

product streams (yields) referenced to the feed from the measured density distribution and size distribution. These inconsistent data can be used for the process evaluation and calculation of chemical composition distribution of the products in coal preparation. To estimate reliable and meaningful mass balance results, while conserving mass in the system, this algorithm includes additional constraints: the sum of component data must equal 100%, and individual component datum must have a non-negative value. Applications of the methodology are demonstrated using the measured data sets obtained from the size and specific gravity based separators with multi-stream products.

97/04426 Study on multistage hydrolysis of coal by thermogravimetry

Li, W. and Li, B. *Huaxue Xuebao*, 1996, 24, (6), 480-484. (In Chinese)
At heating rate of 5°C/min and 25°C/min in a pressurized thermobalance, the multi-stage hydrolysis of Xianfeng lignite, Datong bituminous coal and Yanzhou high sulfur coal was investigated. The results show that the conversion of coal at high heating rate in multi-stage hydrolysis is higher than that at constantly slow heating rate. The effect of keeping temperature at 500°C or 600°C for 10 min at high heating rate is more pronounced than that at slow heating rate. The increase extent of conversion with keeping temperature at 600°C is more markedly than that at 500°C for Xianfeng and Datong coal, but the result is opposite for Yanzhou coal. The multi-stage hydrolysis process is an ideal desulfurization method for pre-combustion utilization, which makes the sulfur removal of Yanzhou coal up to 90%.

97/04427 A study on non-evaporative hot water drying of low-rank coal and its possible applicability in upgrading Indian lignites

Rao, M. J. *et al.* *Solid Liquid Separate Miner. Metall. Ind., Sel. Pap. Natl. Semin.*, 1996, 219-237. Edited by Bhima R. R. and Ansari, M. I., Indian Institute of Mineral Engineers, Bhubaneswar Chapter, Bhubaneswar, India. The effects of temperature, residence time and particle size on the degree of low-rank coal (LRC) upgrading using non-evaporative drying process, hot water drying (HWD) is investigated. This work has been carried out on a Tertiary low-rank coal from Beluga coal field, Alaska. Replicated factorial tests were conducted. The results were subjected to variance analysis. Particle size had no witnessed effect. Most of the coal upgrading via HWD occurred rapidly within the first 5 min of residence time, after which the rate of the upgrading process declined. Fifty-five min of additional resistance time is necessary to produce a similar percentage increase in coal properties to those achieved in the first 5 min. The properties of hot water dried products were very sensitive to process temperature. Calorific value, carbon and oxygen contents, and equilibrium moisture levels all appear to change linearly with temperature 275-325°C. Moreover, this process is potentially applicable in upgrading Indian lignites to develop more environmentally friendly coals for power generation.

97/04428 Sulfur removal by fine coal cleaning processes

Rubiera, F. *et al.* *Fuel*, 1997, 76, (13), 1187-1194.
As part of a collaborative project to develop a commercial-scale fine coal cleaning process to remove pyritic sulfur, investigations were undertaken. Wet processes, particularly for ultrafine (<0.1 mm) material, were studied. The suitability of some commercially available enhanced gravity concentrators to separate fine coal was determined. A small-diameter water-only cyclone was developed to treat coal crushed to <0.2 mm, and the results of tests are presented. Single-, two- and three-stage froth flotation tests were carried out to compare the results with those obtained from the water-only cyclone and combinations of the water-only cyclone with froth flotation. The reduction in sulfur emission value that can be achieved depends on the sulfur liberation characteristics of the feed material.

97/04429 Test on pyrite ores in coal series

Chen, L. *Huagong Kuangshan Jishu.*, 1997, 26, (4), 15, 6. (In Chinese)
Gravity concentration or flotation can provide better separation indexes in the process of separating pyrite ores from coal series sediments in Guizhou Province. The optimum separation effect is achieved by combining gravity concentration and flotation. Sulfur concentrate with 45% sulfur can be obtained by the flowsheet of middlings regrinding and refloatation. The sulfur concentrate after making acid, its slag contains over 60% iron which can be recovered by iron-smelting.

97/04430 Treatment method for mixtures of coal and coal tar and/or heavy oils

Konishi, T. *et al.* *Jpn. Kokai Tokkyo Koho JP 09 03,457 [97 03,457]* (Cl. C10B55/02), 7 Jan 1997, Appl. 95/157,476, 23 Jun 1995, 27 pp. (In Japanese)
Coal and coal tar and/or heavy oils is mixed to form a slurry, feeding the slurry to a service tank for temporary storage at the outlet side of the mixer by a twin screw pump. The slurry is passed from the service tank by a discharge pump to a tubular reactor having the later segment of the reactor tube made of stainless steel for heat treatment to obtain a swelled/solidified coal. Then swelled coal is then thermally decomposed in a fluidized pyrolysis furnace at the outlet side of the reactor for manufacturing-recovering high calorific gas, tar, gas-liquid mixtures and reformed residues.

97/04431 The use of a structural model to explain the behavior of brown coal during pressurized steam drying

Bongers, G. D. *et al.* *DGMK Tagungsber.*, 1997, 9702, (Proceedings ICCS '97, Volume 1), 483-486.

As part of an investigation into the shrinkage of brown coal during pressurized steam drying, Hg porosimetry, CO₂ surface area analysis, and TEM were used to characterize their physical structure. A simple conceptual model is proposed to describe the relationship between the porosity of the dried coal and the severity of the drying conditions. The porosity of the dried coal can be tailored by controlling the temperature-time history of steam drying.

97/04432 Use of hydrocyclones at Belorechenskaya coal beneficiation plant

Sbitnev, M. P. *et al.* *Ugol' Ukr.*, 1997, (2-3), 26-29. (In Russian)
The improvement of coal beneficiation efficiency at the Belorechenskaya plant, Ukraine, is achieved with hydrocyclone separation for preliminary separation of flotation feed and additional separation of jiggling cone.

Transport, Storage

97/04433 Characterization of strange attractors in the self-ignition of coal stockpiles

Continillo, G. *et al.* *Fractals Chaos Chemical Eng., Proc. Int. CFIC 96 Conf.*, 1996, (Pub. 1997), 385-396. Edited by Giona, M. and Biardi, G., World Scientific, Singapore.

Chaotic behavior was researched in previous work via numerical experiments for two distributed-parameter models of the self-ignition of coal stockpiles. In the present work, quantitative characterization of the strange attractors found is conducted. For each attractor the power spectrum, the Lyapunov Characteristic Exponents (LCE) and the fractal dimension is estimated. The Lyapunov exponents are computed by discretizing the PDE model along the space coordinates, thus generating a model described by a large set of ODES. The algorithm was implemented with MATLAB, SIMULINK, and with a Fortran-C code in the search for the best computational efficiency. The power spectra and the fractal dimensions are computed a posteriori by taking, as a starting point, time-series generated by numerical simulations. Fractal dimensions are computed using the 'Grassberger-Procaccia' algorithm and power spectra are estimated using an FFT algorithm or preprocessed time series. Bifurcations and regions of chaotic behavior are identified in a subset of the parameter space and even quasi-periodic behaviour has been detected.

97/04434 Combating endogen underground fires at Markush-hegy mine

Vidor, P. *Banyasz. Kohnsz. Lapok, Banyasz.*, 1996, 129, (6), 596-603. (In Hungarian)
Discusses the causes of coal mine fires in 1994/95 at Markush-hegy (Hungary) as a result of self-ignition, methods used for combating endogen underground fires, mechanism and control of CO generation.

97/04435 Determination of the handleability of a coal blend using an extrusion trough

Brown, D. W. *et al.* *Fuel*, 1997, 76, (13), 1183-1186.
Both producers and users experience a considerable problem in the lack of reliable techniques to determine how a particular coal blend will pass through a handling plant. Current procedures have drawbacks, for example, the Jenike shear cell test is complex, lengthy to carry out and requires a trained operator, whilst the Durham Cone is simple to use but produces results that are neither reliable or repeatable. A number of coals from different sources have been subjected to tests, revealing a hydraulic pressure required to move coal along an extrusion trough can be used as a quantitative measure of the handleability of a coal blend.

97/04436 Difficulties with standard tests to predict shipping hazards with coals and carbons

Jones, J. C. *J. Fire Sci.*, 1997, 15, (3), 175-179.
A German low-rank coal was studied, in relation to shipping hazards, to determine the ignition times for a 3-m cube.

97/04437 Experimental investigation of protecting coal piles against spontaneous ignition by dissipating heat with heat pipes

Xu, L. *et al.* *Energy Environ., Proc. Int. Conf.*, 1995, (Pub. 1996), 532-537. Edited by Chen, Z. *et al.*, Begell House, New York.
Methods to avoid spontaneous ignition in coal stockpiles were investigated in experiments based on the theory that the high temperature is one of the causes of coal oxidation. The methods involved dissipating heat and decreasing temperature of the coal piles with heat pipes, which have the characteristics of high equivalent heat conducting coefficient and one-way heat transfer feature. It introduces the process and the results of the site experiments, and provides the rate of heat dissipation and effective range of