, the degree of* ***Doctor of Philosophy (Technology)*** *has been conferred on him at the Convocation held in Mumbai on 18th December, 2004.*

In testimony whereof are set the Seal of the said University and the signature of the said Vice-Chancellor.

Vijay Khole

2004-PHTE-9

कुलगुरू VICE-CHANCELLOR

Resume

Name: **Dr. AMOL A. KULKARNI**

Present Address : Chem. Eng. & Proc. Dev. Division
National Chemical Laboratory
Dr. Homi Bhabha Road,
Pashan, Pune – 411008, INDIA

E-mail : aa.kulkarni@ncl.res.in, amol.kulkarni@gmail.com

Phone : 91-20-25902153 (O), 91-9881235277 (Mobile)

Fax : 91 20 25902621

Date of Birth : December 3rd, 1976

Employment:

- Since April, 2005 – till date Scientist in the Chem. Eng. Proc. Dev. Division at CSIR-National Chemical Laboratory, Pune
  - April, 2005 – April 2009: Scientist C
  - April, 2009 – April 20012: Scientist E-1
  - April 2012 – April 2016: Senior Scientist (E-II)
  - April 2016 – till date: Senior Principal Scientist (F)

Visiting Research Fellowships:

- **IUSSTF Research Fellow** at Department of Chemical Engineering, Massachusetts Institute of Technology (MIT), Cambridge, MA, USA (Jan – June 2010)
- **Humboldt Research Fellow** (January 2004 – March 2005): Max Planck Inst. for Dynamics of Complex Technical Systems (Magdeburg, Germany)

ACADEMIC QUALIFICATION

Degree	Year	Institution	Class
Ph. D. (Tech., Chem. Eng.)	2003	Inst. of Chem T	A Grade
(Title: Transport Phenomena & Non-Linear Dynamics in Multiphase Systems: Guide: Professor J. B. Joshi)			
M. Chem. Engg.	2000	UDCT	First Class with Distinction
(Title: Design of Multiphase Process Devices (Research Guide: Professor J. B. Joshi)			
B. Chem. Engg.	1998	UDCT[1]	First Class

ACHIEVEMENTS

- Shanti Swaroop Bhatnagar Award in Engineering Sciences (2020)
- Dr. A. V. Rama Rao Chair Professor in CSIR (2020-2023)
- CPILA-Hamid Process of the Year award (2019), NCL Research Foundation
- Selection Committee Member, Humboldt Foundation, Bonn (Germany) (2018-2023)
- Prof. C. V. Sheshadri Distinguished Memorial lecture at IIT-Kanpur (Nov 2017)
- VASVIK award for 'Chemical Sciences & Technology' for the year 2016
- Swarna Jayanti Fellowship (2015) by Dept. of Sci. Tech. (GoI)
- Technology of the Year Award (2016) by NCL Research Foundation
- OPPI Young Scientist Award (2015) by Org. of Pharmaceutical Producers in India

[1] University Department of Chemical Technology (UDCT), Mumbai was renamed as Institute of Chemical Technology (ICT) on January 26, 2009 and is a Deemed University

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- Scientist of the Year Award (2013) by the National Chemical Laboratory, Pune
- CSIR Young Scientist Award (2011)
- Young Associate of the Indian Academy of Sciences (2011)
- Indian National Science Academy's (INSA) Medal for Young Scientist (2009)
- INAE Young Engineer Award 2009 from Indian National Academy of Engineering
- Indo-US Science and Technology Forum Research Fellowship (IUSSTF) 2009-2010 for doing research at Massachusets Institute of Technology (MIT), Cambridge, USA
- Max-Planck-Visiting Fellowship by the Max-Planck-Society (Germany) 2008-11.
- Humboldt Research Fellowship by AvH Foundation, Germany for the Postdoctoral work at Max Planck Institute (Jan 2004-March 2005).
- Ambuja Cement Best Ph.D. Thesis Award in UICT for 2003-2004.
- 'Innovative Potential of Students Projects Awards-2001' by Indian National Academy of Engineering (INAE) for the Masters' Thesis.
- Awarded with 'The Best M. Chem. Eng. Thesis Award' in UDCT for 2000-2001.
- Recipient of National Merit Scholarship (1992-1998).
- Among the top rankers in 10^{th} and 12^{th} standard in the state of Maharashtra.

- Regional Editor, Journal of Flow Chemistry (Kluwar Scientific)
- Regional Editor, Advanced Powder Technology (Elsevier Sci.)
- Member of Advisory Board of Reaction Chemistry and Engineering (RSc)
- *Scientific Reviewer* for almost all journals in chemical engineering, process development, process intensification and also for Physics of Fluids, J. Fluid Mechanics, Eu. Journal of Organic Chemistry, Organic Process Research & Development, ACS Omega, etc.

- Member of the Project Selection Committee (Chemical Engineering Group), Research Foundation - Flanders (FWO), Belgium (2020-2022)

RESEARCH INTERESTS:

- Microreaction technology: microfluidics, design, modelling and experimentation
- Process development and scale-up of flow reactors
- Continuous synthesis and manufacturing of API, dyes, agrochemicals, pigments and nanomaterials
- Experimental and computational fluid dynamics of multiphase reactors and design
- Flow visualization and analysis of diffused and reacting interfaces

PUBLICATIONS

1. Shukla C. A., Kute, M. and Kulkarni, A. A. (2021) Towards Sustainable Continuous Production of Azo Dyes: Possibilities and Techno-Economic Analysis, Green Chemistry (Just accepted)
2. Deshpande J. B.; Chakraborty, S. and Kulkarni, A. A. (2021) Heterogeneous Nucleation in Citrate Synthesis of AgNPs: Effect of Mixing and Solvation Dynamics, Chemical Engineering Journal, 421(2), 127753
3. Atpalkar, R. S.; Athvale, P.; Reddy, D. S. and Kulkarni, A. A. (2021) Scalable, sustainable and catalyst free continuous flow ozonolysis of fatty acids, Green Chemistry, 23(6), 2391-2396

4. Sampat, C.; Pal, S. and Kulkarni, A. A. (2021) Effect of wettability on hydrodynamics and mass transfer in small capillaries, Chemical Engineering Research and Design, 169, 265-274
5. Patil, S.; Kate, P.; Deshpande, J. B. and Kulkarni, A. A. (2021), Quantitative understanding of nucleation and growth kinetics of silver nanowires, Chemical Engineering Journal, 414, 128711
6. Patil, P.; Patil, S.; Kate, P. and Kulkarni, A. A. (2021) Inkjet Printing of Silver nanowire on flexible surfaces and methodologies to improve conductivity and stability of the printed patterns, Nanoscale Advances, 3, 240 - 248
7. Pal, S.; Madane, K.; Mane, M. and Kulkarni, A. A. (2020) Impingement Dynamics of Jets in a Confined Impinging Jet Reactor, Ind. Eng. Chem. Res. (https://dx.doi.org/10.1021/acs.iecr.0c04717)
8. Pal, S.; Nikam, A. and Kulkarni, A. A. (2020) Antisolvent based ultrasound-assisted batch and continuous flow precipitation of metformin hydrochloride particles, J. Flow Chemistry (10.1007/s41981-020-00137-y)
9. Mule G. and Kulkarni, A. A. (2020) Effect of object shape on the flow past microstructures in small channel, Fluid Dynamics Research, https://doi.org/10.1088/1873-7005/abcd8b (Accepted)
10. Jadhav, P. M.; Pande, R. K. and Kulkarni, A. A. (2020) Estimation of reaction kinetics for aromatic and heterocycles nitration in mixed acids through computational chemistry approach, International Journal of Chemical Kinetics (*Accepted*)
11. Shukla, C. A.; Atapalkar, R. S. and Kulkarni, A. A. (2020) Efficient processing of reactions involving diazonium salts: Meerwein arylation in an impinging-jet reactor, Org. Proc. Res. & Dev. (10.1021/acs.oprd.0c00271)
12. Sheik, A. R.; Kulkarni, A. A. and Kali S (2020) Solvent extraction of copper enhanced by mixing cavities in micromixer, Solvent Extraction Research and Development of Japan. vol. 28(1).
13. Bari, A. H.; Jundale, R. B. and Kulkarni, A. A. (2020) Understanding the role of solvent properties on reaction kinetics for synthesis of silica nanoparticles, Chem. Eng. J., 398, 125427, (https://doi.org/10.1016/j.cej.2020.125427)
14. Raval, J.; Suryavanshi, N.; and Kulkarni, A. A. (2020) Effect of physical properties of dispersed phase on the residence time distribution in straight capillaries, Chem. Eng. Science., (DOI: 10.1016/j.ces.2020.115715)
15. Said M. S.; Khonde, N. S.; Thorat , M. N.; Atapalkar , R. S.; Kulkarni, A. A.; Gajbhiye, J. and Dastager, S., (2020) A New TBAF Complex, Highly Stable, Facile and Selective Source for Nucleophilic Fluorination: Application in Batch and Flow Chemistry, Asian J. Org. Chem., (https://doi.org/10.1002/ajoc.202000235)
16. Sharma, M. K.; Raval, J.; Ahn, G. N.; Kim, D. P. and Kulkarni, A. A. (2020) Assessing the impact of deviations in optimized multistep flow synthesis on the scale-up, Reac. Chem. & Eng., (DOI: 10.1039/D0RE00025F)
17. Sharma, M. K.; Suru, A.; Joshi, A. and Kulkarni, A. A. (2020) Novel flow reactor for handling suspensions: Hydrodynamics and performance evaluation, Ind. & Eng. Chem. Res. (DOI: 10.1021/acs.iecr.9b06864)

18. Shukla, C. A.; Atapalkar, R. S. and Kulkarni, A. A. (2020) Selectivity Engineering of Meerwein Arylation in a Continuous Flow Reactor: A Modelling Approach, REACTION CHEMISTRY & ENGINEERING (DOI: 10.1039/C9RE00477G)

19. Deshpande, J. B.; Dharne, M. and Kulkarni, A. A. (2020) Continuous Interfacial Centrifugal Separation and Recovery of Silver Nanoparticles, Chemical Engineering & Technology (DOI: 10.1002/ceat.201800722)

20. Shukla, C. A.; Pal, S. and Kulkarni, A. A. (2020) Hydrodynamics and Selectivity Engineering of a Multipoint Dosing Flow Reactor, Industrial & Engineering Chemistry Research (10.1021/acs.iecr.9b04431)

21. Sharma, B. M.; Atapalkar, R. S. and Kulkarni, A. A. (2019) Continuous flow solvent free organic synthesis involving solids (reactants/products) using screw reactor, Green Chemistry, 2019, 21, 5639 - 5646

22. Sharma, M. K.; Acharya, R. B. and Kulkarni, A. A. (2019) Exploring the Steady Operation of a Continuous Pilot Plant for Di-nitration Reaction, Chemical Engineering & Technology, DOI: 10.1002/ceat.201900140

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26. Nikam A. V., Prasad B.L.V. and Kulkarni, A. A. (2018), Wet chemical synthesis of metal oxide nanoparticles: a review, *CrystEngComm.*, 20, 5091 - 5107

27. Sharma, M. K.; Acharya, R. B.; Shukla, C. A. and Kulkarni, A. A. (2018) Assessing the possibilities of designing a unified multistep continuous flow synthesis platform, *Beilstein Journal of Organic Chemistry*, 14 (1), 1917-1936

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33. Kulkarni, A. A.; Sebastian, V. (2017) Insights in the Diffusion Controlled Interfacial Flow Synthesis of Au Nanostructures in a Microfluidic system, *Langmuir*, 33, 14315−14324

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45. Sharma, Y.; Joshi, R. A. and Kulkarni, A. A. (2015) Continuous-flow nitration of o-xylene: Effect of nitrating agent and feasibility of tubular reactors for scale-up, *Org. Process Res. Dev.*, *19* (9), 1138–1147

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47. Jose Nieves, M., Kulkarni A. A., and Jensen K. F. (2015) OpenFOAM computational fluid dynamic simulations of single phase flows in an Advanced-Flow Reactor, *Ind. Eng. Chem. Res.*, 7543-7553

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48. Ranade, V. V.; Sharma, M.; and Kulkarni, A. A. (2015) CRE for MAGIC (Modular, Agile, Intensified & Continuous) Processes, *Chem. Eng. J.* 278, 454–468

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52. Nikam, A.; Arulkashmir, A.; Krishnamoorthy, K.; Kulkarni, A. A. and Prasad, B. L. V. (2014) pH dependent single step rapid synthesis of CuO and Cu_2O nanoparticles from the same precursor, *Crystal Growth & Des.*, 14, 4329−4334

53. Debnath, S.; Kienle, A. and Kulkarni, A. A. (2014) Evaluation of multipoint dosing strategy in a miniaturized tubular reactor: Nitration of salicylic acid, *Chem. Eng. Tech.*, 37(6), 927-937

54. Kulkarni, A. A. (2014) Continuous flow nitration in miniaturized devices, *Beilstein J. Org. Chem.*, 10, 405–424. (in top 10 most accessed articles in 2014, > 3500 times)

55. Sharma, M.; Reddy V. S. and Kulkarni, A. A. (2014) 3D Flow Reactors: Flow, Hydrodynamics, and Performance, *Ind. Eng. Chem. Res.*, 53 (5), 1916–1923

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57. Kumari, S.; Kulkarni, A. A.; Guruswamy, K.; Sen Gupta, S. S. (2013) Large centimetre-size macroporous ferritin gels as versatile nanoreactors, *Chem. Mat.*, 25, 4813−4819

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59. Ravi Kumar, D.V.; S. R. Kumavat, Kulkarni A. A. and Prasad, B.L.V. (2013) Surfactant less synthesis of anisotropic gold nanostructures: Can dicarboxylic acids alone act as shape directing agents?, *RSC Advances*, 3, 21641

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61. Jose Nieves, M., Kulkarni A. A., and Jensen K. F. (2013) Gas-Liquid flow and mass transfer in an advanced flow reactor, *Ind. Eng. Chem. Res.*, *52* (26), 8996–9010

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64. Jose Nieves, M., Kulkarni A. A., and Jensen K. F. (2012) Hydrodynamics of Liquid-Liquid flow in Corning Advanced Flow Reactor, *Ind. Eng. Chem. Res.*, *51* (50), 16251–16262

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Conferences and Invited Lectures

1. A. A. Kulkarni; Patil, S.; Kate, P. and Prasad B. L. V., Reaction engineering and scale-up of a continuous process for manufacturing silver nanowires (4th Indo-German Workshop on Chemical Reaction Engineering and separations), Berlin, Feb 23-26, 2020
2. A. A. Kulkarni, Continuous multi-step manufacturing of fine chemicals: Aromatic nitration, Feb 28, 2020, BASF, Ludwigshafen, Germany
3. A. A. Kulkarni, Large scale synthesis of functional nano materials (Sept 24-26, 2019) Cambridge Univ., Cambridge, UK
4. A. A. Kulkarni, Continuous flow synthesis and control of Au nanoparticles (Sept, 27, 2019) (Univ. Col. London, London, UK)
5. R. Jundale, Atul Bari, A. A. Kulkarni, In-line functionalization of continuously synthesized mesoporous SiO2 (IMRET18), Karlsruhe Inst. Tech. (KIT), Germany (October 20-24. 2018)
6. J. Yadav, R. Gupta, A. A. kulkarni, Computational modelling of transport processes in liquid-liquid slug flow in microchannels (IMRET18), Karlsruhe Inst. Tech. (KIT), Germany (October 20-24. 2018)
7. M. K. Sharma and A. A. Kulkarni, Analysis of different steady states in pilot scale pinched tube flow reactors: A case study (IMRET18), Karlsruhe Inst. Tech. (KIT), Germany (October 20-24. 2018)
8. C. A Shukla, A. A. Kulkarni, Selectivity engineering of continuous flow Meerwein arylation using non-isothermal model (IMRET18), Karlsruhe Inst. Tech. (KIT), Germany (October 20-24. 2018)
9. Joy Raval, N. Suryavanshi, A. A. Kulkarni, Effect of continuous phase properties on the residence time distribution of two-phase flow in capillaries, (IMRET18), Karlsruhe Inst. Tech. (KIT), Germany (October 20-24. 2018)
10. Jundale, R. B.; Bari, A. and Kulkarni, A. A. "Continuous flow synthesis of submicron silica particles: reaction kinetics and optimization", 25th International Symposium on Chemical Reaction Engineering to be held at Florence (Italy) May 20-23, 2018

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11. Sharma, M. K. and Kulkarni, A. A. "Design and scale-up of a pinched tube flow reactor for continuous di-nitration" 25th International Symposium on Chemical Reaction Engineering to be held at Florence (Italy) May 20-23, 2018
12. Shukla, C. A. and Kulkarni, A. A. "Reaction engineering approach for designing an impinging-jet reactor for Meerwein arylation" 25th International Symposium on Chemical Reaction Engineering to be held at Florence (Italy) May 20-23, 2018
13. Kulkarni, A. A., (2017) Continuous manufacturing of nanomaterials for making electronic printing inks, Nanoconclave, August 2017, New Delhi
14. Kulkarni, A. A., (2017) Continuous flow synthesis for high value API, NIPER, January 24, 2017, Hyderabad
15. Kulkarni, A. A., (2017) Multistep Flow Synthesis: A Chemical Engineer's view, Flow Chemistry India, January-2017, Mumbai
16. Kulkarni, A. A. (2016) Continuous flow synthesis of API, September 16, 2016 Yunan Minzu Univ. (Kunming) China
17. Kulkarni, A. A. (2016) Numbering-up of microreactors: challenges and some solutions for 2D and 3D systems, International Conference on Micro Reaction Technology (IMRET14), September 12 to 14, 2016 Beijing (Invited talk) China
18. Y. Sharma and Kulkarni, A. A., (2016) Multistep flow synthesis of isopropyl phenol, IMRET14, September 12 to 14, 2016 Beijing, China
19. Pal, S.; Shukla, C. S.; Phukan, M. and Kulkarni, A. A. (2016) Residence time distribution in multipoint injection system, IMRET14, Sept. 12 - 14, 2016 Beijing
20. Sharma, M., Potdar S. and Kulkarni, A. A. (2016), Pinch tube flow reactor for exothermic multi-phase reactions, 24th Int. Symp. on Chemical Reaction Engineering (ISCRE24), June 12-15, 2016, Minnesota, USA
21. Kulkarni, A. A., Multipoint injection approach for process intensification (Indo-German Workshop on Reactors and Separators, IIT-Guwahati, Feb 2016)
22. Kulkarni, A. A. Dispersed phase (drobble: drop-bubble) dynamics in a boiling stirred tank reactor, Eu Mixing Conference, St. Petersburg (Russia) (June 27, 2015)
23. Mule, G. M. and Kulkarni, A. A., Flow patterns generated by fractal impeller in a stirred tank, Eu Mixing Conference, St. Petersburg (Russia) (June 27, 2015)
24. Kulkarni, A. A., Scale-up of flow reactors, (Flow Chemistry India, Jan-2015, Mumbai)
25. Kulkarni, A. A., Reaction Matrix for Flow Synthesis: Identification and Analysis (Workshop on Intensification and Up-scaling of Continuous Processes, NCL, Pune, Dec 13-14, 2014)
26. Kulkarni, A. A., Selection of Flow Reactors (Workshop on Intensification and Up-scaling of Continuous Processes, NCL, Pune, Dec 13-14, 2014)
27. Kulkarni, A. A., Process Intensification using New Generation Flow Reactors (Flow Chemistry India, January 23-24, 2014, Hyderabad)
28. Kulkarni, A. A.; RTD of solids in microchannels, IMRET13, Budapest, Hungary
29. Kulkarni A. A., Role of Interface in Microfluidic Synthesis, Key Note lecture at 3rd Asia-Pacific Symposium on Chemical and Biological Microfluidics, August 2013, Seoul, Korea
30. Kulkarni A. A., Flow synthesis using tubular reactors, POSTECH, August 2013, Korea
31. Kulkarni, A. A. Microreactors for exothermic reactions, RSC-DST Symposium on Process Intensification, Queens Univ., Belfast (Dec 2012)
32. Kulkarni A. A., Continuous flow nitration in microreactors: role of slug size and residence time distribution in nitration of benzaldehyde, Indo-German Workshop on Microreaction Technology, March 4-5, 2009. NCL, Pune
33. Kulkarni, A. A., Process Intensification using Microreactors: A case Study of Nitration (Indo-German Workshop, IIT-Chennai, Feb 2008, New Delhi)

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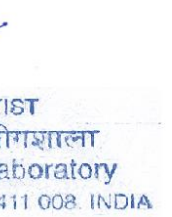
34. Kulkarni, A. A.; Karale, C. M.; Ranade, V. V.; Mandal, N. and Sadekar, G. K. Development of a Cross Flow Micro Heat Exchanger: Design and Analysis, *IMRET10*, New Orleans, (April 2008)
35. Kaspereit, M, Kulkarni, A. A., Kienle, A. (2007) Dynamics and operation of a micro-scale chromatographic reactor for heterogeneously catalysed liquid phase reactions (CAMURE-ISMR)
36. Kulkarni A. A., Joshi J. B., Shukla, S.U., Ravikumar V. and Kulkarni B. D. (2007) Recursive wavelet transforms and principal component analysis: Applications to stirred tanks and bubble column hydrodynamics (CAMURE-ISMR, *Pune*)
37. Rampure, M. R., Kulkarni A. A. and Ranade, V. V., (2007) Flow pattern in bubble columns at high gas velocities. (CAMURE-ISMR, *Pune)*
38. Zeyer, K. P.; Kulkarni, A. A.; Kienle, A.; Vasudeva Kumar, M. and Pushpavanam, S., (2007) Nonlinear behavior of reactor-separator and reactor-distillation networks: Influence of the energy balance formulation, Comp. Aided Chem. Eng., 24, 425-430
39. Kulkarni, A. A.; Gorasia, A. K. and Ranade, V. V., Mesh microreactor for gas-liquid-solid catalytic hydrogenation reaction: hydrodynamics & performance (GLS-8, Dec 2007, NewDelhi)
40. Kulkarni, A. A., Application of Micro-Scale Chromatographic Reactor for Heterogeneously Catalyzed Perfumery Synthesis, (GLS-8, Dec 2007, NewDelhi)
41. Kulkarni A. A., Joshi J. B., (2006) Effective interfacial area and mass transfer coefficient in G-L BCR (*German Japanese Symp. Bubble Column Reactors, 2006, Germany*)
42. Kulkarni, A. A., Zeyer, K. P., Jacobs, T., and Kienle, A. (2006) Microreaction technology for homogeneous and heterogeneous esterification reactions (*ACHEMA, Frankfurt, Germany*)
43. Kulkarni, A. A., Zeyer, K. P., Jacobs, T., Kaspereit, M, and Kienle, A. (2006) Feasibility studies and the dynamics of esterification reactions in a micro plant (*IMRET-9, Postdam*)
44. Kulkarni A. A. & Joshi J. B. (August 21-24, 2005) Measurement of eddy diffusivity in bubble columns and validation based on the intermittency models. *Gas-Liquid and Gas-Liquid-Solid Reactor Engineering Conference* (GLS-7), Strasbourg, France
45. Kulkarni A. A. & Joshi J. B. (September 24-28, 2004) The Lift Force on Bubbles In A Swarm: Experimental Analysis Using LDA, *3rd Int. Symp. on Two-Phase Flow Modelling and Experimentation*, Pisa, Italy.
46. Kulkarni A. A. (November 19, 2004) Sparger characterization in bubble column reactors: Symbolic and eigenvalue analysis of LDA data, *Braunschweig Univ*., Germany
47. Kulkarni A. A. (April 11-12, 2002) Estimation of effective interfacial area in bubble column from bubble size and shape distribution, *Multiphase Fluid Dynamics Research Consortium* (MFDRC-AIChE), Purdue University, U.S.A.
48. Kulkarni A. A. (May 26, 2002) Characterization of turbulence through eddy isolation methodology, *Yale University*, New Haven, USA
49. Kulkarni A. A., Joshi, J. B. & Ramkrishna, D., (June 26-28, 2002) Motion of bubbles in turbulent flows: size, shape and directional distribution, Prof. Robert Brodkey Int. Symp. on Turbulence in Chem. Proc., as a part of *14th International Symposium in Applied Mechanics*, Virginia Tech, USA.

(C) Patents filed (37) and granted (17)*:*

Granted patents:

1. A. A. Kulkarni, R. A. Joshi, R. R. Joshi, N. T. Nivangune, M. A. Jagtap, Continuous flow process for the preparation of sulphoxide compounds, EP2451810 B1 (Feb 05, 2013)
2. A. A. Kulkarni, B. D. Kulkarni, Fractal impeller for stirring, US9138699 (Sept 22, 2015)



3. A. A. Kulkarni, R. A. Joshi, R. R. Joshi, Continuous two step flow synthesis of M-amino acetophenone US9150497 (October 6, 2015)
4. A. A. Kulkarni, R. A. Joshi, R. R. Joshi, Methodology for the continuous flow manufacturing of beta-amino crotonate, US9199913 (Dec 1, 2015)
5. V.V. Ranade, A.A. Kulkarni, V.M. Bhandari, Vortex diodes as effluent treatment devices, US9422952 (Aug 23, 2016)
6. A. A. Kulkarni, V. V. Ranade, Continuous modular reactor, US9446375 (Sept 20, 2016)
7. V. V Ranade; A. A Kulkarni; V. M. Bhandari, Vortex diodes as reactors and effluent treatment devices, US9725338 (Aug 8, 2017)
8. A. A. Kulkarni, Device for thermokinetic property measurement, US9869595 (Jan 16, 2018)
9. A. A. Kulkarni, V. V. Ranade, Tube in Tube Continuous Glass-Lined Reactor, EP3079805 (Jan 31, 2018)
10. A. A. Kulkarni, V. V. Ranade, Tube in tube continuous glass-lined reactor US9956537 (May 1, 2018)
11. A. A. Kulkarni; R. A. Joshi; R. R. Joshi, Continuous Flow Manufacturing of Direct Yellow-11 Dye , IN297091 (May 25, 2018)
12. A. A. Kulkarni, V. V. Ranade, Glass Lined Micro Reactors, US9993795 (June 12, 2018)
13. V. V. Ranade and A. A. Kulkarni, Continuous Modulator Reactors, EP2766111 (August 1, 2018)
14. V. Ravi Kumar; B. L. V. Prasad; A. A. Kulkarni, Methodology for continuous flow manufacturing of nanocrystalline materials, US10106432 (Oct 23, 2018)
15. A. A. Kulkarni, R. A. Joshi, R. R. Joshi, N. T. Nivangune, M. A. Jagtap, Continuous flow process for the preparation of sulphoxide compounds, CA2767516 (Nov 6, 2018)
16. A. A. Kulkarni, R. A. Joshi, Y. Sharma, R. R. Joshi, Continuous flow liquid phase nitration of alkyl benzene compounds, IN304474, (Dec 14, 2018)
17. A. A. Kulkarni, R. A. Joshi, Y. Sharma, R. R. Joshi, Continuous two step flow synthesis of m-amino acetophenone (EP766338, 20-1-2020)

Design registrations

- Design No. 247209 for Microreactor
- Design No. 247208 for Micromixer

Book Chapter:

1. Jundale, R. B. and Kulkarni, A. A. (2019) Continuous flow synthesis of nanomaterials (Book chapter in *Chemical reactions and processes under flow conditions*) RSC (UK), Editor: Santiago V. Luis and Eduardo García-Verdugo
2. Ravi Kumar Darbha, Suneha Patil & Amol A. Kulkarni (2021) Continuous flow methods for synthesis of functional materials, (Book chapter in Flow Synthesis, Volume 2, Editor: Volker Hessel et al.)

Industry Training on Continuous flow: For last 4 years (Sept 2016 onwads) I have been conducting industry training on continuous flow synthesis. This is a 1 week training and per participant we charge Rs. 50,000/- for 1 week. Till date we have trained 40 industries and about 65 Lakh has been collected as ECF from these sessions. This has helped those industries successfully implement continuous manufacturing at different levels.

Academic responsibilities:

MTech/PhD level Course taught **for AcSIR**: Advanced Reaction Engineering (4 credit course) 40 hours (Since 2010 for every odd semester).

Research group at glance:

No. of PhD Students: Completed: 8, In progress: 8
No. of Masters students: > 25 over last 10 years
No. of BTech projects supervised: > 25 over last 10 years
No. of project assistants: > 40 over last 10 years
No. of postdocs and Research Associates (RA) supervised: 4 over last 10 years

Projects Completed and in progress: Details of project being implemented/completed as Principal Investigators/Co-PI along with its salient features

Govt. Funded Projects

No.	Title of the project	Period	Funding agency	Budget	Features
1.	Continuous process for anionic polymerization of HTPB	Feb 2019-Jan 20	HEMRL (DRDO)	Rs. 89 Lakh	To develop a flow synthesis approach for anionic polymerization of HTPB
2.	Development of a process control algorithm for flow synthesis of nanoparticles	Sept 2018 – Aug 2020	DST-UKIERI	Rs. 37.0 Lakh	Develop a control approach for nano scale synthesis using macroscopic parameters
3.	Developing a continuous manufacturing platform for Azo dyes and API	Oct 2018 – March 2020	CSIR	Rs. 80 Lakh	To develop a flow synthesis approach for several azo dyes and APIs. A diazo forum is created with 6 industries to be involved.
4.	Understanding reactive interface in microfluidic systems	June 2016-May 2021	DST, Govt. of India	Rs. 1.63 Cr	Studying the properties of reacting interface and underlying physics
5.	Continuous flow manufacturing of functional nanoscale materials	October 2016 – Sept 2019	DST, Govt. of India	Rs. 4.6 Cr	Process development for specific functional nanomaterials

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6.	Continuous process for dinitro xyledine	Sept 2016 – Aug 2018	CSIR	Rs. 52 Lakh	Process development for specific agrochemical (Rs. 17.6 Lakh received as 1st installment from Industry)
7.	Understanding numbering-up in microreactors	July 2015 – June 2018	DST	Rs. 37 Lakh	Development of methods for uniform flow distribution in network of channels
8.	Laboratory scale development of anionic polymerization of isoprene	Apr 2016-Sept 17	HEMRL (DRDO)	Rs. 56 Lakh	To develop a lab scale protocol for anionic polymerization for a strategic material
9.	Continuous process for Ag nanoparticles	Jan 2016 – March 2017	CSIR	Rs. 12 Lakh	Process development for Ag nanoparticles in dry powder form
10.	Continuous process for reprecipitation of ammonium perchlorite	Jan 2016 – March 2017	HEMRL (Min. of Defense)	Rs. 9.9 Lakh	Development of a process for 5 kg/hr of ammonium perchlorite of specific particle size and shape
11.	Indus Magic Program	2012-2017	CSIR, Govt. of India	Rs. 1.2 Cr. (only for WP4)	Responsible for work package on Batch to continuous transformation (WP4)
12.	Engineering of multiphase micro and mini flow reactors for reactions involving solid particles	Dec 2010 to Nov 2014	DST, Govt. of India	Rs. 34.06 Lakh	Studied clogging of micro/mini channels due to flow of slurry. Model systems and real reactions are being studied.
13.	Bubble dynamics in reactive and non-reactive flows and in dispersions	Jan 2006 – June 2009	DST, Govt. of India	Rs. 21.65 Lakh	In this project we studied the dynamics of a bubble rising in pool of reactive liquid.
14.	Flow modeling of fluidic devices: Primary controller	Oct 2007 – Dec 2009	DAE Project (IGCAR)	Rs. 23.15 Lakh	A protocol was developed for the CFD simulations of a primary controller system that comprises of a converging-diverging system with leakage.

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15.	CFD Modeling of Vortex Diodes	Jan – Oct 2006	DAE Project (IGCAR)	Rs. 6.5 Lakh	A protocol was developed for the CFD simulations of a vortex diode and its design. This is successfully implemented at IGCAR.
16.	Design of a microsystem for gas-liquid catalytic reactions	June 2005 – May 2007	Start-up Grant from NCL	Rs. 12 Lakh	Development of a gas-liquid microreactor for exothermic reactions.

Industry sponsored projects:

These are from various industries from Pharma, agrochemical and fine chemicals sectors

No.	Title of the project	Year	Funds (Rs. Lakh)	Features
17.	Continuous flow Grignard reaction	2021	22	Cannot disclose the details as NCL has signed a confidentiality agreement with the individual industries against specific deliverables.
18.	Continuous flow synthesis of a dinitrated herbicide	2020	15	
19.	Continuous process for catalytic hydration for perfumery intermediates	2020	25	
20.	Continuous flow process for deuterated solvents	2019	25	
21.	Continuous flow synthesis of an agrochemical using CSTRs in series	2018	10	
22.	Design of pilot plat for continuous manufacturing of 1-nitro naphthalin	2018	4	
23.	Continuous flow synthesis of an agrochemical involving CS_2	2017	7.5	
24.	Continuous flow synthesis of 1-nitro naphthalin	2017	12	
25.	Continuous flow synthesis of quinaldines as intermediates for pigments	2015	12	
26.	Development of a continuous process step of a reaction involving ethylene oxide as a reactant for the synthesis of a drug	2014	10	
27.	Understanding the parametric effect on photobromination reaction	2014	7.5	
28.	Studying the parametric effect on continuous flow nitration	2014	7.5	
29.	Develop batch to continuous nitration process for the production of an agrochemical intermediate	2013	7.0	
30.	Development of a process for continuous flow nitration of Acetophenone	2012	7.0	
31.	Design of scale-up continuous reactor for Y-11 dye	2011	18	

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32.	Development of a process for continuous flow synthesis of direct yellow 11 dye using miniaturized devices	2010	6.3
33.	Industrial Consortium on Microreaction Technology (Ranbaxy Ltd., L&T Ltd., Gharda Chemicals, RIL, GMM Pfaudler, Arch Pharma, etc.)	2007 to 2010	18 per year for 5 years
34.	Effect of viscosity on mass transfer in boiling reactor (Dow Chem)	Jan 08 - Mar 09	38

Industrial Consultancy projects

No.	Title of the project	Year (period)	Budget (Rs. Lakh)	Features
33.	Batch to continuous transformation for specific ongoing and new processes	2021-2022	55.0	For all of these consultancy projects for variety of Pharma and specialty chemicals companies, the industries need help in identification of the reactions/steps that can be made continuous and developing end to end facility/ process for its implementation. All the work is related to the following sectors of chemical industry: (i) agrochemical intermediates, (ii) pharmaceutical intermediates, (iii) speciality chemicals and (iv) perfumery components
34.		2020-2021	18.0	
35.		2029-20	16.5	
36.		2017-18 (1 Yr)	10.0	
37.		2017-18 (1 Yr)	5.0	
38.		2016-17 (0.5 Yr)	2.5	
39.		2016-17 (1 Yr)	7.5	
40.		2016-17 (1 Year)	10	
41.		2015-16 (1 Year)	15	
42.		2014-15 (1 year)	5	
43.		2013-14 (1 year)	4	
44.		2014 (1 year)	4	
45.		2013-14 (1 year)	4	
46.		2012-13 (1 year)	3.5	
47.	Screening and evaluation of processes for API	2011 (1 year)	5	

Royalty:

- **10 designs of microreactors are licensed** to Amar Equipment Pvt. Ltd. (Mumbai) over a period of 2013-2018.
- **2 designs of glass lined flow reactors licensed** to GMM-pfaudler Ltd. (Mumbai) on Feb 17, 2020 for license fees and fixed royalty per unit sold to the user industry.

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