A Quarterly R&D Abstract Service by IIME

MINERALS ENGINEERING

- A Global Alert Service

Issue No. 99, October 2013

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INDIAN INSTITUTE OF MINERAL ENGINEERS

C/o Mineral Processing Division

CSIR-NATIONAL METALLURGICAL LABORATORY

JAMSHEDPUR 831 007, JHARKHAND WEBSITE: www.iimeindia.com

INDIAN INSTITUTE OF MINERAL ENGINEERS

C/o Mineral Processing Division

CSIR-National Metallurgical Laboratory

Jamshedpur 831 007, Jharkhand

Issue No. 99, October 2013

Characterisation and separation studies of Indian chromite beneficiation plant tailing

Tripathy, SK; Murthy, YR; Singh, V
sunilk.tripathy@tatasteel.com
INTERNATIONAL JOURNAL OF MINERAL PROCESSING, Jul, 2013, Vol. 122, pp. 47-53

Detailed characterisation and recovery of chromite from the beneficiation plant tailing of Sukinda, India, was investigated. Different characterisation techniques viz, size analysis, size-wise chemical analysis, size-wise density measurement, X-ray diffraction analysis, heavy liquid separation, scanning electron microscopy, mineral analysis by QEMSCAN and thermo gravimetric analysis were carried out. Based on the results, two flow sheets comprising gravity, magnetic separation and flotation, were used to recover chromite values. A chromite concentrate of 45.0% Cr2O3 with a Cr:Fe ratio of 2.3 can be produced from the tailing analyzing 17.0% Cr2O3 and Cr:Fe ratio of 0.49.
10.1016/j.minpro.2013.04.008

Concentration of a Sudanese low-grade iron ore

Seifelnassr, AAS; Moslim, EM; Abouzeid, AZM
abdel.abouzeid@gmail.com
INTERNATIONAL JOURNAL OF MINERAL PROCESSING, Jul, 2013, Vol. 122, pp. 59-62

The iron ore deposit of the Northern State of Sudan, at Wadi Haifa, is a huge deposit, but is low in grade. It assays 36% Fe and 48% silica. The present study is an attempt to investigate the amenability of this newly discovered ore for upgrading. Based on the appreciable differences in specific gravity and magnetic susceptibility between the desired iron minerals and the gangue minerals, it was suggested that gravity separation and/or magnetic separation may be useful to concentrate this type of low-grade ore. As a result of the fine dissemination of the iron minerals and the most abundant gangue mineral, quartz, the optimum degree of grind is around 150 mu m. Using two-stage separation, roughing and cleaning, it was possible to obtain a high grade concentrate assaying about 64% Fe at a recovery of 72%.
10.1016/j.minpro.2013.04.001

Numerical study of gas-solid flow in a coal beneficiation fluidized bed using kinetic theory of granular flow

Wang, QG; Lu, JF; Yin, WD; Yang, HR; Wei, LB
yhr@mail.tsinghua.edu.cn
FUEL PROCESSING TECHNOLOGY, Jul, 2013, Vol. 111, pp. 29-41

Modeling the dynamic behavior of gas -solid flow in a pilot scale coal beneficiation fluidized bed (CBFB) model was performed in this work, a transient two-dimensional simulation was done based on the Eulerian model together with the kinetic theory of granular flows. Three steps were conducted to testify the choices of sub-models in CBFB modeling, including gas -solid exchange drag models, gas phase turbulence models, granular temperature models and wall boundary condition models for solid phase. Instantaneous and time-averaged results of particle volume fraction, bubble number and size, particle velocity distributions and vortices, as well as bed density distributions were obtained. The impacts of the sub-models on the flow characteristics in the dense CBFB were illustrated in detail and suitable models with better predictions of CBFB flow pattern were then demonstrated. The Syamlal - O'Brien drag model predicted better results in bed characteristics. The dispersed k-epsilon turbulence model should be used to describe the gas turbulence in the dense CBFB flow regime. The partial slip wall condition for particles had a slight influence in the small model. The partial differential equation granular temperature model could predict the inter-phase surfaces more clearly and the flow pattern more accurately.
10.1016/j.fuproc.2013.01.009

The assessment of particulate matter emitted from stone-crushing industry by correlating rock textures with particles generated after comminution and dispersed in air environment

Belardi, G; Vignaroli, G; Plescia, P; Passeri, L
vignarol@uniroma3.it
ENVIRONMENTAL SCIENCE AND POLLUTION RESEARCH, Jul, 2013, Vol. 20(7), pp. 4711-4728

The generation and emission of particulate matter from abrasion industry are subjects of the pollution monitoring by multidisciplinary study involving earth sciences and engineering disciplines. This work investigates the correlation between textural properties of in situ rock with class size distribution and morphology of particles generated after rock comminution and particles emitted in the air. A special comminution-dust sampling architecture was realised. The combined use of scanning electron microscopy and particle size analyser was considered in performing digital image analysis on both crushed products and airborne particles collected onto membrane filters. The results show that the size and morphology of crushed particles are linked to the petrographic rock properties. In particular, particles with fibrous morphology are prominent in rocks showing foliated textures where elongated minerals occurred, with implication for asbestos-

bearing rocks. For what concerns the airborne particles, the results show that their aerodynamic diameters are independent of the crusher operating conditions. External parameters probably intervene in the distribution of the airborne particles emission, including the dynamic air fluxes, or environmental conditions. By applying mathematical models, the morphology and size range of airborne particles following the comminution processes can be predicted, and results has implication for pollutants contamination due to particulate matters emitted by crush stone industry.
10.1007/s11356-012-1434-7

Americium sorption on smectite-rich natural clay from granitic ground water
Kumar, S; Pente, AS; Bajpai, RK; Kaushik, CP; Tomar, BS
bstomar@barc.gov.in
APPLIED GEOCHEMISTRY, Aug, 2013, Vol. 35, pp. 28-34

Because of their significant retention capability, clay minerals have been proposed as a potential engineered barrier in high level nuclear radioactive waste disposal repositories. Smectite-rich natural clay is being considered as a backfill and buffer material for the Indian repository program. In the present study the sorption of Am by the clay, from granitic ground water, has been investigated. To identify the minerals in the clay controlling the sorption process, the adsorption isotherm of Eu(III), a chemical analogue of Am(III), was determined on montmorillonite-kaolinite clay mixtures having 0-20 wt% kaolinite. The effect of experimental parameters, such as, pH, ionic strength, and the presence of cation and anions on Am(III) sorption was further investigated to develop a sorption model for the natural clay. Overlapping adsorption isotherms of Eu(III) obtained for different montmorillonite-kaolinite clay suspensions established montmorillonite as the main sorbent for Eu/Am(III) in the natural clay. Americium(III) sorption increases with pH in three distinct stages: at lower pH values (<4) the sorption is virtually insensitive to pH, then rises sharply (4-7) and subsequently attains a constant value at higher pH values (>8). Decreasing ionic strength increases the sorption at pH < 6 indicating the dominant role of ion exchange reactions at lower pH. A surface complexation model, developed for natural clay by including ion exchange site and amphoteric sites present at edges, simulates the sorption profiles at varying pH and ionic strength well and confirms the montmorillonite fraction as the sorbent controlling Am(III) sorption. The presence of Ca(II) as well as anions (Cl NO3-) does not affect Am(III) sorption on clay under granitic ground water pH and ionic strength conditions. However, the profile of Am(III) sorption to Ca(II)equilibrated clay differs from that for Na-equilibrated clay corroborating weaker exchange of Ca(II)Am(III) in comparison to Na(I)-Am(III). The presence of SO42- in the sorption system lowers Am(III) sorption at lower pH values. Modeling the sorption data indicated the participation of SO42- containing Am surface species. The thermodynamic model developed for sorption onto natural clay was checked for Eu(III) sorption from granitic ground water at pH 6.1. The model simulates the sorption at lower metal ion concentration while there is deviation at higher metal ion concentration. Inclusion of

more types of surface sites and the effect of organic material need to be tested to correct the model for this deviation. (C) 2013 Elsevier Ltd. All rights reserved.
10.1016/j.apgeochem.2013.05.016

Bio-mineralization and potential biogeochemical processes in bauxite deposits: genetic and ore quality significance

Laskou, M; Economou-Eliopoulos, M
laskou@geol.uoa.gr
MINERALOGY AND PETROLOGY, Aug, 2013, Vol. 107(4), pp. 471-486

The Parnassos-Ghiona bauxite deposit in Greece of karst type is the 11th largest bauxite producer in the world. The mineralogical, major and trace-element contents and delta O-18, delta C-12, delta S-34 isotopic compositions of bauxite ores from this deposit and associated limestone provide valuable evidence for their origin and biogeochemical processes resulting in the beneficiation of low grade bauxite ores. The organic matter as thin coal layers, overlying the bauxite deposits, within limestone itself (negative delta C-12 isotopic values) and the negative delta S-34 values in sulfides within bauxite ores point to the existence of the appropriate circumstances for Fe bio-leaching and bio-mineralization. Furthermore, a consortium of microorganisms of varying morphological forms (filament-like and spherical to lenticular at an average size of 2 mu m), either as fossils or presently living and producing enzymes, is a powerful factor to catalyze the redox reactions, expedite the rates of metal extraction and provide alternative pathways for metal leaching processes resulting in the beneficiation of bauxite ore.
10.1007/s00710-012-0257-z

Comparison of different breakage mechanisms in terms of product particle size distribution and mineral liberation

Ozcan, O; Benzer, H
ozgozcan@hacettepe.edu.tr
MINERALS ENGINEERING, Aug, 2013, Vol. 49, pp. 103-108

The comminution process is still governed by a large number of factors that influence the liberation of the valuable components in the ore. A better understanding of these basic factors will provide more certainty about the design of equipment in order to achieve the best liberation and energy efficiency. Impact and bed breakage mechanisms were investigated as two distinctly different modes of breakage. Standard drop weight tests and hydraulic piston-die press tests were conducted with different energy intensities on samples. This paper describes the work carried out for the comparison of mineral liberation and particle size distribution in the particle bed breakage with impact breakage of two different copper ores. Ground products from these two different modes of breakage were screened into size fractions which were analyzed for the particle size distributions by sieve analysis and the degree of liberation by an image analysis system. The results of these analyses were statistically compared to make inferences in relation

to the stated objective of the work. Test results indicated that compressive bed breakage mechanism gives finer product particle size distribution and provides better mineral liberation compared to impact breakage mechanism. (C) 2013 Elsevier Ltd. All rights reserved.
10.1016/j.mineng.2013.05.006

Consumption of steel grinding media in mills - A review
Aldrich, C
chris.aldrich@curtin.edu.au
MINERALS ENGINEERING, Aug, 2013, Vol. 49, pp. 77-91

In this study, the current understanding of the factors affecting the consumption of steel media in comminution systems in mineral processing are reviewed, together with models predicting wear losses in grinding media. Media wear arises as a consequence of complex interaction between a range of variables related to processing conditions, the characteristics of the media, as well as the ores or slurries, and is not well understood as yet, despite extensive study over the last 50 years and more. The three basic wear mechanisms, impact, abrasion and corrosion, can simultaneously influence mass loss in grinding media. Present studies are difficult to compare directly, owing to imprecise information with regard to the composition of the media or grinding conditions. As a result, most current models do not account for varying conditions inside the mill and their use is restricted to conditions similar to those associated with their calibration. This may not always be possible and alternative modelling methodologies are discussed and demonstrated by means of a case study on simulated data. (C) 2013 Elsevier Ltd. All rights reserved.
10.1016/j.mineng.2013.04.023

Stirred milling kinetics of siliceous goethitic nickel laterite for selective comminution
Tong, L; Klein, B; Zanin, M; Quast, K; Skinner, W; Addai-Mensah, J; Robinson, D
lbtong@mining.ubc.ca; bklein@apsc.ubc.ca; Massimiliano.Zanin@unisa.edu.au
MINERALS ENGINEERING, Aug, 2013, Vol. 49, pp. 109-115

The objective of this study is to determine how grinding conditions affect the breakage rate with respect to the sample mass, major elements, and minerals present in siliceous goethitic (SG) nickel laterite. This information is helpful in determining the optimal grinding conditions for selective comminution and nickel upgrade. The kinetics of batch wet grinding of nickel laterites with feed sizes of 2.38-1.68, 1.68-1.18, 1.18-0.85, 0.85-0.6, 0.6-0.42, 0.42-0.3, 0.3-0.21, and 0.21-0.15 mm were determined using a Netzsch LME4 stirred mill under the following conditions: 1000 rpm, 50% charge volume, 150.0 g of solid. The grinding behaviour of the majority of the feed samples was non-first-order due to the fast breakage rate of soft minerals and the low breakage rate of hard minerals in the feed. Therefore, an enrichment of the soft mineral was obtained in the underscreen product by selective

grinding. The effect of selective grinding on Ni upgrade was evaluated by looking at grinding time, feed size, and product size. Optimum grinding time with respect to Ni upgrade was 0.25 mm for SG nickel laterite samples. Generally, grinding larger particles and/or collecting finer product size yielded better Ni upgrade results. The effect of selective grinding was evaluated by the changes of the major soft and hard minerals for the selected samples. Selective grinding was also examined with respect to the major element weight ratio (e.g. Si/Ni for SG nickel laterite). With respect to Ni upgrade, the best result was achieved from the 1.18-0.85 mm feed on the -400 mesh product after grinding for 0.25 min. The Ni grade increased from 0.73% to 1.30% (upgrade 76.8%), with 14.4% Ni recovery; the Mg grade increased from 1.30% to 3.96% (upgrade 205.6%); the Si grade decreased from 28.7% to 16.2%.
10.1016/j.mineng.2013.05.013

A novel process for titanium sand by magnetic separation and gravity concentration

Chen, LZ; Wen, SM; Xu, GD; Xie, HY
chluzheng@hotmail.com
MINERAL PROCESSING AND EXTRACTIVE METALLURGY REVIEW, 2013, Vol. 34(3), pp. 139-150

With the continuous depletion of high-grade titanium ores and the increasing demand for titanium dioxide, the low-grade titanium sand has become an important source for the production of ilmenite concentrate; however, the large-scale utilization of the sand is disappointedly scarce, due to its leanness in valuable minerals and insufficient methods available to handle such low-grade sands. A typically low-grade titanium sand was first ground and then processed by low-intensity magnetic separation (LMS) and high gradient magnetic separation (HGMS) to recover titanomagnetite and ilmenite, respectively; as the TiO2 grade of the sand is low, the primary treatment of the sand by magnetic separations is effective, with 78.45% by mass weight of the sand discarded as tailings. The primary titanomagnetite concentrate was further ground and liberated to obtain a high-grade titanomagnetite concentrate through LMS reconcentration; the primary ilmenite concentrate was separated with spirals to remove the sterile limonite and magnetic gangues, and its concentrate was ground and liberated to achieve a high-grade ilmenite concentrate through HGMS refining. This novel process achieved an effective processing of the sand and obtained a high-grade ilmenite concentrate assaying 46.30% TiO2 with a high recovery of 57.88%, and a by-product of titanomagnetite concentrate assaying as high as 54.17% Fe.
10.1080/08827508.2011.623749

Analysis of the Chemical, Physical and Energetic Parameters of Coal Sludge Deposits Inventoried in the Silesian Province

Baic, I
ROCZNIK OCHRONA SRODOWISKA, MIDDLE POMERANIAN SCI SOC ENV PROT

KOSZALIN, 2013, Vol. 15, pp. 1525-1548

The paper presents result of investigation of physical, chemical and energetic properties of steam coal slurries deposited in twenty four impoundments. Performed investigation include determination of chemical composition, moisture content, volatile matter, sulfur and calorific value at various states. Additionally, properties of coal slurry of particle size below 0.1 mm are presented. The paper presents also results of energetic potential analysis of coal slurries deposited in impoundments. Results shown are for "as received" basis and for concentrates after beneficiation. Coal slurries were beneficiated using the following techniques: hydrocyclone classifier-separator, centrifugal separator, Reichert spiral separator LD4 and flotation. Assessment of energetic potential was made for concentrate whereas losses of energetic potential due to beneficiation were estimated. The most effective method was flotation where the loss of energetic potential was 15% and varied from 3 to 31% depending on the impoundment. Average value of obtained concentrate was 25 057 kJ/kg being the highest among all of the methods. The research was performed under the development project Nr N R09 0006 06/2009 titled: "Identification of energetic potential of coal slurries in the national fuel balance and technological development strategy of their usage". The project is implemented by the Institute of Mechanized Construction & Rock Mining in Warsaw in cooperation with the Department of Mineral Processing and Waste Utilization of the Silesian University of Technology.

Effect of Particle Fineness on the Finely Disseminated Iron Ore for Beneficiation

Qiu, TS; Zhang, WX; Fang, XH; Gao, GK

POWDERS AND GRAINS 2013

7th International Conference on Micromechanics of Granular Media (Powders and Grains), JUL 08-12, 2013, Sydney, AUSTRALIA, AMER INST PHYSICS, MELVILLE, 2013, Vol. 1542, pp. 1294-1295

This paper focused on Oolitic hematite ore which consists of extremely unequal disseminated particles that are fine-grained and easy to become muddy, It presents the effect of particle fineness, roasting temperature and roasting time and other variables on the beneficiation of this ore. The effect of particle fineness on the concentrate quality was also studied after magnetic roasting, the so-called process of "magnetic roasting-stage grinding-low intensity magnetic separation-cationic reverse flotation" was adopted to treat the raw ore under various experimental conditions including particle fineness, roasting temperature and roasting time, etc. it is found the concentrate grade of TFe of raw ore can be increased from 48.32%(original) to 61.30% at a recovery rate of 80.73%. Results show that the effect of particle fineness on mineral processing indexes is significant.

10.1063/1.4812176

Mixed Concrete Optimization Using Fly Ash, Silica Fume and Iron Slag on the SCC's Compressive Strength

Raharjo, D; Subakti, A; Tavio
putro_yeah@yahoo.com; subaktiaman@yahoo.com; tavio@its.ac.id
2ND INTERNATIONAL CONFERENCE ON REHABILITATION AND MAINTENANCE IN CIVIL ENGINEERING (ICRMCE), MAR 08-10, 2012, Solo, INDONESIA, ELSEVIER SCIENCE BV, AMSTERDAM, 2013, Vol. 54, pp. 827-839

Self-Compacting Concrete (SCC) is an innovative concrete that does not require vibration process to its placing. SCC is able to flow under its own weight, enables it to meet or filling formwork and reached its highest density. SCC requires a mineral Admixture such as fly ash, superplaticiser and other compounds such as iron slag waste from steel mill wastes in the form of fine aggregate in order to meet the specified flowability. Some trial mixtures containing fly ash, silica fume, policarboxilate based of superplasticer, and iron slag have been performed that aims to determine the SCC's optimal composition and meet the requirements of filling ability, passing ability, viscosity and segregation. The concrete's filling ability, passing ability, viscosity and segregation were conducted using slump cone, L-box and V-funnel The cylindrical sample of 10 cm in diameter and 20 cm in heigh of hardenened SCC was also tested at 3.7, 14, 28 and 56 days of concrete age. There were 33 variation of concrete mixture using 495 samples total mixture have been tested. Each composition contained various superplasticizer dosage from 0.5 to 1.8% of cementitious weight. The dosage of silica fume was also varied 0%, 10% and 20% of fly ash weight. The goal that expected from this study is to obtain the optimal material composition of the mixture that produce the maximum compressive strength but cheaper and comptetiteve in price. (C) 2013 The Authors. Published by Elsevier Ltd. Selection and peer-review under responsibility of Department of Civil Engineering, Sebelas Maret University
10.1016/j.proeng.2013.03.076

Recycling of Waste Mineral Materials

Wodzinski, P
ROCZNIK OCHRONA SRODOWISKA, MIDDLE POMERANIAN SCI SOC ENV PROT KOSZALIN, 2013, Vol. 15, pp 1378-1392

This paper deals with the issues of recycling of granular materials in terms of the implementation of two basic technological processes that are used there: grinding and screening of those materials. Primarily mobile sets, used for this form of recycling are discussed. Granular materials discussed in this paper are mineral substances that are found as e.g. tailings, resulting from extraction of minerals. Furthermore, the paper deals with the (performance) characteristics of the mobile units and achievable capacity. Machines and whole sets of equipment discussed in this paper are used to recycle all the waste minerals. The paper contains only description of the basic trends in mechanical engineering destined for recycling

mineral granular materials. Work is not an advertisement of such machines manufacturers, currently on the European market.

The effect of sodium sulphate on the hydrogen reduction process of nickel laterite ore

Lu, J; Liu, SJ; Ju, SG; Du, WG; Pan, F; Yang, S
tjulj@sina.com; 13303460889@163.com; shanggj62@163.com
MINERALS ENGINEERING, Aug, 2013, Vol. 49, pp. 154-164

A series of nickel laterite ores with different calculated amounts of anhydrous sodium sulphate were prepared by physical blending or sodium sulphate solution impregnation. The reduction of the prepared nickel laterite ore by H-2 was carried out in a fluidised-bed reactor with provisions for temperature and agitation control, and the magnetic separation of the reduced ore was performed using a Davis tube magnetic separator. The mineralogical properties of the raw laterite ore, reduced ore and magnetic concentrate were characterised using ICP, TG-DSC, N-2 adsorption, X-ray diffraction and optical microscopy. The catalytic activity of sodium sulphate was also studied by using Hydrogen temperature-programed reduction. The experimental results indicate that Na2SO4 could overcome the kinetic problems faced by the laterite ore and that it exhibited noticeable catalytic activity only if the temperature reached at least 750 degrees C. This high temperature accelerated the crystal phase transition of the silicate minerals and increased the utilisation of H-2. In comparing the results from the two different methods for adding Na2SO4, the nickel content and recovery of the magnetic concentrate were increased by using the impregnation method rather than the physical blending method and the increasing amount of sodium sulphate assisted in the further beneficiation of nickel. The partial pressure of H-2 and the reducing time also affected the reduction process of the iron oxides. The results of the microscopic study indicated that the formation of a Fe-S solid solution, which was derived from the SO2 sulphide reduction of FeO, was conducive to mass transfer and accelerated the coalescence of metallic ferronickel particles. For the nickel laterite ore, under the synergistic effect of sodium sulphate and hydrogen, a nickel content and nickel recovery of 6.38% and 91.07% were obtained, respectively, with high product selectivity.
10.1016/j.mineng.2013.05.023

Study on particle dynamics in different cross sectional shapes of air dense medium fluidized bed separator

Sahu, AK; Tripathy, A; Biswal, SK
altriatl@gmail.com
FUEL, Sep, 2013, Vol. 111, pp. 472-477

Dry coal washing is gaining popularity on account of its ability to produce clean coal without the use of water which is becoming to be a costly resource for beneficiation. Air dense medium fluidized bed separation (ADMFBS) is one of the dry beneficiation

techniques which is used for cleaning of coal. Fine magnetite particles are used as medium to make pseudo-fluid by fluidization method. The effectiveness of ADMFBS depends on stability of the fluidized bed. In the present work, an attempt has been made to study the stability characteristics of different cross-sectional shapes of fluidized bed having same cross-sectional area. Different indicators like fluidization index, particulate expansion function, pressure drop of bed and distributor, minimum fluidization and bubbling velocities were used to characterize the stability of fluidized bed. The effect of different operating and design parameters on the homogeneity and stability of the fluidized bed was studied. It was observed that cross sectional shape of the fluidized bed column has a significant effect on the stability of the bed. Moreover, rectangular cross-sectional shape provides better stability properties compared to square or circular shape.
10.1016/j.fuel.2013.04.011

From Science Direct

F.A. Charalambous, R. Ram, S. McMaster, J. Tardio, S.K. Bhargava, An investigation on the dissolution of synthetic brannerite (UTi2O6), Hydrometallurgy, Volume 139, July 2013, Pages 1-8, ISSN 0304-386X, http://dx.doi.org/10.1016/j.hydromet.2013.06.017.

(http://www.sciencedirect.com/science/article/pii/S0304386X13001254)

Abstract: A number of different uranium minerals are processed in different regions of the world to produce the uranium that is used to generate electricity. The three main types of uranium minerals that are found at the world's largest single uranium bearing ore body at Roxbury Downs, South Australia are uraninite (nominally UO_2), coffinite [$U(SiO_4)_{1-x}(OH)_{4x}$], and brannerite [$U(Ti, Fe)_2O_6$]. Detailed knowledge of the influence of temperature, [H_2SO_4] and [Fe]/solution oxidation–reduction potential (ORP) on the dissolution of uraninite are well known, yet little information on the influence of the aforementioned on the dissolution of brannerite has been reported in the literature. In this study the influence of three key parameters on the rate of synthetic brannerite (UTi_2O_6) dissolution was investigated. The parameters that were investigated included temperature, [H_2SO_4] and [Fe(III)]. Of these parameters [H_2SO_4] and temperature were found to have the most significant effect on the rate/overall extent of UTi_2O_6 dissolution under the test conditions used. Tests conducted on synthetic brannerite residues combined with fresh synthetic brannerite showed that decreases in dissolution rates observed during the dissolution of synthetic brannerite were predominantly not due to decreasing brannerite slurry concentration. The significant decreases in dissolution observed were most likely due to one or more of the following: changes in surface

composition/surface passivation, changes in surface morphology and/or changes in particle size.

Keywords: Uranium; Synthetic brannerite; Synthetic brannerite dissolution; Leaching

Alessio Cibati, Ka Yu Cheng, Christina Morris, Maneesha P. Ginige, Erkan Sahinkaya, Francesca Pagnanelli, Anna H. Kaksonen, Selective precipitation of metals from synthetic spent refinery catalyst leach liquor with biogenic H2S produced in a lactate-fed anaerobic baffled reactor, Hydrometallurgy, Volume 139, July 2013, Pages 154-161, ISSN 0304-386X, http://dx.doi.org/10.1016/j.hydromet.2013.01.022.

(http://www.sciencedirect.com/science/article/pii/S0304386X13000261)

Abstract: This work evaluated the feasibility of using biogenic H2S and NaOH to selectively precipitate molybdenum (Mo), nickel (Ni), cobalt (Co) and vanadium (V) from synthetic spent refinery catalyst leach liquor. A lactate-fed sulfate-reducing anaerobic baffled reactor (ABR) was operated at room temperature to generate the required H2S. The average sulfate reduction rate in the ABR was 130 mg L− 1 d− 1 and the average dissolved sulfide concentration was 190 mg L− 1. Biogenic H2S facilitated the selective precipitation of Mo at pH 2 with recoveries of 36–72%. Vanadium precipitation of 64–70% was achieved with NaOH at pH 6. The purity indices of Mo and V precipitates were 0.97 and 0.90 at pH 2 and pH 6, respectively. Percent Ni and Co precipitations were only up to 23 and 16%, respectively at pH 3.5, and the purity indices of these metals were low due to their simultaneous precipitation. After the optimization of the Ni and Co precipitations, the mixed Ni–Co sulfide solids could be sold to smelters or hydrometallurgical processing to recover the metals. Moreover, using biogenic H2S to selectively precipitate Mo at pH 2 as sulfide and NaOH to precipitate V at pH 6 as hydroxide/oxide could be a viable option for recovering these metals from spent catalysts leachate.

Keywords: Anaerobic baffled reactor; Metal recovery; Spent refinery catalysts; Sulfide precipitation; Sulfate reducing bacteria

Xiugen Fu, Jian Wang, Fuwen Tan, Xinglei Feng, Shengqiang Zeng, Minerals and potentially hazardous trace elements in the Late Triassic coals from the Qiangtang Basin, China, International Journal of Coal Geology, Vol.116–117, 1 September 2013, Pages 93-105, http://dx.doi.org/10.1016/j.coal.2013.07.013.

(http://www.sciencedirect.com/science/article/pii/S0166516213001729)

Abstract: The Tumen coal mine has the largest coal resources in Tibet, which have been developed and utilized as an important energy source in the last decades. It

has raised some health problems during the coal exploration and utilization in Tibet. Fifty Late Triassic coal (or coaly) samples were picked up from the Qiangtang Basin (Tumen mine, Woruoshan and Hongshuihe areas) to determine the minerals, potentially hazardous elements and their mode of occurrence and possible sources. Coal samples from the Qiangtang Basin have medium- and high-ash yields (15.20–47.88%) with low or medium-high total sulfur content (0.04–4.86%). Minerals in Qiangtang Basin coal include clay minerals, dolomite, quartz, pyrite, siderite, and hematite, and trace amounts of halite, feldspar, anhydrite, barite, chromite, and galena. Potentially hazardous trace elements in coal samples include As, Hg, Pb, and Se. Arsenic is controlled mainly by aluminosilicate minerals. Mercury occurs mainly as an organic-bound form. The organically bound Pb is dominant. Selenium is controlled mainly by Fe-bearing (probably pyrite). A proportion of the elevated concentrations of As, Hg, Pb and Se in Qiangtang Basin coal may be related to underlying shale bed. These elements might have been eroded or leached from the shale bed, which were subsequently transported and accumulated syngenetically in the coal-forming peat swamps. The enrichment of As, Hg, Pb, and Se in Qiangtang Basin coal, however, is also partly to be related to magmatic/hydrothermal fluids.

Keywords: Late Triassic coal; Hazardous elements; Enrichment origin; Qiangtang Basin; China

Lei Zhao, Colin R. Ward, David French, Ian T. Graham, Mineralogical composition of Late Permian coal seams in the Songzao Coalfield, southwestern China, International Journal of Coal Geology, Volumes 116–117, 1 September 2013, Pages 208-226, http://dx.doi.org/10.1016/j.coal.2013.01.008.

(http://www.sciencedirect.com/science/article/pii/S0166516213000116)

Abstract: Coals from three seam sections in the Songzao Coalfield, SW China, are mainly high-ash, high-sulphur semianthracites. Minerals within the Songzao coals are mainly kaolinite, pyrite (or marcasite in some cases), and quartz, with various proportions of non-kaolinite clay minerals, carbonates, feldspars, and anatase. The illite and mixed-layer illite/smectite (I/S) are Na-rich in some of the Datong coal samples. The I/S in the lower coals of the Datong section is most likely an alteration product of dispersed volcanic ash, due to the availability of necessary ions (e.g. K, Na, and Mg) in the marine-influenced coal swamp. Organically-bound Na, which was expelled from the organic matter with coal rank advance, especially with anthracitization, may have supplied additional Na for the formation of Na-rich illite. Authigenic I/S also occurs in a Tonghua coal ply that is overlain by a mafic bentonite and underlain by an alkali tonstein. Potassium, Na, and Mg for the formation of such I/S were probably derived from the leaching of the adjacent alkali tonstein and mafic bentonite. Although the marine water was also a possible supplier of the alkali elements, authigenic I/S is rare in coal plies that occur further away from the altered volcanic layer. Leaching of the volcanic claystones in the Tonghua coal seam

probably led to the formation of relatively abundant anatase and rhabdophane in the underlying coal ply. Fracture-filling REE minerals (probably REE-hydroxides or oxyhydroxides) also occurring in that coal ply crystallized from ascending REE-rich hydrothermal fluids, probably associated with contemporaneous volcanic activity.

Keywords: Mineral matter; Coal; Tonstein; K-bentonite; Late Permian; SW China

Alexandra Golab, Colin R. Ward, Asep Permana, Paul Lennox, Pieter Botha, High-resolution three-dimensional imaging of coal using microfocus X-ray computed tomography, with special reference to modes of mineral occurrence, International Journal of Coal Geology, Volume 113, 1 July 2013, Pages 97-108, ISSN 0166-5162, http://dx.doi.org/10.1016/j.coal.2012.04.011.

(http://www.sciencedirect.com/science/article/pii/S0166516212001334)

Abstract: Samples of coal from the Sydney and Bowen Basins of eastern Australia have been imaged at high resolution using a large-field, 3D microfocus X-ray computed tomography (μCT) system, with special but not exclusive attention to evaluating the modes of occurrence of the mineral matter within the coal. The samples imaged were 110 mm, 25 mm, 19 mm, 10 mm, and 4 mm in size, yielding voxel dimensions of 54, 30, 12, 6, and 3 μm respectively. Data collection was carried out using a helical stage, providing images with > 20002 voxels in the horizontal (X–Y) plane and up to 3500 voxels high. Three-dimensional image blocks derived from the scans were examined as cross-sections along orthogonal planes and as perspective images, manipulated to be viewed from any angle. Imaging after saturating the coal with X-ray attenuating brine was also carried out to highlight the distribution of connected micro-pores and cleats, and improve the detail of features seen within the samples. Features evaluated within the coals included the size and three-dimensional distribution of siderite nodules, and different types of mineral infillings in petrifactions of maceral components. Individual macerals could also be identified within the coal, based partly on X-ray density and partly on the associated porosity and structure. In some cases high-resolution images enabled the nature of individual plant particles to be identified within the coal samples. Mineral-filled cleats and open fractures were also evaluated, including the origin of radiating fracture patterns around siderite nodules in vitrinite. In some cases several generations of cleat and/or fractures could be distinguished, and the sequence of their formation and infilling was interpreted. Complementary analyses of the mineral matter in the samples were carried out using X-ray diffraction, as well as examination of polished sections by optical microscopy examination. Images obtained from the μCT scans were also registered against SEM–EDX and QemSCAN images of polished sections prepared from the same samples after scanning, providing a more definitive basis for identifying the different components and for integrating μCT data with results from other petrographic and electron microscope studies.

Keywords: Mineral matter; X-ray tomography, petrifactions; Siderite nodules; Fracture fillings; Australia

Asep K. Permana, Colin R. Ward, Zhongsheng Li, Lila W. Gurba, Distribution and origin of minerals in high-rank coals of the South Walker Creek area, Bowen Basin, Australia, International Journal of Coal Geology, Vol.116–117, 1 September 2013, Pages 185-207,http://dx.doi.org/10.1016/j.coal.2013.03.001.

(http://www.sciencedirect.com/science/article/pii/S0166516213000645)

Abstract: The coals of the South Walker Creek area in the northern Bowen Basin, with a vitrinite reflectance (Rvmax) of 1.7 to 1.95%, are among the highest rank coals currently mined in Australia. X-ray diffraction studies have identified an unusual mineral variation through the vertical sequence, with kaolinite-rich assemblages typical of other Australian coals at the top and bottom of the seam section and an illite–chlorite assemblage resembling a metamorphic association in the middle. Calcite and ankerite are also abundant in parts of the vertical sequence. Diaspore is abundant in the middle section of the seam in some areas, and paragonite, dickite or nacrite occurs in some locations as well. The distribution of the non-carbonate mineral assemblages cross-cuts the seam stratigraphy, and appears to be primarily controlled by faults and other structural features. Integration of the mineral distribution with optical and electron microscope data on the coal and non-coal bands, chemical data from coal ash analysis, and information from X-ray micro-tomography, suggests that the illite–chlorite and diaspore-bearing assemblages resulted from hydrothermal effects associated with fluid migration through the middle part of the coal seam. This is further confirmed by the development of metamorphic textures in a tonstein band, also altered to illite and chlorite, in the illite-rich part of the seam section, in contrast to a tonstein with more normal sedimentary textures and a kaolinite composition in the kaolinite-rich upper part of the seam. Detailed studies of cleat mineralisation suggest that fluids rich in Ca, Mg and Al were introduced relatively early in the seam's post-depositional history, associated with heat flow sufficient to alter the minerals in the coal and tonstein in the affected part of the seam section. The relatively uniform vitrinite reflectance profile observed through the seam section may indicate that the coal was already of high rank before the fluids were introduced, or that any localised heat effects on the organic matter associated with the changes in clay mineralogy were overprinted by subsequent wider-ranging rank advance processes.

Marcos L.S. Oliveira, Colin R. Ward, Carlos H. Sampaio, Xavier Querol, César M.N.L. Cutruneo, Silvio R. Taffarel, Luis F.O. Silva, Partitioning of mineralogical and inorganic geochemical components of coals from Santa Catarina, Brazil, by industrial beneficiation processes, International Journal of Coal Geology, Volumes 116–117, 1 September 2013, Pages 75-92, ISSN 0166-5162, http://dx.doi.org/10.1016/j.coal.2013.07.002.

(http://www.sciencedirect.com/science/article/pii/S0166516213001614)

Abstract: Comparative studies of the mineral matter and trace elements in 12 pairs of run-of-mine (ROM) and clean-coal products from beneficiation plants in Santa Catarina, southern Brazil, have been carried out using low-temperature oxygen-plasma ashing, X-ray diffraction and chemical analysis techniques with the aim of evaluating the effect of coal preparation on the mineralogy and chemical composition of the final coal products. The results show that substantial reductions in mineral matter and ash percentages are associated with beneficiation of coals mined from the different deposits. These reductions are accompanied by changes in the percentages of Fe2O3 in the respective coal ashes, due to the reduction in the proportion of pyrite in the mineral matter, and also by a reduction in the percentage of Na2O, possibly due to ion exchange within the clay minerals. The relative proportions of quartz, clay minerals, and minor phases such as calcite and feldspar (mainly albite) within the mineral matter are not, however, significantly changed by the beneficiation processes. The concentrations of most trace elements in the beneficiation products are similar to the respective concentrations in the relevant ROM materials, or are reduced to an extent similar to that of the total mineral matter percentage for the respective coal samples. This suggests an association mainly with the clay-rich mineral matter. The concentrations of As and Pb, however, are reduced to a greater extent for most samples by the beneficiation processes, consistent with a pyrite association. Concentrations of Ge, U and Zr are higher in many of the clean coals than in the respective run-of-mine materials, suggesting the possibility of preferential association, at least for some deposits, with the organic-rich fractions of the coals concerned.

Keywords: Mineral matter; X-ray diffraction; Coal preparation; Pyrite; Trace element

S. Giffin, R. Littke, J. Klaver, J.L. Urai, Application of BIB–SEM technology to characterize macropore morphology in coal, International Journal of Coal Geology, Volume 114, 30 July 2013, Pages 85-95, ISSN 0166-5162, http://dx.doi.org/10.1016/j.coal.2013.02.009.

(http://www.sciencedirect.com/science/article/pii/S016651621300061X)

Abstract: We use broad ion beam (BIB) milling to prepare low-relief polished surfaces of coal samples for high-resolution SEM imaging, in a study of the morphology and distribution of macro- and mesopores. Results show that the BIB-sections of a few square millimeters are not large enough to be statistically representative so that porosity was investigated as a function of maceral type. For a vitrinite maceral type, we found comparably little visible macroporosity within the resolution limits of the SE detector. Less than 2% of all the meso- and macropores studied were found in vitrinites. Pore morphology in an inertinite maceral is dependent on the original maceral. Fusinite yields large, elongated pores (often filled with mineral phases), while macrinite shows comparatively smaller, rounder pores. The distribution of pore sizes follows a similar power law at different

magnifications. Our results show that micropores and macropores in coal belong to different populations, with different size distributions and morphologies. BIB–SEM imaging is a useful tool to study meso- and macropore morphology, especially in the size range between 10 nm and 10 μm, but more maceral types should be characterized for a better characterization of maceral porosity at different stages of coalification.

Keywords: Coal porosity; Broad-ion-beam milling; SEM imaging; Pore morphology; Pore size distribution; Vitrinite maceral; Inertinite maceral

Henryk Sechman, Maciej J. Kotarba, Janusz Fiszer, Marek Dzieniewicz, Distribution of methane and carbon dioxide concentrations in the near-surface zone and their genetic characterization at the abandoned "Nowa Ruda" coal mine (Lower Silesian Coal Basin, SW Poland), International Journal of Coal Geology, Volumes 116–117, 1 September 2013, Pages 1-16, ISSN 0166-5162, http://dx.doi.org/10.1016/j.coal.2013.05.005.

(http://www.sciencedirect.com/science/article/pii/S0166516213001353)

Abstract: The closure of hard coal mines in the Lower Silesian Coal Basin (SW Poland) resulted in migration of coal-bed gases (mostly methane and carbon dioxide) towards the surface. The gases were driven out by rising groundwater table in the Pennsylvanian aquifer (so-called "water piston effect"). Because such migration may be a hazard for inhabitants living in the post-mining lands a surface geochemical survey was carried out in the area of the closed "Nowa Ruda" hard coal mine. The research aimed at: (i) evaluating the distribution of methane and carbon dioxide concentrations in the near-surface zone, (ii) determining the genetic characteristics of soil gases and (iii) comparing their characteristics with that of coal-bed gases. The surface geochemical survey included sampling of soil gases and chromatographic analyses of samples for methane and carbon dioxide concentrations and for stable carbon isotope composition in samples of increased methane and carbon dioxide concentrations. Samples were collected along 8 sampling lines located in the mining fields "Piast", "Słupiec" and "Wacław". In total, 390 soil gas samples were collected from 1.2 m depth. Maximum methane and carbon dioxide concentrations were 7.8 and 5.8 vol.%, respectively. Almost all methane encountered in the analyzed samples of soil gases are of microbial origin and were generated during recent anaerobic processes in the near-surface zone. High concentration of carbon dioxide was generated by aerobic biodegradation of organic matter in abandoned mines. Moreover, carbon dioxide was originated during the near-surface oxidation of methane. Only sometimes insignificant thermogenic component of coal-bed methane and carbon dioxide which migrated to near-surface zone from Pennsylvanian coal-bed strata occurs. Moreover an insignificant component of endogenic carbon dioxide also migrated though the faults from deep-seated volcanic chambers and/or even from upper mantle in the "Piast" mining field. The results of our research revealed that the changes of soils gas concentrations in the "Słupiec" field do not indicate "water

piston effect''. The highest state of gas emergency by inflow of deep-gases to near-surface zone could take place in the years 2008–2010 therefore much later than the near-surface measurement sessions in 2004. In the ''Piast'' field a relatively high number of anomalous concentrations of methane and carbon dioxide were measured. Such values results from degassing of groundwaters, the table of which stabilized within the Pennsylvanian aquifer in 2000. Gases migrated towards the surface along the fracture systems and faults, particularly along the Main and the Great faults. A great number of anomalously high carbon dioxide concentrations were measured in the ''Wacław'' field, which is an effect of groundwater table stabilization within the Pennsylvanian rocks. Carbon dioxide migrates towards the surface along the bedding planes of Pennsylvanian coal-bearing strata and along the linings of remediated ''Wacław'' and ''Wanda'' shafts. The highest state of gas emergency by inflow of deep-gases to near-surface zone caused by the uprising of Pennsylvanian water table (''piston effect'') could take place in ''Piast'' mining field in the years 1998–2000, and in ''Wacław'' mining field in the years 1978–1980, therefore much earlier than the near-surface measurement sessions in 2004.

Keywords: Soil gas; Methane origin; Carbon dioxide origin; Stable isotope; ''Nowa Ruda'' coal mine; Polish Lower Silesian Coal Basin

Sharon M. Swanson, Mark A. Engle, Leslie F. Ruppert, Ronald H. Affolter, Kevin B. Jones, Partitioning of selected trace elements in coal combustion products from two coal-burning power plants in the United States, International Journal of Coal Geology, Volume 113, 1 July 2013, Pages 116-126, ISSN 0166-5162, http://dx.doi.org/10.1016/j.coal.2012.08.010.

(http://www.sciencedirect.com/science/article/pii/S0166516212002133)

Abstract: Samples of feed coal (FC), bottom ash (BA), economizer fly ash (EFA), and fly ash (FA) were collected from power plants in the Central Appalachian basin and Colorado Plateau to determine the partitioning of As, Cr, Hg, Pb, and Se in coal combustion products (CCPs). The Appalachian plant burns a high-sulfur (about 3.9 wt.%) bituminous coal from the Upper Pennsylvanian Pittsburgh coal bed and operates with electrostatic precipitators (ESPs), with flue gas temperatures of about 163 °C in the ESPs. At this plant, As, Pb, Hg, and Se have the greatest median concentrations in FA samples, compared to BA and EFA. A mass balance (not including the FGD process) suggests that the following percentages of trace elements are captured in FA: As (48%), Cr (58%), Pb (54%), Se (20%), and Hg (2%). The relatively high temperatures of the flue gas in the ESPs and low amounts of unburned C in FA (0.5% loss-on-ignition for FA) may have led to the low amount of Hg captured in FA. The Colorado Plateau plant burns a blend of three low-S (about 0.74 wt.%) bituminous coals from the Upper Cretaceous Fruitland Formation and operates with fabric filters (FFs). Flue gas temperatures in the baghouses are about 104 °C. The elements As, Cr, Pb, Hg, and Se have the greatest median concentrations in the fine-grained fly ash product (FAP) produced by cyclone separators, compared to the other CCPs at this plant. The median concentration of

Hg in FA (0.0983 ppm) at the Colorado Plateau plant is significantly higher than that for the Appalachian plant (0.0315 ppm); this higher concentration is related to the efficiency of FFs in Hg capture, the relatively low temperatures of flue gas in the baghouses (particularly in downstream compartments), and the amount of unburned C in FA (0.29% loss-on-ignition for FA).

Keywords: Partitioning; Trace elements; Mercury; Fly ash; Mass balance

Barbara Bielowicz, Petrographic composition of Polish lignite and its possible use in a fluidized bed gasification process, International Journal of Coal Geology, Volumes 116–117, 1 September 2013, Pages 236-246, ISSN 0166-5162, http://dx.doi.org/10.1016/j.coal.2013.07.003.

(http://www.sciencedirect.com/science/article/pii/S0166516213001626)

Abstract: The main objectives of the study include the estimation of the proportion of lithotypes and macerals in lignite deposits and the determination of petrographic criteria for the assessment of quality and possible use of lignite in fluidized bed gasification process. Measures taken to meet the objectives included field research and laboratory studies. The study included results from 293 samples of low-rank coal from Polish deposits. The data used in the study included currently exploited, abandoned and prospective lignite deposits. Lignite deposits were divided into seven regions: A—Western, B—Legnica, C—Wielkopolska, D—Konin, E—Łódź–Bełchatów, F—North, and G—Radom. Polish lignite deposits include mainly humic coal, with four basic lithotypes identified: xylitic coal, xylo-detritic coal, detro-xylitic coal and detritic coal. Dominating lithotypes include detritic coal and xylo-detritic coal. Fibrous xylites, present only in minor amounts in Polish lignite, have a negative influence on coal gasification process (grinding). The highest content of fibrous xylites is observed in the Konin region. Petrographic composition of coal was determined on the basis of maceral group and the sum of gelified macerals. It has been found that the influence of macerals from the huminite group on fluidized bed gasification is significant. The average content of this component in tested coal is 89%. Meanwhile, average content of macerals from the liptinite group in Polish coal is 8%, while for macerals from the inertinite group it is 3%. The content of mineral matter in lignite deposits is a highly variable parameter. According to the proposed scheme, in order to be suitable for fluidized bed gasification, the maceral composition of the coal should contain at least 80% huminite, while the sum of the macerals from the inertinite group and mineral matter should be less than 20%. Taking into account the whole region, it should be noted that petrographic composition of lignite in almost all of the deposits allows its use in the process of fluidized bed gasification. However, limited usefulness in this process can be observed in some of the deposits containing bituminiferous lignite.

Keywords: Lignite; Coal gasification; Petrography; Fluidized bed gasification

Ilknur Erol, Hamit Aydin, Vedat Didari, Suphi Ural, Pneumoconiosis and quartz content of respirable dusts in the coal mines in Zonguldak, Turkey, International Journal of Coal Geology, Volumes 116–117, 1 September 2013, Pages 26-35, ISSN 0166-5162, http://dx.doi.org/10.1016/j.coal.2013.05.008.

(http://www.sciencedirect.com/science/article/pii/S0166516213001407)

Abstract: Coal Worker's Pneumoconiosis (CWP) is one of the most important occupational health problems in Turkish coal mining. Despite the decrease in employment and production at Turkish Hardcoal Enterprise (TTK) in the Zonguldak Basin, the occurrence of pneumoconiosis is still very high, particularly among the face workers. This study aims to evaluate the dust concentrations and quartz contents of respirable dusts in coal faces and pneumoconiosis risks related to face workers in TTK collieries. The mean respirable dust exposure experienced by the face workers was evaluated and compared with the occupational exposure limits. The data on the dust samples exhibit great variations. The quartz contents of respirable dusts were determined by a FTIR spectrophotometer. The mean respirable dust concentration in the coal faces varies from 1.6 to 14.5 mg/m3 while the quartz content varies from 0.7 to 10.4%. The mean respirable dust concentrations in the coal faces in Karadon, Amasra, Armutcuk and Kozlu collieries are above the TLV (5 mg/m3) of Turkey and the percentage of the measurements exceeding the TLV in the coal faces range from 25% to 100. An analysis of variance was performed to investigate the effects of workplace and seam characteristics on respirable dust levels. According to the results of variance analysis (ANOVA), it was seen that there are significant differences between seams and collieries in terms of dust concentration and quartz contents of respirable dust.CWP is still the most important problem in the collieries of TTK. The occurrence of CWP is higher among underground face workers. There have been 200 CWP cases in the last decade with a prevalence rate of 6.3%. CWP rates in the coal faces of the collieries increase as the respirable dust levels and quartz contents increase in general. This finding indicates that the TLV (5 mg/m3) of Turkey should be re-evaluated and additional safety precautions should be taken in the workplaces where high quartz contents of respirable dust exist.

Keywords: Respirable dust; Quartz; Coal rank; Infrared spectroscopy; Pneumoconiosis; Analysis of variance

Zaixing Huang, Michael A. Urynowicz, Patricia J.S. Colberg, Bioassay of chemically treated subbituminous coal derivatives using Pseudomonas putida F1, International Journal of Coal Geology, Volume 115, 1 August 2013, Pages 97-105, ISSN 0166-5162, http://dx.doi.org/10.1016/j.coal.2013.01.012.

(http://www.sciencedirect.com/science/article/pii/S0166516213000219)

Abstract: A selection of chemical reagents representing acids (HNO3), bases (NaOH) and oxidants (KMnO4 and catalyzed H2O2) was used to pretreat coal in order to enhance its solubility. The relative bioavailability of the solubilized fractions was assessed using bioassay with Pseudomonas putida F1 by monitoring the production of carbon dioxide (CO2). This bioassay has been shown to be an effective tool for quickly determining the biological potential of coal as substrate for the enhanced production of biogenic natural gas. The concentrations of total dissolved organic carbon in the pretreated samples showed that nitric acid and sodium hydroxide were the most promising pretreatment agents with up to 14.0% of coal carbon solubilized. However, bioassay results indicated that the coal pretreatment with permanganate at high concentration resulted in the largest fraction of bioavailable solubilized constituents. Approximately 20.0% of the soluble carbon was biochemically converted to CO2 within a period of 14-days, accounting for nearly 1.1% of the total coal carbon. Although high concentrations of nitrate (NO3−) and sodium (Na+) associated with the acid and base pretreatments may have inhibited the activity of the microorganisms during the bioassay, relatively high concentrations of purgeable organic carbon and other readily biodegradable forms support the study's conclusion.

Keywords: Subbituminous coal; Pretreatment; Chemical agents; Biometer assay; Coalbed natural gas

Peter Hatherly, Overview on the application of geophysics in coal mining, International Journal of Coal Geology, Volume 114, 30 July 2013, Pages 74-84, ISSN 0166-5162, http://dx.doi.org/10.1016/j.coal.2013.02.006.

(http://www.sciencedirect.com/science/article/pii/S0166516213000463)

Abstract: Since their introduction to the coal mining industries of the United Kingdom and West Germany in the 1970s, geophysical methods are now utilised in coal mining around the world. The range of applications in both surface and underground mining is extensive. Applications include coal seam mapping and geological fault detection, lithological mapping, geotechnical evaluation, assessment of the rock mass response to mining, detection of voids, location of trapped miners and guidance of drills and mining equipment. The range of techniques that can be employed is also extensive and includes geophysical borehole logging, the potential field methods, seismic reflection (2D and 3D), resistivity, electromagnetics and microseismic monitoring using active and passive sources. This paper discusses the major applications and the geophysical methods that can be applied. It also discusses future trends and suggests that the future motives for applying geophysics will not only include the current motivations of mine safety and productivity but will also include an increased emphasis on environmental management, the monitoring of sequestration activities and the provision of sensors to enable autonomous mining.

Keywords: Geophysics; Coal mining; Overview

Meifen Li, Fangui Zeng, Haizhou Chang, Bingshe Xu, Wei Wang, Aggregate structure evolution of low-rank coals during pyrolysis by in-situ X-ray diffraction, International Journal of Coal Geology, Volumes 116–117, 1 September 2013, Pages 262-269, ISSN 0166-5162, http://dx.doi.org/10.1016/j.coal.2013.07.008.

(http://www.sciencedirect.com/science/article/pii/S0166516213001675)

Abstract: Two competitive processes, i.e. decomposition and condensation, exist in coal pyrolysis. Although a number of approaches have been used to investigate its mechanism, the ex-situ analysis methods cannot reveal the real pyrolysis process because of the complexity of coal pyrolysis. In the present study, the evolution characteristics and mechanism of the aggregate structure of four low-rank coals during pyrolysis process were investigated by the combination of in-situ X-ray diffraction (XRD) and thermogravimetry coupled with mass spectrometry (TG/MS). All the four samples had similar pathways of structural evolution during heat treatment up to 900 °C, which can be divided into four distinct stages based on the X-ray structural parameters (d002, Lc, La). The relationship between the structure evolution of coals and gas generation during pyrolysis was investigated. Stage 1 was characterized by obvious increase of d002 and decrease of Lc and La, indicating the imperfection of the aggregate structure due to the swell of small molecules in the interlayer stacking structure and the broken of the hydrogen bonds. Minor changes of these parameters in stage 2 demonstrated the stability of aromatic layers during the main pyrolysis stage. Stage 3 was identified by the distinct decrease of d002 and increase of Lc and La, reflecting the development of aggregate structure, which is accompanied by the evolution of H2. In the last stage, d002, Lc and La showed minor changes.

Keywords: In-situ; X-ray diffraction; Low-rank coals; TG/MS analysis; Aggregate structure

Elizabeth J.P. Jones, Steve H. Harris, Elliott P. Barnhart, William H. Orem, Arthur C. Clark, Margo D. Corum, Julie D. Kirshtein, Matthew S. Varonka, Mary A. Voytek, The effect of coal bed dewatering and partial oxidation on biogenic methane potential, International Journal of Coal Geology, Volume 115, 1 Aug 2013, pp. 54-63, http://dx.doi.org/10.1016/j.coal.2013.03.011.

(http://www.sciencedirect.com/science/article/pii/S0166516213001055)

Abstract: Coal formation dewatering at a site in the Powder River Basin was associated with enhanced potential for secondary biogenic methane determined by using a bioassay. We hypothesized that dewatering can stimulate microbial activity and increase the bioavailability of coal. We analyzed one dewatered and two water-saturated coals to examine possible ways in which dewatering influences coal bed natural gas biogenesis by looking at differences with respect to the native coal microbial community, coal-methane organic intermediates, and residual coal

oxidation potential. Microbial biomass did not increase in response to dewatering. Small Subunit rRNA sequences retrieved from all coals sampled represented members from genera known to be aerobic, anaerobic and facultatively anaerobic. A Bray Curtis similarity analysis indicated that the microbial communities in water-saturated coals were more similar to each other than to the dewatered coal, suggesting an effect of dewatering. There was a higher incidence of long chain and volatile fatty acid intermediates in incubations of the dewatered coal compared to the water-saturated coals, and this could either be due to differences in microbial enzymatic activities or to chemical oxidation of the coal associated with O2 exposure. Dilute H2O2 treatment of two fractions of structural coal (kerogen and bitumen + kerogen) was used as a proxy for chemical oxidation by O2. The dewatered coal had a low residual oxidation potential compared to the water-saturated coals. Oxidation with 5% H2O2 did increase the bioavailability of structural coal, and the increase in residual oxidation potential in the water saturated coals was approximately equivalent to the higher methanogenic potential measured in the dewatered coal. Evidence from this study supports the idea that coal bed dewatering could stimulate biogenic methanogenesis through partial oxidation of the structural organics in coal once anaerobic conditions are restored.

Keywords: Coalbed natural gas; Biomethanogenesis; Stimulation; Dewatering; Oxidation; Coal bioavailability

Zofia Majewska, Stanisław Majewski, Jerzy Ziętek, Swelling and acoustic emission behaviour of unconfined and confined coal during sorption of CO2, International Journal of Coal Geology, Volumes 116–117, 1 September 2013, Pages 17-25, ISSN 0166-5162, http://dx.doi.org/10.1016/j.coal.2013.06.001.

(http://www.sciencedirect.com/science/article/pii/S0166516213001389)

Abstract: This paper presents the results of simultaneous measurements of strains, stress and acoustic emission (AE) induced in cylindrical coal samples by CO2 sorption. The experiment comprised two sorption tests. In the first one, an unconfined sample was used, while in the second, before sorption, the sample was axially compressed under high vacuum up to 25–30% of its compressive strength (previously determined on a parallel sample in a uniaxial compression test under vacuum). The experimental set-up consisted of a pressure vessel mounted in a loading frame and the associated pressurisation and monitoring systems. Measurements were made keeping the gas pressure inside the test vessel constant.

The experiments have shown that an applied axial stress results in the development of internal stress within the coal and also in the reduction of both swelling and acoustic emission by about 60% and 80%, respectively. This may indicate that the effect of self-stressing as a result of CO2 sorption by coal under constrained conditions should be taken into account in ECBM reservoir modelling.

Cecilia Lund, Pertti Lamberg, Therese Lindberg, Practical way to quantify minerals from chemical assays at Malmberget iron ore operations – An important tool for the geometallurgical program, Minerals Engineering, Vol. 49, August 2013, Pages 7-16, http://dx.doi.org/10.1016/j.mineng.2013.04.005.

(http://www.sciencedirect.com/science/article/pii/S0892687513001106)

Abstract: This is the first step in establishing a geometallurgical program for the Malmberget iron ore deposit, northern Sweden. Geometallurgy captures geological and metallurgical (processing) information into a spatially-based predictive model of mineral processing characteristics. This paper describes the development of a practical, fast and inexpensive technique to quantify minerals from routine chemical assays. Ore samples and process samples from two different orebodies were used in the process of developing this element to mineral conversion technique that involved electron microprobe (EPMA), X-ray fluorescence (XRF) and SATMAGAN analyses. The method was validated against QEMSCAN analyses. From the calculated modal mineralogy an ore classification system was established based on the iron mineralogy, iron mineral grades and gangue mineralogy to create a preliminary geological/geometallurgical model of the ore. However, in a geometallurgical context the modal composition is not sufficient and the geological model requires information on mineral textures, too.

Keywords: Geometallurgy; Iron ore; QEMSCAN; Modal mineralogy; Geological model

Paul R. Norris, Nicolas P. Burton, Darren A. Clark, Mineral sulfide concentrate leaching in high temperature bioreactors, Minerals Engineering, Volume 48, July 2013, Pages 10-19, http://dx.doi.org/10.1016/j.mineng.2013.01.001.

(http://www.sciencedirect.com/science/article/pii/S0892687513000034)

Abstract: Mineral sulfide concentrate oxidation by thermoacidophilic archaea was reported in the 1970s with a culture which was described as “possibly related to Sulfolobus” but which contained the species later named as Acidianus brierleyi. In the following two decades, the mineral sulfide-oxidizing capacity of Sulfolobus metallicus became the subject of many studies partly because it appeared to tolerate higher concentrations of copper and solids in bioreactors than those tolerated by the strains of Acidianus and Metallosphaera that were available. However, some bioreactor pilot plant developments followed with mixed cultures dominated by A. brierleyi at 70 °C. At higher temperatures, pilot and industrial demonstration plants used mixed cultures dominated by poorly characterized novel species. Most of these novel species will require classification in novel genera to reflect their phylogenetic separation from previously named thermoacidophilic archaea.

Keywords: Bioleaching; Thermophiles; Mineral sulfide processing

Jian Zhang, Nimal Subasinghe, Prediction of mineral liberation characteristics of comminuted particles of high grade ores, Minerals Engineering, Volume 49, August 2013, Pages 68-76, http://dx.doi.org/10.1016/j.mineng.2013.05.005.

(http://www.sciencedirect.com/science/article/pii/S0892687513001465)

Abstract: In mineral processing, the liberation of valuable mineral is of key importance in achieving high recoveries from downstream separation processes such as froth flotation and gravity concentration. To quantify mineral liberation, information on ore texture of the parent rock as well as properties of comminuted particles is essential. These properties have been quantified by statistical measures such as the proximity function and covariance function, which were extracted from SEM images of parent rock and particle polished sections, using convenient and efficient image analysis techniques based on Labview™ software. To quantify fully liberated particles, a phase specific line segment function has been introduced and evaluated by placing random line segments on the image. It was also found that the ore texture assumptions made by Barbery are not valid for the high grade sulphide ore tested and the general applicability of these assumptions is therefore questionable. Using the measured information above, predictive liberation models to quantify volumetric grade distribution of particles in 1D and 3D have been developed based on Barbery's work. Results show that the grade distributions of composite particles predicted from the proposed 1D model is closest to measured data than those of Barbery's 1D model. The predictions using the proposed 3D model are similar to those predicted from Barbery's model and are considered more realistic as the model does not rely on assumed ore texture but on measurements made on the parent rock and particle sections.

Keywords: Mineral liberation modelling; Ore texture; Texture descriptors; Particle structure; Image analysis; Labview™

F. May, S. Hamann, A. Quade, V. Brüser, Study on Cu2S mineral surface modification by low temperature Ar/O2 plasmas, Minerals Engineering, Vol. 50–51, Sept 2013, Pages 48-56, http://dx.doi.org/10.1016/j.mineng.2013.06.001.

(http://www.sciencedirect.com/science/article/pii/S0892687513001891)

Abstract: The oxidation of mineral and synthetic chalcocite (Cu2S), using low temperature plasmas, has been investigated and compared to thermodynamic calculations. The main aim of this work is to understand the fundamental interaction between mineral surfaces and low temperature plasmas, with a view to improving froth flotation by mineral pretreatments. Capacitive radio frequency (RF) discharge Ar/O2 plasmas, operating at different external parameters, have been used to treat powder samples, which resulted in surface modifications. These were analyzed by X-ray photoelectron spectroscopy (XPS) and X-ray diffraction (XRD). In situ mass spectrometry (MS) was used to determine oxidation reaction rates. The energy flux density from the plasma on the sample surface was determined by active thermal

probe measurements, and the density of atomic oxygen produced within the plasma zone was obtained by optical emission spectroscopy (OES). Sulfur dioxide (SO2), one reaction product of mineral Cu2S plasma oxidation, was emitted with a certain delay, which depends on energy flux density and atomic oxygen density. In contrast, no delay was found as synthetic Cu2S was treated. This indicates that the contamination by pyrite (FeS2), found in mineral samples, plays an important role, significantly influencing the mechanisms of plasma surface interaction. Comparisons of mass spectrometry (MS)-, XPS- and XRD-measurement results with thermodynamic calculations give evidence for a stepwise plasma processing, whereas the transition of sulfur atoms from FeS2 to Cu2S could be identified as a first step in forming cupric sulfate (CuSO4). This effect might be used to develop selective plasma surface pretreatments for mineral mixtures in order to improve their separation efficiency of froth flotation.

Keywords: Froth flotation; Sulfide ores; Surface modification; Oxidation; Reaction kinetics

Ozgur Ozcan, Hakan Benzer, Comparison of different breakage mechanisms in terms of product particle size distribution and mineral liberation, Minerals Engineering, Volume 49, August 2013, Pages 103-108, ISSN 0892-6875, http://dx.doi.org/10.1016/j.mineng.2013.05.006.

(http://www.sciencedirect.com/science/article/pii/S0892687513001477)

Abstract: The comminution process is still governed by a large number of factors that influence the liberation of the valuable components in the ore. A better understanding of these basic factors will provide more certainty about the design of equipment in order to achieve the best liberation and energy efficiency. Impact and bed breakage mechanisms were investigated as two distinctly different modes of breakage. Standard drop weight tests and hydraulic piston-die press tests were conducted with different energy intensities on samples. This paper describes the work carried out for the comparison of mineral liberation and particle size distribution in the particle bed breakage with impact breakage of two different copper ores. Ground products from these two different modes of breakage were screened into size fractions which were analyzed for the particle size distributions by sieve analysis and the degree of liberation by an image analysis system. The results of these analyses were statistically compared to make inferences in relation to the stated objective of the work. Test results indicated that compressive bed breakage mechanism gives finer product particle size distribution and provides better mineral liberation compared to impact breakage mechanism.

Keywords: Liberation; Breakage; Impact breakage; Compressed bed breakage

Chris Aldrich, Consumption of steel grinding media in mills – A review, Minerals Engineering, Volume 49, August 2013, Pages 77-91, ISSN 0892-6875, http://dx.doi.org/10.1016/j.mineng.2013.04.023.

(http://www.sciencedirect.com/science/article/pii/S0892687513001374)

Abstract: In this study, the current understanding of the factors affecting the consumption of steel media in comminution systems in mineral processing are reviewed, together with models predicting wear losses in grinding media. Media wear arises as a consequence of complex interaction between a range of variables related to processing conditions, the characteristics of the media, as well as the ores or slurries, and is not well understood as yet, despite extensive study over the last 50 years and more. The three basic wear mechanisms, impact, abrasion and corrosion, can simultaneously influence mass loss in grinding media. Present studies are difficult to compare directly, owing to imprecise information with regard to the composition of the media or grinding conditions. As a result, most current models do not account for varying conditions inside the mill and their use is restricted to conditions similar to those associated with their calibration. This may not always be possible and alternative modelling methodologies are discussed and demonstrated by means of a case study on simulated data.

Keywords: Comminution; Grinding media; Wear; Models

Antonio G. Merma, Maurício L. Torem, José J.V. Morán, Marisa B.M. Monte, On the fundamental aspects of apatite and quartz flotation using a Gram positive strain as a bioreagent, Minerals Engineering, Volume 48, July 2013, Pages 61-67, ISSN 0892-6875, http://dx.doi.org/10.1016/j.mineng.2012.10.018.

(http://www.sciencedirect.com/science/article/pii/S0892687512003603)

Abstract: Mineral bioflotation encompasses the principles and methods used in mineral flotation using microorganisms as flotation reagents. This work deals with the fundamental aspects of apatite and quartz flotation using Rhodococcus opacus bacteria as a bioreagent. Each mineral sample was conditioning with the bacterial suspension in a rotary shaker under specific conditions as particle size, biomass concentration, pH solution and conditioning time, for all the studies done during the research. The zeta potential results showed a change in zeta potential measurements of the minerals after the bacterial interaction. This change was more significant in the zeta potential curves of apatite than those for quartz. The results also suggest that the bacterial adhesion onto the mineral surfaces was predominantly specific. The greatest apatite flotability achieved 90% at pH around 5, in the presence of 150 mg L−1 of bacteria after 5 min of flotation. On the other hand, quartz achieved a flotability of 14% under identical experimental conditions. The fundamental flotation studies revealed the prospect that R. opacus presents as a biocollector and biofrother and indicate its promising application in phosphate flotation industry.

Keywords: Biotechnology; Bioflotation; Bioreagents; Phosphates; Apatite; Quartz

Bhagyalaxmi Kar, Hrushikesh Sahoo, Swagat S. Rath, B. Das, Investigations on different starches as depressants for iron ore flotation, Minerals Engineering, Volume 49, Aug 2013, pp 1-6, http://dx.doi.org/10.1016/j.mineng.2013.05.004.

(http://www.sciencedirect.com/science/article/pii/S0892687513001453)

Abstract: Four different starches, namely soluble starch, corn starch, potato starch and rice starch with different characteristics have been studied as depressants for hematite in cationic flotation using dodecylamine as the collector. Surface charge measurement and Fourier transform infrared spectroscopy (FTIR) have been used to understand the starch–hematite interaction. The lowering of surface charge and change of peaks at 750–1500 cm−1 region indicate the presence of hydrogen bonding and chemical interaction between hematite and starches. The results of flotation studies with pure minerals of hematite and quartz and a low grade iron ore at different conditions suggest that all the starches are good depressants for hematite. Maximum adsorption for all the four starches with hematite occurs at the pH value 5–9. However soluble starch is found to be the better depressant at slightly alkaline pH. The flotation of natural occurring banded iron ore using different starches has indicated that it is possible to achieve an iron grade of 63–65% Fe with 85–88% recovery.

Keywords: Starch; Depressant; Flotation; Surface charge; Adsorption; FTIR

Yi Wai Chiang, Rafael M. Santos, Annick Monballiu, Karel Ghyselbrecht, Johan A. Martens, Maria Laura T. Mattos, Tom Van Gerven, Boudewijn Meesschaert, Effects of bioleaching on the chemical, mineralogical and morphological properties of natural and waste-derived alkaline materials, Minerals Engineering, Volume 48, July 2013, Pages 116-125, ISSN 0892-6875, http://dx.doi.org/10.1016/j.mineng.2012.09.004.

(http://www.sciencedirect.com/science/article/pii/S0892687512003020)

Abstract: Bioleaching is a potential route for the valorisation of low value natural and waste alkaline materials. It may serve as a pre-treatment stage to mineral carbonation and sorbent synthesis processes by increasing the surface area and altering the mineralogy of the solid material and by generating an alkaline rich (Ca and Mg) aqueous stream. It may also aid the extraction of high value metals from these materials (e.g. Ni), transforming them into valuable ore reserves. The bioleaching potential of several bacteria (Bacillus circulans, Bacillus licheniformis, Bacillus mucilaginosus, Sporosarcina ureae) and fungi (Aspergillus niger, Humicola grisea, Penicillium chrysogenum) towards the alteration of chemical, mineralogical and morphological properties of pure alkaline materials (wollastonite and olivine) and alkaline waste residues (AOD and BOF steel slags, and MSWI boiler fly ash) at natural pH (neutral to basic) was assessed. Bioleaching was conducted using one-step and two-step methodologies. Increased solubilisation of alkaline earth metals and nickel were verified. Alteration in basicity was accompanied by alteration of

mineralogy. AOD slag experienced solubilisation–precipitation mechanism, as evidenced by the decline of primary phases (such as dicalcium-silicate, bredigite and periclase) and the augmentation of secondary phases (e.g. merwinite and calcite). Nickel-bearing minerals of olivine (clinochlore, lizardite, nimite and willemseite) significantly diminished in quantity after bioleaching. Altered mineralogy resulted in morphological changes of the solid materials and, in particular, in increased specific surface areas. The bioleaching effect can be attributed to the production of organic acids (principally gluconic acid) and exopolysaccharides (EPSs) by the microorganisms. The similarities between fungal and bacterial mediated bioleaching suggest that biogenic substances contribute mostly to its effects, as opposed to bioaccumulation or other direct action of living cells.

Keywords: Bioleaching; Mineral processing; Waste processing; Alkaline materials; Nickel

M. Becker, G. Yorath, B. Ndlovu, M. Harris, D. Deglon, J.-P. Franzidis, A rheological investigation of the behaviour of two Southern African platinum ores, Minerals Engineering, Volume 49, August 2013, Pages 92-97, ISSN 0892-6875, http://dx.doi.org/10.1016/j.mineng.2013.05.007.

(http://www.sciencedirect.com/science/article/pii/S0892687513001489)

Abstract: With the installation of ultrafine grinding on many platinum operations in southern Africa, there were concerns as to whether this would cause rheologically complex behaviour during the subsequent flotation of the ore. Rheologically complex behaviour refers to the non-Newtonian behaviour experienced by some suspensions, associated with exponential increases in yield stress and viscosity with increasing solids content. This is attributed to particle size and solids concentration effects, surface chemistry, and mineralogy. In this study, the rheological behaviour of two different platinum ores; a western limb UG2 ore and a Great Dyke platinum ore were investigated and compared with that of single mineral studies of the major gangue minerals of platinum ores (chromite, orthopyroxene, plagioclase and talc). The results show that Great Dyke ore is considerably more rheologically complex than UG2 ore. Great Dyke flotation concentrate shows high yield stress and viscosity at low solids concentrations (>20 vol.% solids). Should the ROM ore in a Great Dyke flotation operation suddenly show significant changes in ore mineralogy, the rheological properties of the slurry should be considered since they may be detrimental to the overall performance of the operation (e.g. loss of recovery through poor gas dispersion). In contrast, the rheological behaviour of UG2 flotation samples shows little cause for concern for the plant operator. Comparison of the pure mineral samples shows that the complex rheological behaviour of the Great Dyke ore may be attributed to the high degree of low temperature alteration and the formation of phyllosilicate minerals such as talc, more than particle size effects.

B. McFadzean, S.S. Mhlanga, C.T. O'Connor, The effect of thiol collector mixtures on the flotation of pyrite and galena, Minerals Engineering, Vol.50–51, Sept. 2013, Pages 121-129, http://dx.doi.org/10.1016/j.mineng.2013.06.018.

(http://www.sciencedirect.com/science/article/pii/S089268751300215X)

Abstract: Thiol collector mixtures are commonly used in the flotation of base metal sulphides and platinum-bearing ores. There are synergistic benefits claimed for these collector mixtures, with mixtures lowering total dosage requirements, improving coarse particle recovery and the rate of flotation.

Some of the secondary collectors are known to act as frothers. Therefore, a previous study aimed to decouple froth and pulp effects and considered only the bubble–particle attachments in the pulp. This was achieved through microflotation experiments, where various ratios of the ethyl and isobutyl chain lengths of xanthates, dithiocarbamates and dithiophosphates were used as collectors. Results from these experiments showed a marked increase in galena recovery using mixtures of xanthate with either dithiophosphate or dithiocarbamate. In the current study, the froth phase was introduced in the form of batch flotation studies to determine whether benefits noted during microflotation experiments would be carried through to a more realistic froth flotation scenario. The pure minerals used were galena or pyrite and these were tested separately. The findings show that a higher galena recovery (92.2%) was obtained when using a 10:90 mixture of ethyl xanthate (SEX) with diethyl dithiophosphate (SEDTP) compared to 89.0% with the best single collector. Galena and pyrite minerals showed marked differences in their respective frothing effects and in their preferences for collector type. The best collectors for galena were the worst for pyrite (SEDTP and ethyl dithiocarbamate (SEDTC)). The best overall collector for pyrite was a 75:25 SIBX:SEDTP mixture (93.4% recovery compared to 89.8% for SIBX alone). In general, it was found that the batch flotation cell and microflotation cell gave quite different results. This was attributed to the different internal energies of the cells and to differences in particle hydrophobicities, with particles of optimum hydrophobicity stabilising the froth. Actual recoveries of the mixtures were compared to an expected recovery based on the calculated weighted recoveries of the single collectors. This showed that most collector mixtures achieved greater recoveries than would be expected based on their additive performance alone. This synergistic behaviour was most notable for mixtures of strong and weak collectors. Antagonistic behaviour was noted for mixtures of two strong collectors.

Keywords: Froth flotation; Collector mixtures; Sulphide minerals

Jan Drzymala, Przemyslaw B. Kowalczuk, Michael Oteng-Peprah, Dariusz Foszcz, Antoni Muszer, Teresa Henc, Andrzej Luszczkiewicz, Application of the grade-recovery curve in the batch flotation of Polish copper ore, Minerals Engineering, Volume 49, August 2013, Pages 17-23, ISSN 0892-6875, http://dx.doi.org/10.1016/j.mineng.2013.04.024.

(http://www.sciencedirect.com/science/article/pii/S0892687513001386)

Abstract: Ores and raw materials are subjected to mineral processing operations to increase the content of their useful components. Upgrading of these materials can proceed with different selectivity and therefore, there is a need to know and monitor the separation results of the process. The separation results can be evaluated using upgrading tables and curves. The shape of lines of the upgrading curves are usually complex and depends on the graph type and process parameters. The grade-recovery curves are frequently used because are practical and indicate several characteristic features of separation results. Separations by means of batch flotation of several different shale, dolomite and sandstone Polish copper ores were performed along with determination of their mineral composition, copper content, liberation degree, and maximum theoretical copper content in the first concentrate. These data, plotted as the grade-recovery curves, allowed finding other characteristic points such as practical maximum copper content in the first concentrate, maximum curvature which, to a great extent coexists with the liberation degree, maximum recovery of ore valuable components, and the slope of the grade-recovery curve at high recoveries as a measure of liberation of middlings. Correlations between theoretical and practical maximum copper contents in the first concentrate, which depend on the ore type, were also presented. It was confirmed that the ore type significantly influences the shape of the grade-recovery curve and its characteristic points.

Keywords: Grade-recovery curve; Separation; Flotation

Jie Lu, Shoujun Liu, Ju Shangguan, Wenguang Du, Feng Pan, Song Yang, The effect of sodium sulphate on the hydrogen reduction process of nickel laterite ore, Minerals Engineering, Volume 49, August 2013, Pages 154-164, ISSN 0892-6875, http://dx.doi.org/10.1016/j.mineng.2013.05.023.

(http://www.sciencedirect.com/science/article/pii/S0892687513001842)

Abstract: A series of nickel laterite ores with different calculated amounts of anhydrous sodium sulphate were prepared by physical blending or sodium sulphate solution impregnation. The reduction of the prepared nickel laterite ore by H2 was carried out in a fluidised-bed reactor with provisions for temperature and agitation control, and the magnetic separation of the reduced ore was performed using a Davis tube magnetic separator. The mineralogical properties of the raw laterite ore, reduced ore and magnetic concentrate were characterised using ICP, TG–DSC, N2 adsorption, X-ray diffraction and optical microscopy. The catalytic activity of sodium sulphate was also studied by using Hydrogen temperature-programed reduction. The experimental results indicate that Na2SO4 could overcome the kinetic problems faced by the laterite ore and that it exhibited noticeable catalytic activity only if the temperature reached at least 750 °C. This high temperature accelerated the crystal phase transition of the silicate minerals and increased the utilisation of H2. In comparing the results from the two different methods for adding Na2SO4, the nickel

content and recovery of the magnetic concentrate were increased by using the impregnation method rather than the physical blending method and the increasing amount of sodium sulphate assisted in the further beneficiation of nickel. The partial pressure of H2 and the reducing time also affected the reduction process of the iron oxides. The results of the microscopic study indicated that the formation of a Fe–S solid solution, which was derived from the SO2 sulphide reduction of FeO, was conducive to mass transfer and accelerated the coalescence of metallic ferronickel particles. For the nickel laterite ore, under the synergistic effect of sodium sulphate and hydrogen, a nickel content and nickel recovery of 6.38% and 91.07% were obtained, respectively, with high product selectivity.

Keywords: Hydrogen reduction; Nickel laterite ore; Ferronickel; Sodium sulphate; Magnetic separation

Baozhong Ma, Chengyan Wang, Weijiao Yang, Fei Yin, Yongqiang Chen, Screening and reduction roasting of limonitic laterite and ammonia-carbonate leaching of nickel–cobalt to produce a high-grade iron concentrate, Minerals Engineering, Volumes 50–51, September 2013, Pages 106-113, ISSN 0892-6875, http://dx.doi.org/10.1016/j.mineng.2013.06.014.

(http://www.sciencedirect.com/science/article/pii/S0892687513002112)

Abstract: This study focuses on the comprehensive utilization of a limonitic laterite from the Philippines. The ore was screened to remove some silicate minerals and then treated via reduction roasting-ammonia leaching. The optimal conditions of reduction roasting of screened ore (Ore I) were determined through a series of tests. Compared with the extractions of nickel and cobalt from the initial ore, those from Ore I increased from 84.0% to 87.9% and from 35.5% to 47.4%, respectively. The iron in leach residue increased from 56.2% to 60.7% without any further treatment, and the final recovery of iron was up to 85.2%. The improved reduction roasting process was analyzed to illustrate the phase transformations of iron, nickel, and cobalt, as well as the effects of such behaviors on the recoveries of these metals.

Keywords: Limonitic laterite; Iron concentrate; Nickel–cobalt extraction; Silicate mineral removal; Reduction roasting–ammonia leaching

Bellson Awatey, Homie Thanasekaran, Jaisen N. Kohmuench, William Skinner, Massimiliano Zanin, Optimization of operating parameters for coarse sphalerite flotation in the HydroFloat fluidised-bed separator, Minerals Engineering, Volumes 50–51, September 2013, Pages 99-105, ISSN 0892-6875, http://dx.doi.org/10.1016/j.mineng.2013.06.015.

(http://www.sciencedirect.com/science/article/pii/S0892687513002124)

Abstract: Increasing the upper size limit of coarse particle flotation has been a long-standing challenge in the minerals processing industry. The HydroFloat separator, an air-assisted fluidised-bed separator, has been used in this study to float 250–

1180 μm sphalerite particles in batch flotation tests and compared to results achieved utilizing a laboratory-scale conventional Denver cell. The quiescent environment within the HydroFloat cell significantly reduces the turbulent energy dissipation within the collection zone, hence decreasing the detachment of particles from bubbles during flotation. Three operating parameters including bed-level, superficial water and gas rates have been studied, and their effect on the flotation of coarse sphalerite particles is reported. It is shown that coarse sphalerite recovery increases with increasing bed-level, superficial water and gas flow rates. However, there are thresholds for each operating parameter above which recovery starts to decrease. A comparison of recovery with a conventional Denver flotation cell indicates that the HydroFloat separator vastly outperforms the conventional flotation machine for the very coarse particles (+425 μm), and this is mainly attributable to the absence of turbulence and the minimization of a froth zone, both of which are detrimental to coarse particle flotation.

Keywords: HydroFloat; Fluidised bed; Teeter bed; Coarse particles; Flotation

Libin Tong, Bern Klein, Massimiliano Zanin, Keith Quast, William Skinner, Jonas Addai-Mensah, David Robinson, Stirred milling kinetics of siliceous goethitic nickel laterite for selective comminution, Minerals Engineering, Volume 49, August 2013, Pages 109-115, ISSN 0892-6875, http://dx.doi.org/10.1016/j.mineng.2013.05.013.

(http://www.sciencedirect.com/science/article/pii/S0892687513001635)

Abstract: The objective of this study is to determine how grinding conditions affect the breakage rate with respect to the sample mass, major elements, and minerals present in siliceous goethitic (SG) nickel laterite. This information is helpful in determining the optimal grinding conditions for selective comminution and nickel upgrade. The kinetics of batch wet grinding of nickel laterites with feed sizes of 2.38–1.68, 1.68–1.18, 1.18–0.85, 0.85–0.6, 0.6–0.42, 0.42–0.3, 0.3–0.21, and 0.21–0.15 mm were determined using a Netzsch LME4 stirred mill under the following conditions: 1000 rpm, 50% charge volume, 150.0 g of solid. The grinding behaviour of the majority of the feed samples was non-first-order due to the fast breakage rate of soft minerals and the low breakage rate of hard minerals in the feed. Therefore, an enrichment of the soft mineral was obtained in the underscreen product by selective grinding. The effect of selective grinding on Ni upgrade was evaluated by looking at grinding time, feed size, and product size. Optimum grinding time with respect to Ni upgrade was 0.25 min for SG nickel laterite samples. Generally, grinding larger particles and/or collecting finer product size yielded better Ni upgrade results. The effect of selective grinding was evaluated by the changes of the major soft and hard minerals for the selected samples. Selective grinding was also examined with respect to the major element weight ratio (e.g. Si/Ni for SG nickel laterite). With respect to Ni upgrade, the best result was achieved from the 1.18–0.85 mm feed on the −400 mesh product after grinding for 0.25 min. The Ni grade increased from 0.73% to 1.30%

(upgrade 76.8%), with 14.4% Ni recovery; the Mg grade increased from 1.30% to 3.96% (upgrade 205.6%); the Si grade decreased from 28.7% to 16.2%.

Keywords: Nickel laterite; Mineral processing; Comminution; Grinding

B. Arvidson, M. Klemetti, T. Knuutinen, M. Kuusisto, Y.T. Man, C. Hughes-Narborough, Flotation of pyrrhotite to produce magnetite concentrates with a sulphur level below 0.05% w/w, Minerals Engineering, Volumes 50–51, September 2013, Pages 4-12, http://dx.doi.org/10.1016/j.mineng.2013.05.010.

(http://www.sciencedirect.com/science/article/pii/S089268751300160X)

Abstract: Northland Resources is developing several magnetite mineral resources in northern Europe. The Tapuli, Sahavaara and Pellivuoma mineral resources are in Sweden and the Hannukainen resource is in Finland. Three of these resources (Sahavaara, Pellivuoma and Hannukainen) require flotation to remove more than 98% by mass of the sulphur in the feedstock to produce a saleable magnetite concentrate with a sulphur level below 0.05% w/w. The detrimental sulphur containing mineral is monoclinic pyrrhotite and its removal requires flotation. Previous published results related to pyrrhotite flotation from magnetite concentrate, e.g. on a magnetite deposit in Peru, only required the process to produce a final magnetite concentrate with a sulphur level below 0.4% w/w. There is currently no known published information on a process that floats pyrrhotite to achieve a magnetite concentrate with less than 0.05% w/w of sulphur. Extensive bench-scale tests were conducted on samples from Sahavaara, Pellivuoma and Hannukainen. Low-intensity magnetic separation (LIMS) tests showed that LIMS upgraded the magnetite and the sulphur in the pyrrhotite at the same ratio. The final flotation reagent regimes and conditions for each deposit were different being related to differences in mineralogy and grind size. The pH ranged from natural to pH of 4. Large dosage rates of xanthate collectors and long flotation times were needed. Flotation feed percent solids of between 45% and 50% w/w was required. Future work will modify these reagent regimes and flotation conditions in the full-scale plants to further optimise the flotation processes.

Keywords: Pyrrhotite flotation; Sulphur removal; Magnetic separation; Magnetite concentrate

Marc Nassif, James A. Finch, Kristian E. Waters, Developing critical coalescence concentration curves for industrial process waters using dilution, Minerals Engineering, Volumes 50–51, September 2013, Pages 64-68, ISSN 0892-6875, http://dx.doi.org/10.1016/j.mineng.2013.06.011.

(http://www.sciencedirect.com/science/article/pii/S0892687513002082)

Abstract: Critical coalescence concentration (CCC) is commonly used to characterize frothers. The CCC is determined from a plot of Sauter mean bubble size (D32) vs. frother concentration, referred to here as the ‘addition’ method. Industrial

flotation systems can encounter a number of naturally occurring surfactants and salts that also influence bubble size. In effect there is a 'system' CCC. This paper introduces a dilution method to identify the system CCC. The study verifies the dilution technique using the commercial frother DF-250. It is shown that the system CCC can be expressed as an equivalent DF-250 concentration to provide context and a means of comparing water samples. The viability of using gas holdup to provide an estimate of process water D32 is also explored. To illustrate the procedure three samples of process water from the Albian Sands bitumen processing plant were examined. They proved to be similar and yielded a system CCC equivalent to about 20 ppm DF-250. It is concluded that the dilution and frother equivalent techniques can be used to help identify system hydrodynamic properties.

Keywords: Flotation; Bubble size; Frothers; Critical coalescence concentration; Dilution; Frother potential

Nestor Cruz, Yongjun Peng, Saeed Farrokhpay, Dee Bradshaw, Interactions of clay minerals in copper–gold flotation: Part 1 – Rheological properties of clay mineral suspensions in the presence of flotation reagents, Minerals Engineering, Volumes 50–51, September 2013, Pages 30-37, ISSN 0892-6875, http://dx.doi.org/10.1016/j.mineng.2013.06.003.

(http://www.sciencedirect.com/science/article/pii/S089268751300191X)

Abstract: Clay minerals are often associated with copper, gold and other valuable minerals and place a widespread problem in mineral flotation. This paper is one of a series addressing the problem caused by clay minerals in copper–gold flotation. This study seeks to understand the rheological behaviour of kaolinite and bentonite suspensions at natural pH and how the pH modifier, collector and frother normally used in copper–gold flotation affect the rheological properties. It was found that kaolinite and bentonite suspensions may follow Newtonian flows or non-Newtonian flows with pseudoplastic characteristics depending on the solid concentration. Bentonite has a stronger effect on the viscosity of suspensions than kaolinite. The pH modifier, collector and frother have a potential to alter the rheological behaviour of kaolinite and bentonite suspensions and the effect of the pH modifier is more pronounced.

Keywords: Kaolinite; Bentonite; Rheology; pH modifier; Collector; Frother

Samuel A. Awe, Jan-Eric Sundkvist, Nils-Johan Bolin, Åke Sandström, Process flowsheet development for recovering antimony from Sb-bearing copper concentrates, Minerals Engineering, Volume 49, August 2013, Pages 45-53, ISSN 0892-6875, http://dx.doi.org/10.1016/j.mineng.2013.04.026.

(http://www.sciencedirect.com/science/article/pii/S0892687513001404)

Abstract: The technical feasibility, on laboratory scale, of hydro- and electrometallurgical processes of recovering metallic antimony from an antimony-bearing copper sulphide concentrate has been investigated. The influence of Na2S concentration, temperature and solid concentration was studied during the leaching test while the effect of current density, Na2S concentration, electrolyte temperature and NaOH concentration on antimony electrowinning from alkaline sulphide solutions was investigated. The leaching results showed that antimony dissolution is strongly dependent on the concentration of the leaching reagent as well as the leaching temperature. The antimony content in the concentrate was reduced from 1.7% to less than 0.1% Sb which is desirable for copper metallurgy. Cathode current efficiency is one of the important parameters to evaluate the performance of an electrolytic process. It is revealed in this study that current efficiency of antimony deposition from sulphide electrolytes is highly dependent on the concentration of sodium hydroxide and the current density used. The results illustrate that the combined effect of increasing anode current density (which was 10 times higher than the cathode current density) and NaOH concentration enhanced the current efficiency of the electrolytic process. It was demonstrated that excess free sulphide ions impacts the current efficiency of the process detrimentally. An integrated hydro-/electrometallurgical process flowsheet for antimony removal and recovery from a sulphide copper concentrate was developed.

Keywords: Selective leaching; Tetrahedrite; Alkaline sulphide electrolyte; Antimony cathode; Electrowinning; Process flowsheet

Fengnian Shi, Weiran Zuo, Emmy Manlapig, Characterisation of pre-weakening effect on ores by high voltage electrical pulses based on single-particle tests, Minerals Engineering, Volumes 50–51, September 2013, Pages 69-76, ISSN 0892-6875, http://dx.doi.org/10.1016/j.mineng.2013.06.017.

(http://www.sciencedirect.com/science/article/pii/S0892687513002148)

Abstract: A method based on single-particle tests has been developed to characterise the pre-weakening effect of high voltage pulses on ores. A pre-weakening index, PWI, defined as the percentage change in ore breakage resistance indicator (A*b) per unit of specific energy, is used to evaluate the energy efficiency of an electrical comminution machine, and to assess an ore's amenability to pre-weakening by high voltage pulses. A reduced JKRBT (JK Rotary Breakage Tester) testing procedure using five tests (instead of the standard 12 tests per sample) to determine the ore breakage parameters, makes characterisation by high voltage pulse pre-weakening more practical. A gold–copper ore sample treated by high voltage pulses, based on single-particle tests with a specific energy of 1.6 kWh/t, achieved an A*b change from 31 to 84 at a nominal particle size of 30 mm, representing a 171% pre-weakening result. X-ray tomography images show the induced cracks/microcracks in the pulses-treated rocks. The pre-weakening effect was found more pronounced for larger fragments, suggesting that the use of high voltage pulses to pre-weaken AG/SAG mill feed may result in more

significant benefits in terms of energy savings or increased throughput than pre-weakening ball mill feed.

Keywords: Ore characterisation; Pre-weakening index; High voltage pulses; Energy efficiency

Aida Farkish, Mamadou Fall, Rapid dewatering of oil sand mature fine tailings using super absorbent polymer (SAP), Minerals Engineering, Volumes 50–51, September 2013, Pages 38-47, http://dx.doi.org/10.1016/j.mineng.2013.06.002.

(http://www.sciencedirect.com/science/article/pii/S0892687513001908)

Abstract: The Canadian oil sands resources present one of the world's most vast hydrocarbon deposits. The processing of oil sands to extract bitumen generates large volumes of mature fine tailings (MFT). The large volume, poor consolidation and water release ability of MFT have been causing significant economic and environmental concerns. Therefore, significant research efforts have been devoted to finding methods for the dewatering and densification of MFT. In the present paper, a novel approach which consists of the rapid dewatering of MFT by using a super absorbent polymer (SAP) to produce dense MFT is proposed. A comprehensive laboratory investigation on the shear strength testing of MFT specimens dewatered with SAP by using a vane shear apparatus is conducted. Furthermore, the effect of freeze–thaw cycles on the undrained shear strength of the dewatered MFT is studied. Finally, the ability of recycled SAP to dewater and densify MFT is also assessed. Promising results have been obtained. The results indicate that SAP has the ability to significantly dewater, densify and increase the undrained shear strength of MFT. Furthermore, when subjected to freeze–thaw cycles, the MFT dewatered with SAP shows an additional increase in strength and solid content. It is also found that it is possible to regenerate the polymer (still within sachets) through light thermal drying, and the regenerated SAP can still significantly dewater and thus increase the shear strength and solid content of MFT. Therefore, SAP regeneration and the use of regenerated SAP to dewater MFT in a cost-effective way should be assessed in further studies.

Keywords: Oil sand; Tailings; Mature fine tailings; Super absorbent polymer (SAP); Freeze–thaw; Dewatering

Hakan Dundar, Hakan Benzer, Namık Aydogan, Application of population balance model to HPGR crushing, Minerals Engineering, Volumes 50–51, Sep. 2013, Pages 114-120, http://dx.doi.org/10.1016/j.mineng.2013.07.005.

(http://www.sciencedirect.com/science/article/pii/S0892687513002239)

Abstract: Having proved its success in energy efficiency, the High Pressure Grinding Rolls became widespread all over the world in many plants. The first application of the HPGR was in 1985 in a cement plant, mainly for capacity improvement purpose. Then various circuit configurations were derived to achieve reduction in overall

specific energy consumption by transferring more of the grinding required to the HPGR. By mid 1990s, HPGR installations have been used in minerals industry. The HPGR was introduced to minerals industry as a replacement for tertiary crushers, SAG mills and rod mills. In some applications it appears as a pebble crusher in AG milling. HPGR has attracted the attention of many researchers for around two decades, resulting in various modeling approaches for throughput or size reduction of the equipment. This paper will discuss the method of applying population balance model to size reduction of HPGR. Data collected from both cement and minerals industry was used for this study. The breakage rate was defined as a function of the operating pressure and the material characteristics. The material characteristics were determined by compressed bed breakage tests. The relationships between the operating parameters and the model variables lead to predicting the product size distributions of the HPGRs for the given operating conditions.

Keywords: High pressure grinding rolls; Modeling; Cement; Mineral

R. Ram, F.A. Charalambous, S. McMaster, M.I. Pownceby, J. Tardio, S.K. Bhargava, An investigation on the dissolution of natural uraninite ores, Minerals Engineering, Volumes 50–51, September 2013, Pages 83-92, ISSN 0892-6875, http://dx.doi.org/10.1016/j.mineng.2013.06.013.

(http://www.sciencedirect.com/science/article/pii/S0892687513002100)

Abstract: The effect of varying standard leach parameters (particle size, total iron content, acid addition, oxidation–reduction potential and temperature) on the dissolution of uranium from natural uraninite was studied. Tests were conducted using two uraninite ores from Australia and results contrasted with equivalent studies conducted on a synthetic UO2 sample. Mineralogical studies, including EPMA analysis of selected leach residues, were also carried out. Results indicated that under standard leach conditions (0.15 M H2SO4, 50 °C, ORP 460 mV, 6.7E10−3 M FeTOT), both natural samples exhibited lower uranium extraction rates when compared to synthetic UO2. Decreasing particle size, increasing temperature and increasing FeTOT all resulted in an increase in the rate of uranium dissolution whereas changing acid concentration and changing the ORP had a negligible effect on dissolution. Minor differences were observed when comparing results between the two natural samples however in all cases the synthetic UO2 proved easier to extract uranium. The changes in dissolution rates between the natural ores and the synthetic uraninite was attributed to lead impurities within the natural uraninites being preferentially leached and then re-precipitated as a sulphate. The precipitated Pb sulphate was observed coating individual uraninite particles and filling pores and fractures, thus preventing further ingress of the leach solution. This study emphasises the uncertainties in extrapolating experimental results obtained using synthetic systems to studies involving real ores.

Keywords: Uraninite; Uraninite dissolution; Uranium minerals processing

Nural Kuyucak, Ata Akcil, Cyanide and removal options from effluents in gold mining and metallurgical processes, Minerals Engineering, Volumes 50–51, September 2013, Pages 13-29, http://dx.doi.org/10.1016/j.mineng.2013.05.027.

(http://www.sciencedirect.com/science/article/pii/S089268751300188X)

Abstract: Cyanide has been widely used as an essential raw material in several industries including textile, plastics, paints, photography, electroplating, agriculture, food, medicine and mining/metallurgy. Because of its high affinity for gold and silver, cyanide is able to selectively leach these metals from ores. Cyanide and cyanide compounds in wastewater streams are regulated. Residues and wastewater streams containing cyanide compounds have to be treated to reduce the concentration of total cyanide and free cyanide below the regulated limits Natural degradation reactions can render cyanide non-toxic, resulting in carbon dioxide and nitrogen compounds. These natural reactions have been utilised by the mining industry as the most common means of attenuating cyanide. However, the rate of natural degradation is largely dependent on environmental conditions and may not produce an effluent of desirable quality in all cases year round. Technologies that include chemical, biological, electrochemical and photochemical methods have been developed to remove cyanide and cyanide compounds to below the regulated limits in wastewaters. This paper discusses commercially available and emerging methods for removing cyanide from waste streams, particularly from tailings and tailings reclaim waters that are generated in the gold mining processes.

Keywords: Cyanide; Hydrometallurgy; Leaching; Process effluents; Wastewater treatment

Hui Tan, William Skinner, Jonas Addai-Mensah, Influence of fluorite on the isothermal leaching and rheological behaviours of chlorite mineral pulps at low pH, International Journal of Mineral Processing, Volume 123, 10 September 2013, Pages 1-8, http://dx.doi.org/10.1016/j.minpro.2013.04.018.

(http://www.sciencedirect.com/science/article/pii/S0301751613001130)

Abstract: Chlorite clay gangue mineral leaching at low pH may produce viscous slurries, which deleteriously impact on value metal extraction and recovery in metallurgical plant operations. The presence of fluorite as a minor or an accessory mineral phase with chlorite may markedly exacerbate the pulp rheology and reduce the leaching dramatically. In the present work, isothermal leaching and rheological behaviours of chlorite were investigated in the presence of fluorite (chlorite/fluorite mass ratios of 20, 10 and 5 to 1) at pH 1 and 70 °C. Fluorite was found to dramatically enhance the kinetics of chlorite leaching, the mechanism of which was incongruent. The leach dispersion rheology showed a distinctly non-Newtonian behaviour characterized by thixotropy, shear thinning and time and fluorite concentration-dependent shear yield stress. The highest, maximum shear yield stress and apparent viscosities were observed at chlorite/fluorite ratio of 10:1, below

and above which weaker gels formed. Solution-state 27Al and 29Si NMR studies indicated that polycondensation reactions involving solution Al(III) six to four fold coordination and a plethora of Si(IV) tetrahedra complexes led to the formation of aluminosilicate gels. The chlorite/fluorite ratio had a striking impact on the formation and development of the strongly viscous gel structures. The findings suggest that the resulting maximum yield stresses (40–200 Pa) and apparent viscosity (10–25 Pa·s) are highly detrimental to plant chlorite clay–fluorite rich, low grade laterite ores' leaching and handling operations.

Keywords: Chlorite; Fluorite; Leaching; Particle interactions; Shear rheology

Wenying Liu, C.J. Moran, Sue Vink, Impact of chalcopyrite depression by water-borne bacteria in pure and combined mineral systems, International Journal of Mineral Processing, Volume 123, 10 September 2013, Pages 18-24, ISSN 0301-7516, http://dx.doi.org/10.1016/j.minpro.2013.04.017.

(http://www.sciencedirect.com/science/article/pii/S0301751613001117)

Abstract: There is a general trend towards more responsible water management across the minerals industry. Two important strategies have been implementation of water reuse and sourcing of alternative water supplies that otherwise would have been disposed of, such as treated effluent. Both strategies have been shown to result in increased inorganic and organic loads (including bacteria) in mineral processing, in particular, froth flotation. A number of studies have shown the effect of inorganic water constituents on the performance of flotation. However, far less is known about the impacts and processes associated with organic constituents, particularly bacteria. This study investigated the quantitative relationship between bacterial concentration in flotation water using E. coli as the model bacterium and the flotation performance of chalcopyrite. Flotation tests were carried out to quantify the effect of E. coli cells on the flotation of three chalcopyrite-containing systems of increasing complexity: high-purity chalcopyrite, a simulated ore with controlled gangue, and a porphyry copper-gold ore. The experimental results show that E. coli cells negatively affected the flotation efficiency of chalcopyrite in all three systems. The bacterial cells also negatively affected the flotation efficiency of pyrite in the simulated ore system, and gold in the porphyry ore system. The bacterial cells preferentially attached to pyrite over chalcopyrite in the simulated ore system. Findings in this study contribute to identifying some of the potential risks posed by using bacteria-containing water for flotation, when attempting to improve water efficiency.

Keywords: Flotation; Bacteria; Chalcopyrite; Pyrite; Gold

Bingan Xu, Peter Smith, Lynette De Silva, The Bayer digestion behaviour of transition aluminas formed from roasted gibbsite, International Journal of Mineral Processing, Volume 122, 10 July 2013, Pages 22-28, ISSN 0301-7516, http://dx.doi.org/10.1016/j.minpro.2013.04.003.

(http://www.sciencedirect.com/science/article/pii/S0301751613000860)

Abstract: Bauxite with reactive silica content greater than ~ 8% cannot be economically processed by the Bayer process. Roast-leach technology (sometimes called thermo-chemical processing) is potentially one of the options for removal of silica from bauxite using a thermal pre-treatment and leach step. However, the thermal pre-treatment transforms aluminium oxides in both kaolinite and valuable phases (gibbsite and boehmite) to transition aluminas which are difficult to extract using normal Bayer digestion. To better understand and solve this problem, we simplified the roast-leach process by roasting pure gibbsite and digesting the resultant transition aluminas. We investigated the relationship between roast temperature, dehydration extent, transition aluminas and Bayer extraction behaviour. We found that transition aluminas with thermodynamically relatively stable structures and better crystallinity were the cause of extraction difficulty. Extraction can be enhanced using higher caustic concentration and digestion temperature although these measures are not preferred in reality. The practical and effective method is perhaps the counter current double digestion which can extract all transition aluminas and produce pregnant liquor with desired aluminate concentration.

Keywords: High silica bauxite; Roast-leach process; Phase transformation; Gibbsite dehydration; Transition alumina; Bayer digestion

Huifen Yang, Tian Li, Qiongyao Tang, Chuanlong Wang, Wen Ma, Development of a bio-based collector by isolating a bacterial strain using flotation and culturing techniques, International Journal of Mineral Processing, Volume 123, 10 September 2013, Pages 145-151, ISSN 0301-7516, http://dx.doi.org/10.1016/j.minpro.2013.06.004.

(http://www.sciencedirect.com/science/article/pii/S0301751613001403)

Abstract: A microbial bio-based collector was isolated from iron mine soil using a combination of flotation and culturing techniques. Four microbial strains with greater than 75% recovery of pure hematite were separated using the technique. Classification and identification of the 4 strains by 16S rDNA sequences were conducted. Among them only 1 strain, termed F3, can act as a collector for hematite, as it is not pathogenic to humans. The morphology and hematite adsorption (by scanning electron microscopy; SEM), composition, zeta potential and hydrophobicity of strain F3 were further evaluated. Based on the changes in the zeta potential and hydrophobicity of a hematite surface before and after adsorption with F3, its adsorption mechanism was also analysed. The results revealed that the combination technique of flotation and bacterial culturing is a highly effective technique for isolating bio-collectors from iron mine soil. Two flotation stages were required to isolate strain F3, which belongs to the genus Stenotrophomonas. This rod-shaped bacterium had CH2, CH3 and phosphate groups on its cell wall that imparted strong hydrophobicity and negative charge. Adsorption of strain F3

reduced the zeta potential of a hematite surface and enhanced its hydrophobicity. The adsorption of F3 to hematite is presumed to be through chemical adsorption. Therefore, strain F3 can be used as a bio-collector for hematite flotation.

Keywords: Isolating technique; Bio-collector; Flotation; Culturing; Hematite

Peng Huang, Mingli Cao, Qi Liu, Selective depression of sphalerite by chitosan in differential PbZn flotation, International Journal of Mineral Processing, Vol. 122, 10 July 2013, Pages 29-35, http://dx.doi.org/10.1016/j.minpro.2013.04.010.

(http://www.sciencedirect.com/science/article/pii/S030175161300104X)

Abstract: Chitosan was exploited as a selective depressant in the differential PbZn sulfide flotation at pH 4 on artificial galena and sphalerite mixtures. The mixtures were prepared in two different approaches. In the first approach, the high purity galena and sphalerite were blended directly whereas in the second approach, the sphalerite was coated with copper before blending with galena. Using the first approach, it was found that lead ions contaminated the sphalerite surface making the separation non-selective. After adding EDTA, sphalerite was depressed by chitosan while galena was floated at pH 4. Using the second approach, i.e., that the sphalerite was pre-coated with copper before mixing with galena, it was found that the sphalerite was selectively depressed by chitosan without the need to add EDTA. ToF-SIMS and XPS were used to study the interactions of chitosan with uncoated sphalerite and copper-coated sphalerite. The results indicated that the amine groups and the hydroxyl groups in chitosan were involved in the strong interaction between chitosan and sphalerite whether the latter was coated by copper or not. Chitosan did not interact strongly with galena as reported previously.

Keywords: Chitosan; Galena; Sphalerite; ToF-SIMS; XPS

Christian F. Ihle, A cost perspective for long distance ore pipeline water and energy utilization. Part I: Optimal base values, International Journal of Mineral Processing, Volume 122, 10 July 2013, Pages 1-12, ISSN 0301-7516, http://dx.doi.org/10.1016/j.minpro.2013.04.002.

(http://www.sciencedirect.com/science/article/pii/S0301751613000859)

Abstract: Long distance ore pipelines are intensive in water and energy use. Although past efforts have been made to identify the best operational points in terms of energy efficiency, an approach to concurrently include water value, representing aspects such as price or scarcity, is lacking. In the present paper, an optimization scheme to look for better operational points considering energy and water utilization is proposed. A scalar function built upon the computation of energy and water consumption including restrictions inherent to hydraulic transport of solids through pipelines is defined. The relative importance of energy and water consumption is parameterized through the inclusion of water and energy unit costs, along with system variables such as throughput, solids concentration and system

utilization fraction. The optimization problem is solved for different throughput and hydraulic conditions resembling a long distance copper concentrate pipeline and a range of water and energy costs, using a nonlinear, constrained optimization scheme. Results show the appearance of a low water cost regime for low throughput conditions, with a steep, quasi-linear change on optimal properties with water cost, followed by a nonlinear, high water cost regime, related to a weaker, monotonic change of concentration, flow rate, pipeline utilization and water consumption, respectively. For fixed water costs, increasing the energy cost causes an incentive for an additional use of water, thus appearing a double non-linear dependence of optimal results with energy and water costs. For high enough throughputs, the low water cost regime disappears, and is replaced by constant, minimal optimal flow rate and solids concentrations, related to the maximum possible pipeline utilization constraint. Present results show that an equivalent pipeline oversizing at constant throughput would allow, in addition to the computed optimal conditions, for operation at lower specific energy consumption scenarios. Results, compared with some typical copper concentrate pipeline operational conditions, show that optimal values in the sense of the present hydraulic-cost analysis tend to require higher concentrations and lower pipeline utilization fractions than in typical systems, with differences in costs ranging from 16% to 28%.

Keywords: Copper concentrate; Energy efficiency; Water footprint; Long distance pipelines

O. Sivrikaya, A.İ. Arol, An investigation of the relationship between compressive strength and dust generation potential of magnetite pellets, International Journal of Mineral Processing, Volume 123, 10 September 2013, Pages 158-164, http://dx.doi.org/10.1016/j.minpro.2013.06.006.

(http://www.sciencedirect.com/science/article/pii/S0301751613001427)

Abstract: Iron ore pellets should have sufficient mechanical strengths against degradation at all stages of pellet production in pelletizing plants. Besides the strength, pellets should have less dust emission during operation since the process efficiency and the pelletizing equipments are adversely affected by dust. Dust is also a problem for sintered (product) pellets since they abrade during transportation from pellet production site to the reduction facilities. Sufficient mechanical strength and low dust emission of pellets are necessary for better operation and handling of pellets. In this study, dust emission mechanism of sintered magnetite pellets produced with different binders was comparatively studied. The results showed that the dust is not produced by pellet breakdown for sintered pellets with sufficient strength. It was found that dust generation of sintered pellets is not directly dependent on the mechanical strength. One of the dust generation mechanisms of sintered pellets with sufficient strength is the roughness of pellet surfaces. The attrition and impact forces during transportation cause dust generation from pellet surfaces. The surface smoothness is more important since the pellets with high strength and rough surfaces produced more dust than those with smooth surfaces

and low strength. Half of the fines generated due to pellet attrition or impact forces during handling of sintered pellets will become airborne and are considered as loss and operational/environmental problem. The percentage of particulate matter (PM10) which is significant in health risk lied between 30% and 40% by weight of airborne pellet dust.

Keywords: Iron ore pellet; Compressive strength; Dust; Dustiness; Particulate matter

T.C. Alex, A.M. Kalinkin, S.K. Nath, B.I. Gurevich, E.V. Kalinkina, V.V. Tyukavkina, Sanjay Kumar, Utilization of zinc slag through geopolymerization: Influence of milling atmosphere, International Journal of Mineral Processing, Volume 123, 10 September 2013, Pages 102-107, ISSN 0301-7516, http://dx.doi.org/10.1016/j.minpro.2013.06.001.

(http://www.sciencedirect.com/science/article/pii/S0301751613001373)

Abstract: Having no major application, zinc slag generated during imperial smelting process (ISP) all over the world is simply dumped. Some occasional research attempts, seen in the literature, are limited to its use as a replacement for aggregates in construction related applications. This study is a part of our activities towards complete utilization of slag for building material applications using geopolymerization process, which involves formation of a new rock like species from various aluminosilicate minerals under strong alkaline environment. This slag has been subjected to short grinding in a high-energy AGO-2 mill to enhance its reactivity. The paper particularly focuses on the influence of the grinding atmosphere, viz. air or CO2 on the geopolymers prepared from milled slag. Studies have shown that the particulate characteristics mostly remain unaffected by the milling atmosphere. However, conduction calorimetric experiments have shown that the milling atmosphere has a bearing on the reactivity of slag despite their similarity in particulate characteristics; CO2-milled slag has been found to be more reactive than the air-milled slag. Both air and CO2-milled slag has been found good geopolymerization behavior leading to high compressive strength of the geopolymer products; higher compressive strength values for the geopolymer prepared from the latter further shows its enhanced reactivity over the former. TCLP tests of the prepared samples confirm that the release of toxic metals is within USEPA limits and hence the process is an environment friendly way of utilizing the zinc slag.

Keywords: Zinc slag geopolymerization; Milling atmosphere; Reactivity; Compressive strength; TCLP

Jae Han Cho, Yujin Eom, Jung-Min Park, Sang-Bo Lee, Ji-Hyung Hong, Tai Gyu Lee, Mercury leaching characteristics of waste treatment residues generated from various sources in Korea, Waste Management, Volume 33, Issue 7, July 2013, Pages 1675-1681, http://dx.doi.org/10.1016/j.wasman.2013.04.004.

(http://www.sciencedirect.com/science/article/pii/S0956053X13001736)

Abstract: In this study, mercury (Hg) leaching characteristics of the waste treatment residues (fly ash, bottom ash, sludge, and phosphor powder) generated from various sources (municipal, industrial, medical waste incinerators, sewage sludge incinerator, oil refinery, coal-fired power plant, steel manufacturing plant, fluorescent lamp recycler, and cement kiln) in Korea were investigated. First, both Hg content analysis and toxicity characteristic leaching procedure (TCLP) testing was conducted for 31 collected residue samples. The Hg content analysis showed that fly ash from waste incinerators contained more Hg than the other residue samples. However, the TCLP values of fly ash samples with similar Hg content varied widely based on the residue type. Fly ash samples with low and high Hg leaching ratios (RL) were further analyzed to identify the major factors that influence the Hg leaching potential. Buffering capacity of the low-RL fly ash was higher than that of the high-RL fly ash. The Hg speciation results suggest that the low-RL fly ashes consisted primarily of low-solubility Hg compounds (Hg2Cl2, Hg0 or HgS), whereas the high-RL fly ashes contain more than 20% high-solubility Hg compounds (HgCl2 or HgSO4).

Keywords: Mercury; Leaching ratio; Fly ash; Bottom ash; Sludge; Phosphor powder

Wang Xin, C. Srinivasakannan, Duan Xin-hui, Peng Jin-hui, Yang Da-jin, Ju shao-hua, Leaching kinetics of zinc residues augmented with ultrasound, Separation and Purification Technology, Volume 115, 30 August 2013, Pages 66-72, ISSN 1383-5866, http://dx.doi.org/10.1016/j.seppur.2013.04.043.

(http://www.sciencedirect.com/science/article/pii/S1383586613002670)

Abstract: The leaching kinetics of zinc residue, having total Zn content of 12.31%, along with other metallic components such as Fe and Pb, is leached using sulfuric acid as solvent, augmented with ultrasound is presented. The effects of variables such as the leaching temperature, sulfuric acid concentration, particle size, liquid/solid ratio and the ultrasound power have been assessed. The results show the maximum recovery of zinc to be 80% at an ultrasound power of 160 W, leaching temperature of 65 °C, sulfuric acid concentration of 1.4 mol/L, particle size range of 74–89 μm and liquid/solid ratio of 4. The kinetics of leaching is modeled using shrinking core model and the rate controlling step is identified to be the diffusion through the product layer. The raw and the leached residue are characterized using XRD and SEM/EDX analysis. The activation energy is estimated to be 6.57 KJ/mol, while the order of reaction with respect to sulfuric acid concentration is 0.94 and particle size is 0.12 respectively.

Rafeah Wahi, Luqman Abdullah Chuah, Thomas Shean Yaw Choong, Zainab Ngaini, Mohsen Mobarekeh Nourouzi, Oil removal from aqueous state by natural fibrous sorbent: An overview, Separation and Purification Technology, Volume 113, 24 July 2013, Pages 51-63, ISSN 1383-5866, http://dx.doi.org/10.1016/j.seppur.2013.04.015.

(http://www.sciencedirect.com/science/article/pii/S1383586613002219)

Abstract: The threat of oil pollution increases with the expansion of oil exploration and production activities, as well as the industrial growth around the world. The study on the treatment of oily wastewater is a critical issue to the environmental protection as oil caused problems to the wastewater treatment facilities. Although oil particles can efficiently be removed by advanced technologies, the treatments are usually expensive and difficult to maintain. Adsorption and coalescence filtration are promising choice of treatment for its simplicity, effectiveness, and feasibility when appropriate sorbent is used. This review discusses the recent papers on the use of natural fibrous sorbent for removal of oil from wastewater, and its current development. With their excellent oil removal properties, environmental friendliness, easy availability, and feasibility, natural fibrous sorbents are an attractive alternative for oily wastewater treatment.

Keywords: Oily wastewater; Natural fibre; Adsorption; Coalescence

M.A. Abdel-Khalek, A.A. El-Midany, Adsorption of Paenibacillus polymyxa and its impact on coal cleaning, Fuel Processing Technology, Volume 113, September 2013, Pages 52-56, http://dx.doi.org/10.1016/j.fuproc.2013.03.016.

(http://www.sciencedirect.com/science/article/pii/S0378382013001203)

Abstract: The adsorption of micro-organisms and bacteria on minerals surfaces depends mainly on the type of the bacteria used as well as the nature of the studied mineral surface. Such adsorption could change the surface properties of the mineral surface and leads to control its surface for increasing its separation selectivity from associated impurities or enhance/retard the adhesion with other substances. Therefore, in the current study, adsorption of Paenibacillus polymyxa (P. polymyxa) on coal was studied. Several methods were used such as: zeta potential, adsorption isotherms, adsorption kinetics and Fourier Transform InfraRed (FTIR). The main goal is to determine the difference in surface behaviour of coal particles before and after the treatment with P. polymyxa bacteria. The results showed that electrostatic interactions are insignificant in P. polymyxa adsorption on coal particles. The results suggest that the adsorption of bacteria on the coal particles is mainly physical and it depends on electrostatic forces, hydrogen bonding as well as the hydrophobic forces between the bacteria wall and the organic matter in the coal and coal hydrophobicity.

Keywords: Adsorption; Coal; Paenibacillus polymyxa; Separation; Ash; Sulphur

N.L. Ukwattage, P.G. Ranjith, M. Bouazza, The use of coal combustion fly ash as a soil amendment in agricultural lands (with comments on its potential to improve food security and sequester carbon), Fuel, Volume 109, July 2013, Pages 400-408, ISSN 0016-2361, http://dx.doi.org/10.1016/j.fuel.2013.02.016.

(http://www.sciencedirect.com/science/article/pii/S001623611300104X)

Abstract: The growing dependence on coal-fired electricity generation has resulted accumulation of massive quantities of coal combustion by products such as fly ash and bottom ash which are regarded as problematic solid wastes all over the world. Being used beneficially in very less quantities, each year large amount of fly ash is disposed to arable lands which lead to degradation and contamination of land and ground water. However fly ash is identified as a useful soil ameliorant with its properties pertinent to the enhancement of soil fertility and productivity. Fly ash has the potential to improve soil physical, chemical and biological properties and is a source of readily available plant macro and micro-nutrients. Especially for countries whose soils show inherent structural and nutritional limitations for cropping and that need expensive and intensive management, fly ash creates a possible solution to improve crop yields and enhance food security. At the same time the soil added fly ash can involve in terrestrial carbon sequestration by enhancing the microclimate of the soils to facilitate organic matter humification to yield stable forms of soil carbon. This paper reviews the studies of fly ash as a soil amendment in order to present a comprehensive view of the possibility of using fly ash in agricultural lands to improve soil productivity while harvesting possible carbon sequestration benefits. Some identified adverse effects of fly ash addition that can hinder the crop growth in amended soils especially in long term applications have limited its potential use in cultivable lands. However more research work on existing gaps in knowledge to be filled (especially regarding the appropriate application rate and possible environmental contamination) may help to derive the maximum advantages of fly ash in terms soil improvement and waste disposal. The paper, in particularly examines the potential use of this plentiful solid waste material on soil amendment in Australian agricultural soils.

Keywords: Coal fly ash; Soil amendment; Soil CO2 sequestration

M.J. McCarthy, M.R. Jones, L. Zheng, T.L. Robl, J.G. Groppo, Characterising long-term wet-stored fly ash following carbon and particle size separation, Fuel, Volume 111, September 2013, Pages 430-441, ISSN 0016-2361, http://dx.doi.org/10.1016/j.fuel.2013.02.048.

(http://www.sciencedirect.com/science/article/pii/S0016236113001506)

Abstract: The paper describes a study carried out to characterise fly ash produced from hard-coal, following recovery from long-term pond and stockpile storage, and wet process separation. Three power station sites, representative of those in the United Kingdom, were considered and initial work examined the characteristics of recovered material from both types of storage area. Most of this had high loss-on-ignition (LOI) and was relatively coarse, with that in ponds generally having greater variability. Fly ash particles had reaction products on their surfaces and the presence of agglomerates was also noted. Methods including, pre-screening, column (hydraulic) separation, froth flotation and lamella hydraulic classifier were considered for processing. Three trials were carried out using various combinations, and it was possible to separate carbon and fly ash to give material groups ranging

from carbon-rich to low LOI/high fineness, although fine fly ash particles (<5 μm) were distributed throughout these. Relatively minor changes in chemical composition and mineralogy of the separated materials were noted, except for particle groups with high LOI (reflecting fly ash dilution). Similar effects were generally obtained with both pond and stockpile storage. Mass balance calculations were made to quantify material distributions for the three processing trials carried out. Examples are given of yields achieved for potential end-uses from these, which indicate that optimisation to target particular fly ash properties should be possible.

R.S. Blissett, N.A. Rowson, An empirical model for the prediction of the viscosity of slurries of coal fly ash with varying concentration and shear rate at room temperature, Fuel, Volume 111, September 2013, Pages 555-563, ISSN 0016-2361, http://dx.doi.org/10.1016/j.fuel.2013.03.003.

(http://www.sciencedirect.com/science/article/pii/S0016236113001919)

Abstract: Coal fly ash is attracting increasing attention as a raw material for processing into multiple products. Well designed processing equipment requires an understanding of how a suspension's rheology changes with increasing solid concentration and shear rate. Current rheological models applied to coal fly ash are insufficient to describe rheology behaviour over a wide range of concentrations. The current paper analyses the flow curves of two types of coal fly ash differing in particle size, shape, and distribution over a range 10–70 wt.%. It has been shown that both samples exhibit complex non-Newtonian behaviour including shear thinning and shear thickening. A new generalised modelling procedure has been proposed to predict the viscosity behaviour of solid suspensions. The resulting model was able to predict the relative viscosity as a function of both concentration and shear rate with a high degree of accuracy. It is envisaged that this will be extremely useful for the purpose of processing equipment design involving mixing operations.

Keywords: Coal fly ash processing; Rheology; Shear thinning

Debadutta Das, Uma Dash, Jibardhan Meher, Pramila K. Misra, Improving stability of concentrated coal–water slurry using mixture of a natural and synthetic surfactants, Fuel Processing Technology, Volume 113, September 2013, Pages 41-51, http://dx.doi.org/10.1016/j.fuproc.2013.02.021.

(http://www.sciencedirect.com/science/article/pii/S0378382013000921)

Abstract: The use of a surfactant mixture of natural and synthetic surfactants as additives in stabilizing coal-water slurry (CWS) formed from low rank Indian coals has been explored. The surface activities of the synthetic surfactants, hexadecyltrimethyl ammonium bromide (CTAB, cationic surfactant) and sodium dodecyl sulphate (SDS, anionic surfactant) are found to alter when various concentrations of natural surfactant, saponin (non-ionic surfactant) extracted from

the fruits of Sapindous laurifolia are added to them independently. A considerable decrease in viscosity of CWS has been observed on the addition of saponin to the synthetic surfactants, CTAB/SDS (at 50:50 (w/w) for saponin:CTAB; 60:40 (w/w) for saponin:SDS systems). The mixture of anionic-nonionic is however, found to be more effective than the mixture of cationic-nonionic surfactants in reducing the apparent viscosity of the mixtures. The surface tension and contact angle data of the mixtures in solution suggest the high surface activity of the mixtures at these ratios. The rheological behaviors of CWS at weight concentrations varying from 55% to 65% wt.%, the static stability test, effect of pH, temperature, etc. have been studied. The slurries follow Bingham plastic behavior within these ranges of concentrations. A qualitative model of interaction of additive with a coal particle at the interface has been suggested.

Keywords: Surfactant mixture; Additive in coal–water slurry; Saponin; Coal–slurry stabilization; Rheological behavior; Natural surfactant

Ganesh K. Parshetti, Zhengang Liu, Akshay Jain, M.P. Srinivasan, Rajasekhar Balasubramanian, Hydrothermal carbonization of sewage sludge for energy production with coal, Fuel, Volume 111, September 2013, Pages 201-210, ISSN 0016-2361, http://dx.doi.org/10.1016/j.fuel.2013.04.052.

(http://www.sciencedirect.com/science/article/pii/S0016236113003530)

Abstract: Hydrothermal carbonization using subcritical water (250 °C, 8–10 MPa and 15 min reaction time) was investigated to recover solid carbonaceous fuel i.e. sludge char (HT-SL) from urban sewage sludge. The carbonaceous HT-SL had an energy–density of 15.82 MJ kg−1. For achieving maximum waste-to-energy conversion, the co-combustion of HT-SL with low rank Indonesian coal (LRIC) and hydrothermally upgraded LRIC (HT-LRIC) was investigated using a thermogravimetric analyzer (TGA) and the emission characteristics of gaseous pollutants were determined by using coupled Fourier transform infrared spectroscopy (FT-IR). To gain insights into the physico-chemical and microstructure properties, carbonaceous fuel were characterized by proximate, ultimate, field emission scanning electron microscopy, FT-IR, X-ray diffraction, Brunauer, Emmett and Teller and inductively coupled plasma optical emission spectrometry analysis. Conventional TGA and kinetic parameters such as activation energy of various LRIC, HT-LRIC and HT-SL blends were also determined. This fundamental study provides a basic insight into co-combustion of HT-SL with LRIC and HT-LRIC, which forms a scientific basis for the efficient utilization of sewage sludge as an energy source while minimizing greenhouse gas emissions.

Lei Chen, Sze Zheng Yong, Ahmed F. Ghoniem, Modeling the slag behavior in three dimensional CFD simulation of a vertically-oriented oxy-coal combustor, Fuel Processing Technology, Volume 112, August 2013, Pages 106-117, ISSN 0378-3820, http://dx.doi.org/10.1016/j.fuproc.2013.02.010.

(http://www.sciencedirect.com/science/article/pii/S0378382013000647)

Abstract: Slagging and fouling are important phenomena associated with ash handling and discharge in coal combustion and gasification. A slag model has been developed for modeling the ash/slag fate including char/ash deposition, char wall burning, molten slag flow, as well as solid slag layer formation on the reactor wall. The submodels are implemented as user defined functions in a three-dimensional computational fluid dynamics (CFD) code, and applied for the simulation of a pilot scale coal slagging combustion facility. The results on the two-dimensional cylindrical reactor wall show uneven char/ash deposition distribution due to the non-axisymmetric flowfield and char trajectories in the reactor. Molten ash properties such as the temperature of critical viscosity (Tcv) and slag viscosity are critical to the slag layer buildup and solid slag layer formation, and eventually affect the ash partition between slag and fly ash. The proportion of ash captured on the cylindrical wall decreases from 44.1% to 23.5% when Tcv increases from 1580°K to 1780°K. Since the reactor is configured with refractory-brick wall, the slag layer has limited impact on the heat transfer through the wall due to its small thickness.

Javier I. Ordóñez, Luis Moreno, Edelmira D. Gálvez, Luis A. Cisternas, Seawater leaching of caliche mineral in column experiments, Hydrometallurgy, Volume 139, July 2013, Pages 79-87, ISSN 0304-386X, http://dx.doi.org/10.1016/j.hydromet.2013.07.009.

(http://www.sciencedirect.com/science/article/pii/S0304386X13001618)

Abstract: Caliche is a mineral that contains a high fraction of soluble minerals and that is exploited in Northern Chile through vat or heap leaching for the production of iodine and nitrate. In this zone, the water availability is scarce, being a critical issue for the mining industries and whereby the use of other leaching agents as seawater may be a viable alternative. For this reason in the present study, column-leaching experiments using seawater were performed, including different irrigation rates and column heights. It is found that the highly soluble minerals such as nitrate and iodate are rapidly leached, while for other minerals like sulphate and chloride, the outlet concentration increased once that part of the sodium has been removed. Crystals of sodium sulphate were found at the column bottom, when this was dismantled. An existing phenomenological model (Gálvez et al., 2012) was used to analyse the changes of concentration of nitrate and iodine (as iodate) with a good agreement between the experiments and the simulations. On the other hand, for sulphate and chloride a new model was developed, which takes into account the dissolution and precipitation phenomena of these ions. The model was able to capture the trends observed in the experiments for the outlet concentrations of the modelled ions.

Keywords: Caliche; Heap leaching; Modelling; Column experiments; Seawater

P.R Holmes, F.K. Crundwell, Polysulfides do not cause passivation: Results from the dissolution of pyrite and implications for other sulfide minerals, Hydrometallurgy, Volume 139, July 2013, Pages 101-110, ISSN 0304-386X, http://dx.doi.org/10.1016/j.hydromet.2013.07.006.

(http://www.sciencedirect.com/science/article/pii/S0304386X13001588)

Abstract: One of the most prevalent suppositions in hydrometallurgy & geochemistry is that sulfur, polysulfides or metal-deficient layers are responsible for the passivation of the dissolution of mineral sulfides. Hence, the purpose of this work was to determine whether the dominant paradigm, that polysulfides are the cause of passivation, is true. The effect of polysulfides on the rate of dissolution of pyrite was studied specifically under conditions in which passivation and pseudo-passivation were not observed. The argument of this work is that if polysulfides are present on the surface and no passivation is observed, then polysulfides are not the primary passivating agent as previously claimed. In order to do this, pyrite was oxidized electrochemically at different potentials (anodic dissolution) under conditions in which no passivation was observed. The pyrite samples were then analysed by X-ray electron spectroscopy (XPS) and Raman spectroscopy (RS). The thickness of the polysulfide layer was estimated by two methods (i) the gold sputtering technique in conjunction with the XPS analysis, and (ii) a comparison of relative peak heights on the RS. Both techniques showed that the polysulfide thickness increased with potential. However, at the same time the electrical current increased exponentially with potential, indicating that polysulfides are not the causative agent for passivation. Samples were also obtained from experiments in which pyrite was dissolved by ferric ions (oxidative dissolution) and in the presence of bacteria (bacterial dissolution). The thickness of the polysulfide layer was similar in both cases to that of the anodic dissolution experiments, suggesting that neither ferric ions nor bacteria affected these surface coatings. Finally, it is argued that mineral sulfides experience pseudo-passivation, and a more probable explanation for this pseudo-passivation is one based on semiconductor electrochemistry.

Keywords: Leaching; Dissolution; Polysulfides; Pyrite; Chalcopyrite

F.K. Crundwell, The dissolution and leaching of minerals: Mechanisms, myths and misunderstandings, Hydrometallurgy, Volume 139, July 2013, Pages 132-148, http://dx.doi.org/10.1016/j.hydromet.2013.08.003.

(http://www.sciencedirect.com/science/article/pii/S0304386X13001643)

Abstract: The dissolution of minerals is of importance to a number of fields of endeavour. In particular, it is the rate of dissolution that is important. Knowledge of the kinetics might allow the rate to be accelerated or retarded, depending on the field of endeavour. In understanding the mechanism of dissolution, it is the order of reaction that is of particular interest. The kinetics of dissolution of minerals are frequently found to be close to one-half order in the oxidant. The electrochemical

mechanism of dissolution describes this dependence. However, a number of misunderstandings about the dissolution of minerals and the electrochemical mechanism recur, and need to be addressed. This paper addresses seven of these misunderstandings, and makes the following conclusions: (i) mechanism is not the same as chemical pathway, (ii) there is no separation of the surface into anodic sites and cathodic sites, (iii) there is no flow of electrons across the bulk of the mineral, (iv) the oxidation and reduction reactions are coupled by the transfer of electrons, not by a chemically bonded activated state, (v) polysulphides do not passivate the surface, (vi) the first step of the dissolution reaction is not by acid, and (vii) the solids do not need to be electrical conductors to dissolve by the electrochemical mechanism.

Keywords: Dissolution; Leaching; Electrochemical mechanism of dissolution; Sphalerite; Pyrite; Pyrrhotite; Chalcopyrite; Gold

Youqi Fan, Yongxiang Yang, Yanping Xiao, Zhuo Zhao, Ying Lei, Recovery of tellurium from high tellurium-bearing materials by alkaline pressure leaching process: Thermodynamic evaluation and experimental study, Hydrometallurgy, Volume 139, July 2013, Pages 95-99, ISSN 0304-386X, http://dx.doi.org/10.1016/j.hydromet.2013.07.005.

(http://www.sciencedirect.com/science/article/pii/S0304386X13001576)

Abstract: This paper focuses on the recovery of tellurium from high tellurium-bearing material with similar compositions to the anode slime of copper electrorefining, containing about 50% of copper and 34% of tellurium in several different phases. Based on the Pourbaix diagram (Eh-pH) of Cu–Te–Se–H2O in certain conditions, an alkaline pressure leaching process with NaOH as leaching agent was proposed to separate tellurium and selenium selectively from the raw material. Further heterogeneous thermodynamic simulation of the leaching was performed by Factsage 6.3 and the behavior of different species was predicted. The experimental results agree with the simulation results and prove that about 90% of the tellurium can be oxidized to soluble sodium tellurite, while the copper stays in the residue. It is found that selenium is difficult to dissolve with a leaching efficiency of only 20%, which needs more detailed research in the future. For the leaching of tellurium, the established optimal leaching conditions were as follows: L/S ratio of 6:1, free concentration of NaOH of 30–40 g/L, time of 6 h, total pressure of compressed air of 1.0 MPa, temperature of 120 ± 5 °C, and agitation speed of 400 rpm.

Keywords: Tellurium; Selenium; Alkaline pressure leaching; Thermodynamic calculation; Pourbaix diagram

Pavel Raschman, Alena Fedoročková, Gabriel Sučik, Thermal activation of serpentine prior to acid leaching, Hydrometallurgy, Volume 139, July 2013, Pages 149-153, http://dx.doi.org/10.1016/j.hydromet.2013.08.010.

(http://www.sciencedirect.com/science/article/pii/S0304386X13001710)

Abstract: The overall process for producing pure magnesium compounds from serpentinite usually starts with acid leaching. However, if serpentinite is calcined prior to leaching, not only faster magnesium dissolution is achieved, but use of thermally activated serpentine also significantly reduces the problems relating to corrosion of the leaching equipment, because less aggressive leaching agents can be used and/or lower leaching temperatures and pressures can be applied. This paper compares how calcination influences the dissolution behaviour of magnesium in solutions of hydrochloric acid, acetic acid and ammonium chloride. Fine-grained serpentinite, characterized by the extent of serpentine decomposition between 85 and 95%, displayed the highest reactivity. The initial magnesium dissolution rate of calcined serpentinite was up to 30-, 125- and 165-times higher as compared to that of uncalcined serpentinite in solutions of hydrochloric acid, acetic acid and ammonium chloride, respectively, under identical reaction conditions.

Keywords: Serpentinite; Serpentine; Calcination; Magnesium; Dissolution

R.R. Samal, C.K. Sarangi, B.C. Tripathy, K. Sanjay, I.N. Bhattacharya, T. Subbaiah, Behaviour of arsenic(III) and antimony(III) during electrowinning of nickel from aqueous sulphate solutions, Hydrometallurgy, Volume 139, July 2013, Pages 39-45, http://dx.doi.org/10.1016/j.hydromet.2013.07.003.

(http://www.sciencedirect.com/science/article/pii/S0304386X1300145X)

Abstract: The effects of As(III) and Sb(III) over a concentration range of 0 to 1000 mg dm− 3 on the electrowinning of nickel from sulphate solutions have been studied. The cathodic current efficiency decreases whilst the energy consumption increases in the presence of arsenic as well as antimony. Both arsenic and antimony depolarise the cathode when added to the nickel sulphate solution resulting in the cathodic reduction of nickel at more positive potentials. X-ray diffraction (XRD) studies revealed that irrespective of the presence of As(III) or Sb(III) in the nickel sulphate bath up to 100 mg dm− 3, the (200) plane is the most preferred plane of crystal growth. However, at higher concentrations the (111) plane becomes the most preferred one. Scanning electron micrographs show that the crystallites of the electrodeposits obtained in the presence of either As(III) or Sb(III) become non-uniform and are of finer sizes in comparison to that produced from pure nickel sulphate bath, however the deposits deteriorated more in the presence of Sb(III). With the increase in As(III) and Sb(III) in the solution to 1000 mg dm− 3 the deposits become very brittle and peel off the cathode. Energy dispersive X-ray (EDX) analyses indicate that the purity of the nickel deposits decreases with the increase in As(III) or Sb(III) content in the electrolytic solutions but the contamination of the deposit was more due to the presence of As(III) when compared with Sb(III) at higher concentrations.

Keywords: Nickel; Arsenic; Antimony; Current efficiency; Polarisation

Xiugen Fu, Jian Wang, Fuwen Tan, Xinglei Feng, Shengqiang Zeng, Minerals and potentially hazardous trace elements in the Late Triassic coals from the Qiangtang Basin, China, International Journal of Coal Geology, Vol.116–117, 1 September 2013, Pages 93-105, http://dx.doi.org/10.1016/j.coal.2013.07.013.

(http://www.sciencedirect.com/science/article/pii/S0166516213001729)

Abstract: The Tumen coal mine has the largest coal resources in Tibet, which have been developed and utilized as an important energy source in the last decades. It has raised some health problems during the coal exploration and utilization in Tibet. Fifty Late Triassic coal (or coaly) samples were picked up from the Qiangtang Basin (Tumen mine, Woruoshan and Hongshuihe areas) to determine the minerals, potentially hazardous elements and their mode of occurrence and possible sources. Coal samples from the Qiangtang Basin have medium- and high-ash yields (15.20–47.88%) with low or medium-high total sulfur content (0.04–4.86%). Minerals in Qiangtang Basin coal include clay minerals, dolomite, quartz, pyrite, siderite, and hematite, and trace amounts of halite, feldspar, anhydrite, barite, chromite, and galena. Potentially hazardous trace elements in coal samples include As, Hg, Pb, and Se. Arsenic is controlled mainly by aluminosilicate minerals. Mercury occurs mainly as an organic-bound form. The organically bound Pb is dominant. Selenium is controlled mainly by Fe-bearing (probably pyrite). A proportion of the elevated concentrations of As, Hg, Pb and Se in Qiangtang Basin coal may be related to underlying shale bed. These elements might have been eroded or leached from the shale bed, which were subsequently transported and accumulated syngenetically in the coal-forming peat swamps. The enrichment of As, Hg, Pb, and Se in Qiangtang Basin coal, however, is also partly to be related to magmatic/hydrothermal fluids.

Keywords: Late Triassic coal; Hazardous elements; Enrichment origin; Qiangtang Basin; China

Lei Zhao, Colin R. Ward, David French, Ian T. Graham, Mineralogical composition of Late Permian coal seams in the Songzao Coalfield, southwestern China, International Journal of Coal Geology, Volumes 116–117, 1 September 2013, Pages 208-226, http://dx.doi.org/10.1016/j.coal.2013.01.008.

(http://www.sciencedirect.com/science/article/pii/S0166516213000116)

Abstract: Coals from three seam sections in the Songzao Coalfield, SW China, are mainly high-ash, high-sulphur semianthracites. Minerals within the Songzao coals are mainly kaolinite, pyrite (or marcasite in some cases), and quartz, with various proportions of non-kaolinite clay minerals, carbonates, feldspars, and anatase. The illite and mixed-layer illite/smectite (I/S) are Na-rich in some of the Datong coal samples. The I/S in the lower coals of the Datong section is most likely an alteration product of dispersed volcanic ash, due to the availability of necessary ions (e.g. K, Na, and Mg) in the marine-influenced coal swamp. Organically-bound Na, which was expelled from the organic matter with coal rank advance, especially with

anthracitization, may have supplied additional Na for the formation of Na-rich illite. Authigenic I/S also occurs in a Tonghua coal ply that is overlain by a mafic bentonite and underlain by an alkali tonstein. Potassium, Na, and Mg for the formation of such I/S were probably derived from the leaching of the adjacent alkali tonstein and mafic bentonite. Although the marine water was also a possible supplier of the alkali elements, authigenic I/S is rare in coal plies that occur further away from the altered volcanic layer. Leaching of the volcanic claystones in the Tonghua coal seam probably led to the formation of relatively abundant anatase and rhabdophane in the underlying coal ply. Fracture-filling REE minerals (probably REE-hydroxides or oxyhydroxides) also occurring in that coal ply crystallized from ascending REE-rich hydrothermal fluids, probably associated with contemporaneous volcanic activity.

Keywords: Mineral matter; Coal; Tonstein; K-bentonite; Late Permian; SW China

Alexandra Golab, Colin R. Ward, Asep Permana, Paul Lennox, Pieter Botha, High-resolution three-dimensional imaging of coal using microfocus X-ray computed tomography, with special reference to modes of mineral occurrence, International Journal of Coal Geology, Volume 113, 1 July 2013, Pages 97-108, ISSN 0166-5162, http://dx.doi.org/10.1016/j.coal.2012.04.011.

(http://www.sciencedirect.com/science/article/pii/S0166516212001334)

Abstract: Samples of coal from the Sydney and Bowen Basins of eastern Australia have been imaged at high resolution using a large-field, 3D microfocus X-ray computed tomography (μCT) system, with special but not exclusive attention to evaluating the modes of occurrence of the mineral matter within the coal. The samples imaged were 110 mm, 25 mm, 19 mm, 10 mm, and 4 mm in size, yielding voxel dimensions of 54, 30, 12, 6, and 3 μm respectively. Data collection was carried out using a helical stage, providing images with > 20002 voxels in the horizontal (X–Y) plane and up to 3500 voxels high. Three-dimensional image blocks derived from the scans were examined as cross-sections along orthogonal planes and as perspective images, manipulated to be viewed from any angle. Imaging after saturating the coal with X-ray attenuating brine was also carried out to highlight the distribution of connected micro-pores and cleats, and improve the detail of features seen within the samples. Features evaluated within the coals included the size and three-dimensional distribution of siderite nodules, and different types of mineral infillings in petrifactions of maceral components. Individual macerals could also be identified within the coal, based partly on X-ray density and partly on the associated porosity and structure. In some cases high-resolution images enabled the nature of individual plant particles to be identified within the coal samples. Mineral-filled cleats and open fractures were also evaluated, including the origin of radiating fracture patterns around siderite nodules in vitrinite. In some cases several generations of cleat and/or fractures could be distinguished, and the sequence of their formation and infilling was interpreted. Complementary analyses of the mineral matter in the samples were carried out using X-ray diffraction, as well as examination of polished

sections by optical microscopy examination. Images obtained from the μCT scans were also registered against SEM–EDX and QemSCAN images of polished sections prepared from the same samples after scanning, providing a more definitive basis for identifying the different components and for integrating μCT data with results from other petrographic and electron microscope studies.

Keywords: Mineral matter; X-ray tomography, petrifactions; Siderite nodules; Fracture fillings; Australia

Asep K. Permana, Colin R. Ward, Zhongsheng Li, Lila W. Gurba, Distribution and origin of minerals in high-rank coals of the South Walker Creek area, Bowen Basin, Australia, International Journal of Coal Geology, Vol.116–117, 1 September 2013, Pages 185-207,http://dx.doi.org/10.1016/j.coal.2013.03.001.

(http://www.sciencedirect.com/science/article/pii/S0166516213000645)

Abstract: The coals of the South Walker Creek area in the northern Bowen Basin, with a vitrinite reflectance (Rvmax) of 1.7 to 1.95%, are among the highest rank coals currently mined in Australia. X-ray diffraction studies have identified an unusual mineral variation through the vertical sequence, with kaolinite-rich assemblages typical of other Australian coals at the top and bottom of the seam section and an illite–chlorite assemblage resembling a metamorphic association in the middle. Calcite and ankerite are also abundant in parts of the vertical sequence. Diaspore is abundant in the middle section of the seam in some areas, and paragonite, dickite or nacrite occurs in some locations as well. The distribution of the non-carbonate mineral assemblages cross-cuts the seam stratigraphy, and appears to be primarily controlled by faults and other structural features. Integration of the mineral distribution with optical and electron microscope data on the coal and non-coal bands, chemical data from coal ash analysis, and information from X-ray micro-tomography, suggests that the illite–chlorite and diaspore-bearing assemblages resulted from hydrothermal effects associated with fluid migration through the middle part of the coal seam. This is further confirmed by the development of metamorphic textures in a tonstein band, also altered to illite and chlorite, in the illite-rich part of the seam section, in contrast to a tonstein with more normal sedimentary textures and a kaolinite composition in the kaolinite-rich upper part of the seam. Detailed studies of cleat mineralisation suggest that fluids rich in Ca, Mg and Al were introduced relatively early in the seam's post-depositional history, associated with heat flow sufficient to alter the minerals in the coal and tonstein in the affected part of the seam section. The relatively uniform vitrinite reflectance profile observed through the seam section may indicate that the coal was already of high rank before the fluids were introduced, or that any localised heat effects on the organic matter associated with the changes in clay mineralogy were overprinted by subsequent wider-ranging rank advance processes.

Keywords: Mineralogy; X-ray diffraction; Hydrothermal alteration; Ammonian illite; Diaspore; Australia

Marcos L.S. Oliveira, Colin R. Ward, Carlos H. Sampaio, Xavier Querol, César M.N.L. Cutruneo, Silvio R. Taffarel, Luis F.O. Silva, Partitioning of mineralogical and inorganic geochemical components of coals from Santa Catarina, Brazil, by industrial beneficiation processes, International Journal of Coal Geology, Volumes 116–117, 1 September 2013, Pages 75-92, ISSN 0166-5162, http://dx.doi.org/10.1016/j.coal.2013.07.002.

(http://www.sciencedirect.com/science/article/pii/S0166516213001614)

Abstract: Comparative studies of the mineral matter and trace elements in 12 pairs of run-of-mine (ROM) and clean-coal products from beneficiation plants in Santa Catarina, southern Brazil, have been carried out using low-temperature oxygen-plasma ashing, X-ray diffraction and chemical analysis techniques with the aim of evaluating the effect of coal preparation on the mineralogy and chemical composition of the final coal products. The results show that substantial reductions in mineral matter and ash percentages are associated with beneficiation of coals mined from the different deposits. These reductions are accompanied by changes in the percentages of Fe2O3 in the respective coal ashes, due to the reduction in the proportion of pyrite in the mineral matter, and also by a reduction in the percentage of Na2O, possibly due to ion exchange within the clay minerals. The relative proportions of quartz, clay minerals, and minor phases such as calcite and feldspar (mainly albite) within the mineral matter are not, however, significantly changed by the beneficiation processes. The concentrations of most trace elements in the beneficiation products are similar to the respective concentrations in the relevant ROM materials, or are reduced to an extent similar to that of the total mineral matter percentage for the respective coal samples. This suggests an association mainly with the clay-rich mineral matter. The concentrations of As and Pb, however, are reduced to a greater extent for most samples by the beneficiation processes, consistent with a pyrite association. Concentrations of Ge, U and Zr are higher in many of the clean coals than in the respective run-of-mine materials, suggesting the possibility of preferential association, at least for some deposits, with the organic-rich fractions of the coals concerned.

Keywords: Mineral matter; X-ray diffraction; Coal preparation; Pyrite; Trace element

S. Giffin, R. Littke, J. Klaver, J.L. Urai, Application of BIB–SEM technology to characterize macropore morphology in coal, International Journal of Coal Geology, Volume 114, 30 July 2013, Pages 85-95, ISSN 0166-5162, http://dx.doi.org/10.1016/j.coal.2013.02.009.

(http://www.sciencedirect.com/science/article/pii/S016651621300061X)

Abstract: We use broad ion beam (BIB) milling to prepare low-relief polished surfaces of coal samples for high-resolution SEM imaging, in a study of the morphology and distribution of macro- and mesopores. Results show that the BIB-sections of a few square millimeters are not large enough to be statistically

representative so that porosity was investigated as a function of maceral type. For a vitrinite maceral type, we found comparably little visible macroporosity within the resolution limits of the SE detector. Less than 2% of all the meso- and macropores studied were found in vitrinites. Pore morphology in an inertinite maceral is dependent on the original maceral. Fusinite yields large, elongated pores (often filled with mineral phases), while macrinite shows comparatively smaller, rounder pores. The distribution of pore sizes follows a similar power law at different magnifications. Our results show that micropores and macropores in coal belong to different populations, with different size distributions and morphologies. BIB–SEM imaging is a useful tool to study meso- and macropore morphology, especially in the size range between 10 nm and 10 μm, but more maceral types should be characterized for a better characterization of maceral porosity at different stages of coalification.

Keywords: Coal porosity; Broad-ion-beam milling; SEM imaging; Pore morphology; Pore size distribution; Vitrinite maceral; Inertinite maceral

SELECTIVE ABSTRACTS

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Jha, Amrita Kumari and Jha, Manis K and Kumari, Anjan and Sahu, S K and Kumar, Vinay and Pandey, B D (2013) *Selective separation and recovery of cobalt from leach liquor of discarded Li-ion batteries using thiophosphinic extractant.* Separation and Purification Technology, 104 (IF-2.921). pp. 160-166.

Plenty of valuable metals especially cobalt is present in spent batteries. The conventional process of disposing the spent batteries as land fill or metal recovery through pyrometallurgical process was not sustainable step to resolve problems. Present work is a part of systematic study involving solvent extraction for the separation and recovery of cobalt from leach liquor of spent batteries containing 21.83 g/L, 2.77 g/ L, 9.14 g/L and 4.14 g/L of cobalt, lithium, copper and aluminum, respectively. Initially bench scale studies were carried out using synthetic solution of 10.44 g/L cobalt and 1.33 g/L lithium (composition similar to the leach liquor diluted two times) in sulfate medium to optimize the condition for the metal recovery from the leach liquor of available batteries. 15% Cyanex 272 as extractant, 3% isodecanol as phase modifier and kerosene as diluent extracted about 99.9% cobalt from synthetic solution at equilibrium pH 5, O/A ratio 1:1 within 5 min of contact time in two stages. The metal loaded organic was scrubbed with 10% Na2CO3 and stripped with 10% H2SO4. The optimized condition obtained was compared with the

leach liquor of batteries which shows the presence of about 99.99% cobalt in the stripped solution and about 95% Li in the raffinate. Hydrated salt of cobalt can be further obtained by using evaporation, Crystallization,precipitation and cementation process. http://eprints.nmlindia.org/6281/

Jha, Manis K and Kumari , Anjan and Jha, Amrita Kumari and Kumar, Vinay and Hait, Jhumki and Pandey, B D (2013) *Recovery of lithium and cobalt from waste lithium ion batteries of mobile phone.* Waste Management, 33(9) (IF-2.485). pp. 1890-1897.

In view of the stringent environmental regulations, availability of limited natural resources and ever increasing need of alternative energy critical elements, an environmental eco-friendly leaching process is reported for the recovery of lithium and cobalt from the cathode active materials of spent lithiumion batteries of mobile phones. The experiments were carried out to optimize the process parameters for the recovery of lithium and cobalt by varying the concentration of leachant, pulp density, reductant volume and temperature. Leaching with 2 M sulfuric acid with the addition of 5% H2O2 (v/v) at a pulp density of 100 g/L and 75 C resulted in the recovery of 99.1% lithium and 70.0% cobalt in 60 min. H2O2 in sulfuric acid solution acts as an effective reducing agent, which enhance the percentage leaching of metals. Leaching kinetics of lithium in sulfuric acid fitted well to the chemical controlled reaction model i.e. 1 (1 X)1/3 = kct. Leaching kinetics of cobalt fitted well to the model 'ash diffusion control dense constant sizes spherical particles' i.e. 1 3(1 X)2/3 + 2(1 X) = kct. Metals could subsequently be separated selectively from the leach liquor by solvent extraction process to produce their salts by crystallization process from the purified solution. http://eprints.nmlindia.org/6647/

Jha, Manis K and Lee, Jae-chun and Kim, Min-seuk and Jeong, Jinki and Kim, Byung-Su and Kumar, Vinay (2013) *Hydrometallurgical recovery/recycling of platinum by the leaching of spent catalysts: A review.* Hydrometallurgy, 133 (IF-2.027). pp. 23-32.

Platinum is one of the precious metals with many applications, including in catalysis, electronic devices and jewelry. However, its limited resources are becoming depleted. To meet the future demand and conserve resources, it is necessary to process spent platinum-containing materials, such as catalysts, electronic scraps and used equipment. These materials are usually processed by pyro/hydrometallurgical processes consisting of thermal treatment followed by leaching, precipitation or solvent extraction. This paper reviews platinum leaching fromsuch resources using acidic and alkaline solutions in the presence of oxidizing agents, such as nitric acid and hydrogen peroxide, sodium cyanide and iodide solutions. The results of the study are described with respect to the recovery of platinum and other metals under the optimized conditions of leaching with lixiviants. Previous studies have achieved platinumrecovery using aqua regia and acidic solution in the presence of chlorine to

produce platinum from spent catalysts on a commercial scale; however, the process generates toxic nitrogen oxide and chlorine gases. This paper reports the salient findings of efforts to replace the aqua regiawith hydrogen peroxide in acidic solution, chloride salts, sodium cyanide and iodide solution to improve the economics of the existing processes and reduce the environmental pollution. http://eprints.nmlindia.org/6546/

Kruthik, N Lakshmi and Karthika, S and Bhaskar Raju, G and Prabhakar, S (2013) *Efficacy of electrocoagulation and electrooxidation for the purification of wastewater generated from gelatin production plant.* Journal of Environmental Chemical Engineering, 1(3), pp. 183-188.

The effluents of gelatin production plant are highly complex and difficult to treat by conventional methods. The electrochemical techniques involving electrocoagulation and electrooxidation were attempted for the treatment of wastewater from gelatin production plant. Around 60% of TOC removal was achieved by electrocoagulation using aluminum as anode. However, the performance was severely affected due to scaling of the electrodes. The high concentration of dissolved calcium was found to be responsible for scaling of electrodes. To minimize the scaling, calcium was precipitated as CaCO3 using bicarbonate. After the calcium was precipitated, scaling was reduced and the performance of the electrodes was drastically improved. The effect of applied current density and flow rate on TOC removal was studied and the energy consumption for electrocoagulation was estimated. Since the removal of pollutants by electrocoagulation is only partial, the wastewater was processed further by electrooxidation using IrO2–Ta2O5 coated Ti electrode and TiO2 nanotubes grown on titanium sheet (TiO2 NT) as electrodes. The TOC removal was drastically improved in the presence of TiO2 NT electrode. http://eprints.nmlindia.org/6721/

Kumar, Anuj and Kumar, Sanjay (2013) *Developments of Paving blocks from synergistic use of red mud and fly ash using geopolymerization.* Construction and Building Materials, 38 . pp. 865-871.

Red mud, a residue of Bayer's process was used synergistically with fly ash to develop geopolymer. An influence of 0-40% red mud addition on the reaction, structure and properties of fly ash geopolymer was studied using isothermal conduction calorimetry (ICC), Fourier transform infrared spectroscopy (FTIR), electron probe microanalysis (EPMA) and mechanical testing. An improvement in intensity of reaction was observed with the red mud addition at all replacement level but improvement in setting time and compressive strength was observed only in the samples containing 5-20% red mud. Structural characterization revealed that rate of reaction was dependent on the NaOH concentration but the development of

mechanical properties were related to the compact microstructure which was developed due to the combined effect of NaOH concentration, solubility of silicates and the presence of iron oxides. Based on scientific understanding, paving blocks using 10% and 20% red mud was developed. These blocks were meeting IS 15658: 2006 standard and leaching of toxic metals were within permissible limits. http://eprints.nmlindia.org/6599/

Kumar, Sanjay and Garcia-Trinanes, P and Teixeira-Pinto, A and Bao, M (2013) ***Development of alkali activated cement from mechanically activated silico-manganese (SiMn) slag.*** **Cement & Concrete Composites, 40 . pp. 7-13.**

Silico-manganese (SiMn) slag has been used to develop alkali activated cement binder. The reactivity of SiMn slag was altered by mechanical activation using eccentric vibratory and attrition mill. The reaction kinetics during alkali activation of SiMn slag and structural reorganization were studied using isothermal conduction calorimetry and Fourier transform infrared spectroscopy. The particle size after milling was smaller in attrition milled samples but reaction started earlier in vibratory milled samples due to more reactivity. This observation was further supported by compressive strength which was highest in samples prepared from vibratory milled slag. The main reaction product was C-S-H (C = CaO, S = SiO2, H = H2O) of low crystallinity of different types with varying Si/Al and Ca/Si ratio. An attempt has been made to relate the microstructure with mechanical properties. The results obtained in this study establish technical suitability of SiMn slag as raw material for alkali activated cement. (C) 2013 Elsevier Ltd. All rights reserved http://eprints.nmlindia.org/6667/

Kumar, Vinod and Lee, Jae-chun and Jeong, Jinki and Jha, Manis K and Kim, Byung-Su and Singh, Ratnakar (2013) ***Novel physical separation process for eco-friendly recycling of rare and valuable metals from end-of-life DVD-PCBs.*** **Separation and Purification Technology, 111 (IF-2.921). pp. 145-154.**

Present paper reports a simple and eco-friendly physical separation process for the recycling of metallic values from PCBs. The separation of material is based on distribution of metallic and non-metallic constituents in different size fractions depending on their liberation size due to their malleable or ductile nature. The studies showed the enrichment of metals in coarser particles (1000 + 150 lm) and non- metals in the fine particles 150 lm following pneumatic separation and froth flotation process.A grade of 88% with 75%recovery was achieved by froth flotation,but lower grade of 75% with 65% recovery were obtained by pneumatic separation with 1500 lm powder.Overall grade of metals was achieved up to 88% by controlling the feed and air flow rates during pneumatic separation.Using this

beneficiation technique, the concentration of rare metals in the different fractions varying from 1.88%to 4.18%was enriched up to 9%.

http://eprints.nmlindia.org/6572/

Kumari, Archana and Jha, Manis K and Hait, Jhumki and Sahu, S K and Kumar, Vinay (2013) *Processing of Korean monazite concentrate for the recovery of rare earth metals (REMs).* Journal of Indian Chemical Society, 90 . pp. 2105-2110.

Rare earths metals (REMs) have gained immense awareness due to their inimitable properties and wide range of applications. REMs are naturally present in minerals like monazite, bastnasite, apatite, etc. The present work is focused on comparative study for the recovery of REMs from original Korean monazite and dephosphorized monazite by acid treatment. Direct leaching of original sample using dilute HCl at elevated temperature for 2 hrs maintaining pulp density < 100 g/L results in ~25% REMs dissolution, which increases to 45% by two-step leaching due to the presence of phosphate in the mineral which hinders the REMs leaching due to the formation of RE complex. However, > 93% REMs is leached in single stage from dephosphorized monazite under same conditions. Systematic dephosphorization studies were made using pyro/ hydrometallurgical methods. Further precipitation, solvent extraction or ion exchange method are used for the selective separation of REMs from the generated leach liquor. http://eprints.nmlindia.org/6751/

Nath, S K and Kumar, Sanjay (2013) *Influence of iron making slags on strength and microstructure of fly ash geopolymer.* Construction and Building Materials, 38 (IF-1.834). pp. 924-930.

Two types of iron making slag namely granulated blast furnace slag and granulated corex slag has been added in the range of 0–50% into a fly ash based geopolymer system respectively. The effect of slag addi- tion to the geopolymerization reaction and consequent structural rearrangement has been studied using Isothermal Conduction Calorimeter and Fourier Transform Infrared Spectroscopy. The effect of corex slag is found to be similar to that of the granulated blast furnace slag. In both the cases, the main reaction product is C–S–H gel (C = CaO, S = SiO 2 , H = H 2 O). An attempt has been made to correlate the reaction, structure and properties. It is found that corex slag, which is generated by a different process of iron mak- ing, gives the similar kind of result as granulated blast furnace slag in fly ash based geopolymer. Thus it can be safely used as substitute of granulated blast furnace slag in alkali activated or geopolymer system. http://eprints.nmlindia.org/6334/

Nayak, B (2013) *Mineral matter and the nature of pyrite in some high-sulfur tertiary coals of Meghalaya, northeast India.* Journal of the Geological Society, 81(2), pp. 203-214.

Coal samples collected from four different sources in the Jaintia Hills of Meghalaya, northeast India, have been investigated for their sulfur content, mineral matter, and to assess their potential behavior upon beneficiation. These coals contain high sulfur which occurs both in organic and inorganic forms. The organic sulfur content is much higher than the inorganic sulfur. Studies on differ-ent size and gravity fractions indicated that the mineral phases are concentrated in higher density fractions (d > 1.8) and in general are fine grained (< 50 mu m). Data of reflected-light optical microscope and electron probe micro-analysis (EPMA) revealed that minerals in these coals are sulfides-pyrite, marcasite, sphalerite, pent-landite; sulfates-barite, jarosite; oxides-hematite, rutile; hydroxides-gibbsite, goethite; phosphate-monazite; carbonate-calcite, siderite and silicates-quartz, mica, chlorite, and kaolinitic clay. The disulfides of iron occur in two modes - mainly pyrite and occasionally marc-asite with wide size ranges and in various forms, such as: framboid, colloidal precipitate, colloform-banded, fine disseminations, discrete grains, dendritic (feathery), recrystallized, nuggets, discoidal, massive, cavity-fracture- and cleat-fillings. Framboidal pyrite has formed primarily due to biological activities of sulfur reducing bacteria in the early stages of coalification. Massive and other varieties have formed at later stages due to coal-escence and recrystallization of the earlier formed pyrites. Sulfur isotopic values indicate a biogenic origin for the pyrites. Association of trace metals, such as Ni, and Zn has been recorded in these pyrites. Given the large fractions of organic sulfur present, these coals can be upgraded only partially to reduce the sulfur content by beneficiation. http://eprints.nmlindia.org/6601/

Nayak, B and Das, Swapan K and Munda, Parikshit (2013) *Biogenic signature and ultra microfossils in ferromanganese nodules of the Central Indian Ocean Basin.* Journal of Asian Earth Sciences, Volume 73, 5 September 2013, Pages 296–305 (IF-2.379). pp. 296-305.

Theories related to the precipitation mechanism of the metallic elements in marine manganese nodules have remained controversial between two schools of thoughts (1) chemical oxidation (abiotic origin) and (2) deposition of the metals through microbial enzymatic processes (biogenic origin). One of the most important evidence in support of the biogenic origin is the occurrence of fossilized microbes. However, well-documented literature in this regard is either lacking or very scanty in case of Indian Ocean nodules. Using high resolution FEG-SEM we have recorded various biogenic signatures and ultra microfossils in the ferromanganese nodule samples from Central Indian Ocean Basin (CIOB) that are presented in this paper. The microfossils are mostly protozoans belonging to varieties of bacteria, diatoms and foraminifera. Some of the features recorded in this study have perhaps never

been reported before from any manganese nodules. The chemical compositions of these ultra microfossils indicate a high-level of manganese precipitation in and around them in comparison to the distant surrounding areas. While clumpy microbes are enriched with nickel, the rod shaped bacteria are rich in copper. Up to 4.70 wt.% nickel and 5.31 wt.% Cu have been recorded in the fossilized microbe bodies. The high abundance of biogenic features as well as microfossils in the ferromanganese nodules and their chemical compositions support arguments in favor of a dominant role of the microorganisms in the construction of the nodules of the CIOB. http://eprints.nmlindia.org/6720/

Rath, R K and Mohanty, Sunati and Nayak, B and Singh, Ratnakar and Bhattacharyya, K K (2013) ***A Comparative Study on Processing of High Alumina Hematite Iron Ore by Gravity, Magnetic and Flotation Methods.*** **Journal of Materials Science and Engineering A, 3(5), pp. 349-354.**

The low grade iron ore sample contains both lumps and fines. It is mostly hematitic iron ore and considerable amount of goethitic/limonitic material is also present in it. The major impurities present were quartz and clay. It is observed that the iron bearing phases are poorly liberated above 300 µm and the liberation improves below 300 µm. More than 80% liberation is achieved below 106 µm. Based on the liberation data, the feed for the different beneficiation methods was prepared by stage crushed the ROM followed by grinding passing to 106µm and the ground material (-106 µm) was deslimed. The underflow was subjected to various beneficiation techniques such as tabling, enhanced gravity separator (EGS), wet high intensity magnetic separation (WHIMS) and flotation and the results are discussed. All the methods studied could able to produce pellet grade concentrate with iron content of 64.5%, however, a marginal higher yield was observed for WHIMS (81%). http://eprints.nmlindia.org/6678/

Samal, S and Ray, Ajoy K and Bandopadhyay, A (2013) ***Proposal for resources, utilization and processes of red mud in India - A review.*** **International Journal of Mineral Processing, 118 (IF-1.378). pp. 43-45.**

Red mud is a solid waste produced in the process of alumina production from bauxite following the Bayer process. More than 4 million tons of red mud is generated annually in India only. Presently, it is stored or dumped on land, or in the oceans near alumina refineries. However, its high alkalinity is a potential pollution to threat water, land and air. While high costs are associated with the large area of land required for storage of the residue. India is amongst the major producers of alumina in the world. There are some differences in mineralogical composition between the residues from India and other countries due to the difference in the ore type in its production processes. Significant achievements in treatment and utilization of red

mud have been obtained in India in the last decade. In this paper, the various proposals for the utilization of red mud generated in India are presented. Similarly, the drawbacks associated with these potential commercial applications of red mud are discussed. http://eprints.nmlindia.org/6608/

Samanta, Salkat and Goswami, M C and Baidya, T K and Mukherjee, S and Dey, R (2013) *Mineralogy and carbothermal reduction behaviour of vanadium-bearing titaniferous magnetite ore in Eastern India.* International Journal of Minerals Metallurgy and Materials, 20(10) (IF-0.483). pp. 917-924.

Vanadium-bearing titaniferous magnetite bands hosted by Precambrian gabbro-norite-anorthositic rocks or their metamorphic equivalents were discovered in some parts of Eastern Indian Shield, containing 48%-49% Fe (total), 10%-25% TiO2, and 0.3%-2.20% V2O5 by mass. Mineralogical and petrological study, composition, and characterization of the vanadium-bearing titaniferous magnetite ore were carried out by scanning electron microscopy-energy dispersive X-ray (SEM-EDX), wave length X-ray florescence (WDXRF), inductively coupled plasma-atomic emission spectroscopy (ICP-AES), X-ray diffraction (XRD), etc. Chemical beneficiation for valuable metals, such as Fe, Ti, and V, was performed by reduction roasting. The direct and indirect reduction were investigated by mixing the lump ore with solid activated charcoal in a closed reactor and purging the reducing gas mixture in standard reducibility index apparatus at different temperatures and time intervals. The reduction roasting parameters were optimized. Finally, the reduced samples were crushed and upgraded by magnetic separation. The results show that, the maximum mass fractions of magnetic and nonmagnetic parts achieved are 69.36% and 30.64%, respectively, which contain 10.6% TiO2 and 0.84% V2O5 in the magnetic part and 36.5% TiO2 and 0.22% V2O5 in the nonmagnetic part http://eprints.nmlindia.org/6791/

Shin, Doyun and Jeong, Jinki and Lee, Sujeong and Pandey, B D and Lee, Jae-chun (2013) *Evaluation of bioleaching factors on gold recovery from ore by cyanide-producing bacteria.* Minerals Engineering, 48 (IF-1.207). pp. 20-24.

The present study was conducted to investigate the gold bioleaching factors from ore by cyanide producing bacterium Chromobacterium violaceum. The optimal condition for cyanide production by C.violaceum was pH9 and 5g/L of glycine in YP medium in 2-days of incubation. In shake flask culture, gold bioleaching from the ores by C.violaceum, pH, and biooxidative treatment. The three types of low grade ores viz, R, S. and H were used. The gold bioleaching effeciencies were recorded as 0%, 50%, and 5% for ores R, S, and H, respectively, when C. violaceum culture was used without any pretreatment (protocol 1). In the experimental protocol involving grinding and pre-grown C.violaceum, leaching efficiencies increased to 60%, 100%

and 40% for ore R, S, and H samples, respectively. Especially, the bioleaching efficiency of ore S enhanced to almost 100% with pre-grown C.violaceum (protocol 3) due to their mineralogical characteristics of the ores. For refractory gold (i.e., ore R) grinding as pretreatment was needed, and for ore S (almost all of the gold was cyanidable) cyanide production was activated by using pre-grown bacteria. Biooxidation with Acidithiobacillus ferrooxidans and pH adjustment (i.e., 9-11) did not affect the bioleaching efficiencies. The mineralogical cause of gold refractoriness was analyzed by automated SEM that showed most of gold in the ore was entrapped in pyrite and silica. The results indicated that gold bioleaching by C.violaceum from low grade ore can be enhanced by grinding and pre-grown microbe; use of appropriate experimental condition is important according to the mineralogical characteristics. http://eprints.nmlindia.org/6628/

Singh, Ashok K and Sharma, Mamta and Singh, Mahendra P (2013) *SEM and reflected light petrography: A case study on natural cokes from seam XIV, Jharia coalfield, India.* Fuel, 112 (IF-3.357). pp. 502-512.

This paper is an attempt to characterize the natural coke (local name 'jhama') and associated unaltered coal drawn from seam XIV, Burragarh colliery, Jharia coalfield with help of Scanning Electron Microscopy (SEM) and organic petrography techniques. The organic petrography was carried out using DM4500 advanced polarizing microscope, while scanning electron micrography was performed on a JEOL-840A JSM. The coal and natural coke samples were pulverized and beneficiated, and fractions of different sizes (50–0.50 mm) at varying specific gravities (1.4 to >1.8) were subjected to this study with a view to expose the concentrations of microstructures and microtextures of natural coke in different specific gravity fractions. In addition, an effort was made to compare the variety of textures as seen with the help of optical microscopy with those as revealed under scanning electron microscope. SEM photographs revealed some textural features of natural coke, which remained unexposed in optical microscopy. This may be due to the use of unpolished samples and greater depth of focus achieved by SEM. The features which were studied through these two microscopy methods are characterization of carbonized matrix, mosaics, flow textures, micro, meso and macropores and cracks formed due to escape of volatiles including properties of mineral matter or their altered products (glassy matrix). The different washability fractions of Burragarh natural coke have shown that there is gradual decrease of reactive macerals and increase of anisotropic mosaics, flow textures and deposited carbons up to specific gravity of 1.70. The approach thus enabled a combined maceral–mineral analysis, which bears good implications on academic and industrial use of natural cokes. http://eprints.nmlindia.org/6696/

Singh, Ranjeet K and Das, Avimanyu (2013) *Analysis of separation response of Kelsey centrifugal jig in processing fine coal.* Fuel Processing Technology, 115 (IF-2.816). pp. 71-78.

Beneficiation of fine coal of size 300 × 150 μm was investigated in a laboratory Kelsey jig. A number of process variables were studied while others were kept constant. Silica sand of size − 1.68 + 0.85 mm was used as ragging material to prevent pegging of the internal screen. The thickness of the ragging bed was established to be most crucial in controlling the separation. Rotational speed significantly affected the porosity of the ragging bed and particle momentum which had a contrasting influence on process performance. Pulsation rate determined bed dilation and misplacement of heavier particles. A slip velocity based estimation of the particle momentum indicated that the passage of particles in the intermediate momentum region to the overflow or underflow determined the performance. In a single pass through the Kelsey jig an absolute 7% reduction in the ash content was achieved at over 55% yield. A thicker bed depth was found to facilitate rejection of high ash materials. Models were developed for the response parameters and optimization performed. Operating regimes were identified for roughing or cleaning application of the Kelsey jig for optimum performance. It was established that Kelsey jig could be effective in fine coal cleaning if operated in a controlled manner.
http://eprints.nmlindia.org/6714/

Vaish, A K and Singh, S D and Minj, R K and Gupta, R C (2013) *Exploration and Exploitation of Multi-Metallic Magnetite Ore of Nagaland for Value Added Product.* Transactions of the Indian Institute o Metals, 66(5-6) (IF-0.215). pp. 491-499.

The multi-metallic magnetite ore at Pokhpur, Tuensang district of Nagaland is of special significance due to the presence of Ni, Cr and Co. Its smelting was carried out to selectively reduce all the oxides of nickel, chromium, cobalt and iron present in the ore into their metallic form. The reduction of chromium was found to be the controlling factor to determine the amount of reductant required to be added in the charge mix. Initially the basic laboratory scale smelting reduction study was carried out in a graphite crucible fitted in an induction furnace at two different temperatures using two reductant prior to pilot scale smelting trails in 500 kVA submerged arc furnace. The product comprising of chromium, nickel and cobalt was used to make grinding media which has been successfully tested in cement plants.
http://eprints.nmlindia.org/6746/

Vasumathi, N and Vijaya Kumar, T V and Subba Rao, S and Prabhakar, S and Bhaskar Raju, G and Shivakumar, S and Uma, Raman (2013) *Eco Friendly and*

Cost-Effective Reagent for Coal Flotation. **International Journal of Engineering Research, 2(7) (IF-0.421). pp. 418-423.**

Conventionally, diesel in combination with a frother is used widely in flotation of coal fines. With the continuous price escalation of petroleum products and their negative impact on environment, attempts were made to formulate an eco-friendly single reagent to replace diesel-frother system without affecting the flotation performance. Laboratory flotation tests were carried out, on a coking coal sample from eastern India, that analyzed 25.67% ash and 53.97% fixed carbon using a series of reagents developed. Among them, the performance of Sokem 590C derived from a vegetable oil was found to be encouraging. Concentrate assaying 11.77% ash and 66.40% fixed carbon was obtained with yield of 56.57%. Moreover, the reagent is biodegradable and eco friendly. Based on favorable kinetics and encouraging test results, plant trials were conducted at a coal preparation plant and the superiority of this reagent was demonstrated. http://eprints.nmlindia.org/6745/

Vidyadhar, A and Das, Avimanyu (2013) ***Enrichment implication of froth flotation kinetics in the separation and recovery of metal values from printed circuit boards.*** **Separation and Purification Technology, 118 (IF-2.894). pp. 305-312.**

The e-waste printed circuit boards (PCBs) are rich in metal content and processing these wastes for extracting the metal values and removing the non-metallic constituents is a prospective proposition. Froth flotation methodology was observed to be a promising technique for rejecting plastics from the comminution product. It has been shown that nearly reagent-free flotation of relatively coarse size (−1.0 mm) pulverized e-waste is feasible with a reasonably good product at a high yield and excellent recovery. In the present research work, enrichment of ground 1.0 mm PCB powder was investigated through flotation route by varying the operating variables such as frother dosage, pulp density, air flow rate and rotational speed of impeller. The liberation studies accomplish that liberation of metal value from non-metallic constituents at −1.0 mm size is excellent and the particulate system is significantly rich in metal value, containing around 23% metal. In-depth study of froth flotation kinetics is primarily focused on high rejection of plastics and also identification of optimum operating conditions for the same. Single-stage flotation enhances metal content from 23% to over 37%, contributing a mass yield of around 75% with recovery of nearly 95% metal values, suffering nominal loss of around 4% metal value only, while effectively rejecting 32% of the materials in feed through float fraction. The interdependence of kinetics and process variables has been discussed and it has been concluded that a high rotor speed aids efficient rejection of the plastics. However, addition of frother is essential to help stabilize the froth and enhance the kinetics, while efficient pre-concentration is facilitated through a combination of moderate air flow with low pulp density. Generation of pre-concentration through flotation route from the entire −1.0 mm comminution product stands accomplished. http://eprints.nmlindia.org/6715/

Vidyadhar, A and Das, Avimanyu (2013) *Stratification and segregation features of pulverized electronic waste in flowing film concentration.* Journal of Environmental Management, 118 (IF-3.245). pp. 49-54.

Gravity separation of metals from plastics in pulverized e-waste using flowing film concentration in a shaking table was investigated. Over 51% rejection of plastics in a single stage operation was achieved under optimum conditions. The shaking table was shown to be suitable for processing ground PCBs. Pulverized e-waste containing 22% metals was enriched to around 40% metals in a single pass. Statistical models for the mass yield of metal-rich stream and its grade were developed by design of experiments. Optimization was carried out to maximize the mass yield at a target product grade and preferred operating regimes were established. Experiments were designed to prevent metal loss and over 95% recovery values were obtained under all conditions. Settling distances of metals and plastics were computed and shown to be good indicators of separation performance. Particle morphology and stratification in the troughs in between the riffles were shown to influence the separation significantly. Water flow-assisted motion of the plastics was captured and its role in determining the effectiveness of separation was described. The efficacy of tabling was well established for treating ground PCBs. The wet process was shown to be environment friendly and sustainable. It is also relatively cheap and has good potential for industrial application. However, rigorous cost estimates will be required before commercial application. http://eprints.nmlindia.org/6363/

Vijaya Kumar, T V and Vasumathi, N and Subba Rao, S and Prabhakar, S and Bhaskar Raju, G (2013) *Recovery of ultrafine iron values from tailing pond of iron ore washing plants.* The Indian Mineralogist, 1-2, pp. 83-92.

Most of the Iron ore washing plants set up in India in the earlier days consist of sizing of the ore by dry / wet screening, washing and classification by screw classifiers. In this classical approach, iron values were lost in the form of fines and ultrafines into the tailing ponds as they had little commercial value in those days and accumulated in huge quantities over the years. As the high grade deposits are getting exhausted and the demand for high grade finer material for pellet making is ever increasing, focus is shifting towards recovering the values from the erstwhile tailing ponds by column flotation. This is also supposed to mitigate to certain extent the environmental problems caused by the ever expanding and unmanageable tailing dams. A case study is presented wherein a composite sample is prepared from samples drawn systematically from multi - locations in a sprawling tailing dam. Laboratory scale column flotation tests on this composite tailings sample, basically originating from two operating iron ore beneficiation plants of JSW Steel Ltd., one of the leading producers of steel in India, are found to be encouraging. De-sliming followed by reverse and cationic flotation tests using flotation column resulted in the

concentrate of 61.88% Fe, 4.81% SiO2, 2.52% Al2O3 and 3.30% loss on ignition (LOI) from the tailings analysing 57.86% Fe, 7.10% SiO2, 3.52% Al2O3 and 6.14% LOI with 52% weight recovery. The causes for the quality improvement could be attributed to de-sliming of unliberated ultra fines of kaoline and hydrated iron oxides and their further reduction by efficient flotation process. The process and the cationic collector developed for this purpose are adopted in the new flotation plant created to treat these tailings. http://eprints.nmlindia.org/6978/