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Applicability of a Dense-Medium Cyclone and Vorsyl Separator for Upgrading Non-Coking Coal Fines for Use as a Blast Furnace Injection Fuel

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International Journal of Coal Preparation and Utilization, TAYLOR & FRANCIS INC, PHILADELPHIA, 2009, Vol 29(1), Jan-Feb, pp. 23-33.

Replacement of metallurgical coke by high injection rates of thermal coal into the blast furnace is an important technology as it reduces the cost of hot metals significantly. However, one of the main problems that prevents the use of thermal coals is their high mineral-matter contents. Although, the ash content of coals to be injected in a blast furnace should be as low as possible, a maximum of 16% ash is acceptable. A non-coking coal sample from Chhattisgarh area, India, having a feed ash content of around 27% was collected for beneficiation studies to a grade acceptable for the injection purposes. A series of experiments were conducted in a 76-mm diameter dense-medium cyclone (DMC) and a Vorsyl separator (VS). It is observed that a clean coal having around 16% ash can be produced using both the cyclones if the variables are properly optimized. Further, it is observed that at the same ash level the yield of clean coal was 5%-6% more in VS than in DMC. It has also been demonstrated that at the same ash level, the magnetite medium stability in a VS was better than a DMC.
10.1080/19392690802628754

Research on the triboelectrostatic separation of minerals from coal

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Proc. of the International Conference on Mining Science & Technology (Icmst2009)
International Conference on Mining Science and Technology, 2009, Xuzhou, PEOPLES R CHINA, ELSEVIER SCIENCE BV, AMSTERDAM, 2009, Vol. 1(1), pp. 845-850.

For realizing to the triboelectrostatic separation of mineral matters from cleaned coal with density of <1.35 g/cm(3), the quartz, kaolin and pyrite are pulverized to

less than 75 mu m and mixed according to various proportions, then fed to a triboelectrostatic separator. The material adhere to electrodes are divided to three subsection samples. The samples are analyzed with XRF, sulphur and ash analyzer. A quantity of quartz of 69.31%-71.27%, kaolin of 75.66%-81.93%, pyrite of 86.74%-90.52% could be removed under the same conditions. The results indicate that in the process of triboelectrostatic separation, coal would charged positively and quartz, kaolin, pyrite, calcite would charged negatively. Coal and these mineral matters could be separated effectively.
10.1016/j.proeps.2009.09.132

Dynamic modelling and simulation of semi-autogenous mills
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Minerals Engineering, JAN, 2009, Vol. 22(1), pp. 70-77.

This paper presents a dynamic simulator of the semi-autogenous grinding operation deduced from first principles coupled to an on-line parameter estimation scheme able to simulate industrial operations for control purposes. Model equations are based on conventional non-stationary population balance approach to develop the necessary dynamic model of the semi-autogenous mill operation. The model is able to predict the time-evolution of key operating variables such as product flow rate, level charge, power-draw and load position. as function of other important variables such as mill rotational speed and fresh feed characteristics. The set of ordinary differential equations was solved using MATLAB/SIMULINK as a graphic programming platform, a very helpful tool for understanding the grinding phenomenon. Using an on-line parameter estimator, the simulator was tested and validated at an 1800 t/h copper-ore mill showing the effectiveness of the system to track the dynamic behaviour of the variables. It is now being used for the study of advanced control schemes.
10.1016/j.mineng.2008.04.009

Chemical and petrographical characterization of feed coal, fly ash and bottom ash from the Figueira Power Plant, Parana, Brazil
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International Journal of Coal Geology, ELSEVIER SCIENCE BV, AMSTERDAM, Jan-31, 2009, Vol. 77, pp. 269-281.

The aim of the present study is the petrographic and chemical characterization of the coal at the Figueira Power Plant, Parana, Brazil, prior and after the beneficiation process and the chemical characterization of fly and bottom ashes generated in the combustion process. Petrographic characterization was carried out through maceral analysis and vitrinite reflectance measurements. Chemical characterization included

proximate analysis, determination of calorific value and sulphur content, ultimate analysis, X-ray diffraction, X-ray fluorescence, Inductively Coupled Plasma - Mass Spectrometry (ICP-MS) and Inductively Coupled Plasma - Atomic Emission Spectrometry (ICP-AES) analysis, and determination of Total Organic Carbon (TOC) content. Vitrinite reflectance analyses indicate a high volatile B/C bituminous coal (0.61 to 0.73% Rrandom). Maceral analyses show predominance of the vitrinite maceral group (51.6 to 70.9 vol.%, m.m.f). Except of the Run of mine (ROM) coal sample, the average calorific value of the coals is 5205 kcal/kg and ash yields range from 21.4 to 38.1 wt.%. The mineralogical composition (X-ray diffraction) of coals includes kaolinite, quartz, plagioclase and pyrite, whereas fly and bottom ashes are composed by mullite, ettringite, quartz, magnetite, and hematite. Analyses of major elements from coal, fly and bottom ashes indicate a high SiO(2), Al(2)O(3), and Fe(2)O(3) content.

Trace elements analysis of in-situ and ROM coals by ICP-MS and ICP-AES show highest concentration in Zn and As. Most of the toxic elements such as As, Cd, Cr, Mo, Ni, Pb, and Zn are significantly reduced by coal beneficiation. Considering the spatial distribution of trace elements in the beneficiated coal samples, which were collected over a period of three months, there appears to be little variation in Cd and Zn concentrations, whereas trace elements such as As, Mo, and Pb show a larger variation. According to the International Classification of in-seam coals the Cambui coals are of parajortho bituminous rank of low grade (except for the ROM sample), and are characterized by the predominance of vitrinite macerals.
10.1016/j.coal.2008.05.005

Briquetting of Coal Fines and Sawdust Part I: Binder and Briquetting-Parameters Evaluations

Taulbee, D.; Patil, D. P.; Honaker, Rick Q.; Parekh, B. K.
International Journal Of Coal Preparation And Utilization, Vol. 29(1), Jan-Feb, 2009, pp. 1-22

Various technical and economic aspects relating to the briquetting of fine coal with sawdust have been evaluated with the results for two segments of that study presented here: binder and briquetting-parameter evaluations. Approximately 50 potential binder formulations were subjected to a series of screening evaluations to identify three formulations that were the most cost effective for briquetting fine coal with sawdust. Two of the binders, guar gum and wheat starch, were selected as most suitable for the pulverized coal market while the third formulation, lignosulfonate/lime, was targeted for the stoker market. Following binder selection, a number of briquetting parameters including binder and sawdust concentration, sawdust type, briquetting pressure and dwell time, coal and sawdust particle size, clay content, moisture content, and cure temperature and cure time were evaluated. Briquetting pressure and dwell time have the least impact while binder and sawdust

concentrations, sawdust type, and curing conditions exerted the greatest influence on briquette quality.
10.1080/19392690802628705

Precautionary Measures in Determining Volatile Matter in Natural Coke Washability Fractions

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International Journal Of Coal Preparation And Utilization, Vol. 29(1), Jan-Feb, 2009, pp. 34-47

Industrial utilization of heat-altered coal, especially natural coke derived from coking coal, has become a challenge. As such approximately 3,500 million tones (Mt) reserves of baked coals are available in different coalfields of India. In the present investigation, a natural coke sample (03 tone) was collected from a huge dump of seam XIV of Burragarh colliery under leasehold of Bharat Coking Coal Ltd., a subsidiary of Coal India Ltd, situated in Dhanbad district of Jharkhand state. It was observed that the volatile matter in the washability fractions of different size ranges (50 to 0.5mm) at specific gravity 1.40 to 1.80 showed erratic distribution with respect to ash. To check the abnormality, the subsamples were subjected to microscopic (petrographic) study and chemical analysis including CO2 determination. The high concentration of CO2 is related to high concentration of carbonate minerals generated due to igneous intrusions in coal seams. Based on above observations, it was concluded that the volatile matter can be corrected through determined CO2 content in each fraction. Since efforts are being made to use natural coke in different industries such as steel, power, cement, carbon artifacts, etc., a careful investigation of volatile matter distribution in natural coke washability fractions would be of immense help in planning its bulk use.
10.1080/19392690802628820

Fine coal preparation using novel tribo-electrostatic separator

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Minerals Engineering, JAN, 2009, Vol. 22(2), pp. 119-127.

Dry coal beneficiation has been examined by tribo-electrostatic method using Indian thermal coal sample from Ramagundam coal mines. The process of tribo-electric coal/ash cleaning is carried out with a newly built cylindrical fluidised bed tribo-charger with internal baffles, made up of copper metal. The charge transfer in coal maceral and mineral particles after repeated contact with copper plate tribo-charger is measured. Separation of particles in an electrostatic separator according to the polarity of particle charge generated during tribo-electrification is discussed with respect to gas flow rate and residence time in fluidised bed tribo-charger and

the applied electric field. The coal and mineral particles charge with positive and negative polarities respectively. The magnitude of particles charge found to be relatively high illustrating greater efficiency of contact electrification in fluidised bed tribo-charger. The separation results with 300 mu m size fraction of coal containing 43% ash showed that the ash content can be reduced to 18% and 33% with an yield of about 30% and 67%, respectively. These results are comparable to the maximum separation efficiency curve of washability studies on this coal sample. Since the ash percentage of coal particles collected in the bins close to positive and negative electrodes are about 70% and 20%, a better yield with low ash content can be accomplished on recycling the material. 10.1016/j.mineng.2008.05.009

Leaching of waste battery paste components. Part 1: Lead citrate synthesis from PbO and PbO2

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Hydrometallurgy, JAN, 2009, Vol. 95, pp. 53-60

In this study, as part of developing a new process which can avoid smelting and electro-winning, citric acid based reagents in aqueous media were reacted with PbO and PbO2. These two oxides are important components in the spent lead-acid battery paste and together account for up to 50% of the paste by weight. PbSO4, the main component in a spent battery paste accounting for the remaining 50%, is dealt with in Part 2 in a separate paper. Reaction between PbO and C6H8O7 center dot H2O or PbO2 with a mixture of C6H8O7 center dot H2O and H2O2 yielded lead citrate, Pb(C6H6O7)center dot H2O, which was characterised by XRD, SEM and FT-IR analysis. Optimal synthesis conditions were determined by investigating the effect of time, temperature, concentration, and the starting Pb oxide/water ratio. The optimal condition for leaching a mol of PbO at room temperature (20 degrees C) was found to be: 1 mol of (C6H8O7)center dot H2O solution; 1/3 as the starting PbO/water ratio and 15 min of reaction time. Pure citrate product, Pb(C6H6O7)center dot H2O was rapidly crystallized from the solution, in the leaching process. Leaching of PbO2 required the use of a mild reducing agent. For each mole of PbO2, the optimum condition at 20 degrees C was found to be: a solution containing 4 mol of C6H8O7 center dot H2O and 2 mol of H2O2; 1/5 as the starting solid PbO2/water ratio; and 60 min of reaction time. The product, as with PbO, was pure Pb (C6H6O7)center dot H2O compound. The remaining lead content of the filtrate solution was 0.017% and 1% corresponding to recoveries of 99.98% and 99% of lead as citrate, after the leaching/crystalization/filtration process with PbO and PbO2, respectively. Asymmetric stretching vibrations between 1599 and 1662 cm(-1), whereas symmetric vibrations between 1520 and 1327 cm(-1) for lead citrate synthesised from PbO and asymmetric stretching vibrations between 1600 and 1642 cm(-1) as well as symmetric vibrations between 1517 and 1326 cm(-1) for the product obtained from PbO2 revealed the strong IR adsorptions associated with

a carboxylate structure. XRD data was identical to the well documented crystalline Pb(C6H6O7)center dot H2O compound from both the oxides, SEM revealed the formation of plate/sheet like morphologies. The difference in the column size of the Pb(C6H6O7)center dot H2O formed from the two lead oxides can be related to difference in the rate of the respective reactions. 10.1016/j.hydromet.2008.04.012

Fractal evaluation of particle size distributions of chromites in different comminution environments

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Minerals Engineering, JAN, 2009, Vol. 22(2), pp. 156-167.

Particle size distributions (PSDs) are often rendered as cumulative functions, either as number of particles larger than a certain diameter, or as mass smaller than a certain diameter. The fractional exponent of the number/mass-size power law has been interpreted as the fractal dimension of the distribution. An application of PSD in comminuted chromites by means of the fractal mass distribution is presented. The five types of chromite samples were subjected to four comminution events: jaw, cone, hammer Crushing and ball milling. The PSDs generated by different comminution devices has been evaluated by mass-based fractal fragmentation theory and the fractal dimensions of fragmentation (DO, a value quantifying the intensity of fragmentation, have been obtained for each chromite ore. The results of the present study show that the particle size distributions of the comminuted chromites having different mineralogical characteristics are fractal in nature. Single and multifractal methods have been successfully applied to characterize particle size distributions (PSD) of chromite samples comminuted by different comminution devices. In general, depending oil the energy events, the chromite ores having different mineralogical characteristics showed a general trend of PSDs, and hence. the ranges of D-F for a specific device. It call be Concluded that breakage mechanisms have more effective on fractal dimensions of chromite samples although the mineralogical properties and size of the chromite ores broken are also a factor.
10.1016/j.mineng.2008.06.002

Froth flotation for beneficiation of printed circuit boards comminution fines: an overview

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Mineral Processing And Extractive Metallurgy Review, TAYLOR & FRANCIS INC, PHILADELPHIA, 2009, Vol. 30(2), pp. 101-121.

End-of-life printed circuit boards (PCBs) are a complex secondary resource stock that continues to evolve more complexly in new generation devices. This is a major challenge in its physical processing. The value of precious and base metals loss to the -75m fraction generated during PCB comminution has been identified as a major constraint toward improving physical processing. Application of froth flotation for beneficiation of this fines fraction is conceivable, as each group of particles in the mix has distinct surface properties that can be exploited. However, recognizing the complex flotation system such a sample can produce, an informed discourse has been presented herein: starting from a characterization of the resource stock, then to a review of almost three decades of PCB physical processing, before attempting to simplify the flotation complexities. This overview is intended to be a springboard for detailed investigations into this theme. 10.1080/08827500802333123

Removal of vanadium from molybdate solution by ion exchange

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Hydrometallurgy, FEB, 2009, Vol. 95, pp. 203-206

Due to numerous co-properties in chemistry of molybdenum and vanadium, it is relatively more difficult to remove vanadium from molybdate solution. To produce high-quality ammonium molybdate with the molybdenum materials containing vanadium, the separation of vanadium from the molybdate solution under batch and column mode using ion exchange technique with the strong base resin D296 was studied. In the solution, the pH value was about 7.2, the molybdenum concentration was in the range of 60-80 g/L, vanadium concentration was near 0.6 g/L, chloride ions 20 g/L The concentration of vanadium (V(2)O(5)) Was not more than 0.01 g/l in the effluent until effluent/resin volume ratio over 20 at 25 +/- 0.5 degrees C for contact time 60 min and, the average concentration of vanadium (V(2)O(5)) was less 0.008 g/L in the effluent collected till the breakthrough point 0.02 g/L V(2)O(5). it was found that the separation can be only performed in the pH range of 6.5-8.5 and, chloride ions have an important influence on the separation as well. When Cl(-) concentration is increased near 70 g/l, it is impossible to remove vanadium from the solution with the resin. The loaded resin was stripped and regenerated using HCl 6 mol/L the desorption ratio of vanadium was over 98.5%. 10.1016/j.hydromet.2008.05.051

Selective separation of rare earths and impurities from ilmenite ore by addition of K+ and Al3+ ions

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Hydrometallurgy, FEB, 2009, Vol. 95, pp. 254-261

A new technique for the selective separation of rare earth oxides and impurities from lower grade titaniferous ores has been developed. The process includes

roasting the ore with alkali followed by aqueous leaching which liberates 80% of rare earth oxides from the mineral matrix. The removal of rare earth oxides from ilmenite ore was closely linked with additions of aluminium and potassium ions. Both the cations appear to generate lattice strains within the ilmenite structure which leads to breaking of the lattice and separation of rare earth oxides. The influence of both K+ and Al3+ cations on ilmenite was similar but the mechanism of the reaction was found to be different which we have explained on the basis of crystal structure and ionic radius. 10.1016/j.hydromet.2008.06.004

An Evaluation of a Two-Stage Spiral Processing Fine Anthracite Refuse

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International Journal of Coal Preparation and Utilization, TAYLOR & FRANCIS INC, PHILADELPHIA, 2009, Vol. 29(2), Mar- Apr, pp. 49-67.

Testing was conducted to evaluate the performance of a two-stage Multotec SX7 spiral concentrator treating fine anthracite refuse. Two sets of samples were collected from an anthracite cleaning plant located in eastern Pennsylvania. One sample consisted of the thickener feed slurry (nominal-1.2mm) and the other consisted of the thickener underflow slurry. A third sample was prepared by desliming the thickener feed using a 102-mm diameter Krebs cyclone to produce a nominal-1.2+0.025mm product. The effects of slurry flow rate and solids concentration on spiral performance were investigated. For the+0.025mm material, the feed ash value could be reduced from 71% to 21%, while producing a refuse with an ash value of 91%. Regardless of whether the feed slurry was deslimed or undeslimed, the+0.025mm material would separate. The separation occurred even with the thickener underflow, which had been treated with flocculant. The-0.025mm material split in approximately the same proportion as the water.
10.1080/19392690902784804

Novel approach to zinc removal from circum-neutral mine waters using pelletised recovered hydrous ferric oxide

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Journal Of Hazardous Materials, Feb-15, 2009, Vol. 162(1), pp. 512-520.

Data are presented which evaluate the performance of a pilot-scale treatment system using pelletised hydrous ferric oxide (HFO; a waste stream from coal mine water treatment) as a high surface area sorbent for removing zinc (Zn) from a metal mine water discharge in the North Pennines Orefield, UK. Over a 10-month period the system removed Zn at mean area- and volume-adjusted removal rates of 3.7 and 8.1 g m(-3) day(-1), respectively, with a mean treatment efficiency of 32% at a low mean

residence time of 49 min. There were seasonal effects in Zn removal owing to establishment and dieback of algae in the treatment tank. This led to increased Zn uptake in early summer months followed by slight Zn release upon algae senescence. In addition to these biosorptive processes, the principal sinks for Zn appear to be (1) sorption onto the HFO surface. and (2) precipitation with calcite-dominated secondary minerals. The latter were formed as a product of dissolution of portlandite in the cement binder and calcium recarbonation. Further optimisation of the HFO pelletisation process holds the possibility for providing a low-cost, low footprint treatment option for metal rich mine waters, in addition to a valuable after-use for recovered HFO from coal mine water treatment facilities. 10.1016/j.jhazmat.2008.05.078

Role of silicate phases during comminution of titania slag

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Minerals Engineering, JAN, 2009, Vol. 22(2), pp. 182-189.

Titania slag is the primary product of ilmenite smelting, and serves as a feedstock to the TiO(2) pigment industry. The fine material (smaller than 106 mu m in diameter) which is produced during milling of titania slag is enriched in some impurities, notably SiO(2), Al(2)O(3), K(2)O and CaO. Investigation of microstructures of solidified slags confirmed that these oxides partition to the silicate phases which form during final solidification. The presence of silicates on the surfaces of particles in milled slag supports the suggestion that the silicates contribute to fracture during crushing and milling. No significant macro-segregation was found in the slag ingots.
10.1016/j.mineng.2008.06.009

Application of magnetic separation technology for the processing of a colemanite ore

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Journal Of The South African Institute Of Mining And Metallurgy, SOUTH AFRICAN INST MINING METALLURGY, MARSHALLTOWN, FEB, 2009, Vol. 109(2), pp. 139-145.

Application of magnetic separation was investigated for the enrichment of colemanite ores by removing the magnetic gangue fraction. The detailed XRD analysis of the ore has indicated that the gangue fraction is composed predominantly of the iron-bearing silicates such as smectite and, to a lesser extent, illite. Magnetic susceptibility measurements of the colemanite and gangue samples have proved that colemanite is diamagnetic in character whereas gangue fraction is weakly paramagnetic to allow the removal of this fraction by magnetic separation. Magnetic separation of the crushed and sized ore samples (-5 mm +75 mu m) was performed using a high intensity permanent magnetic separator. Under the test conditions a

colemanite concentrate (41.29 wt.% B(2)O(3)) was found to be produced from the crushed ore (30.76 wt.% B(2)O(3)) at a recovery of 96.76%. These findings suggest that magnetic separation has great potential as an alternative process for the production of a concentrate of commercially sufficient grade.

Electrolysis and heat pretreatment methods to promote CO(2) sequestration by mineral carbonation

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Chemical Engineering Research & Design, INST CHEMICAL ENGINEERS, RUGBY, FEB, 2009, Vol. 87(2A), pp. 210-215.

As a new mineral carbonation process for CO(2) sequestration, electrolysis of NaCl solution and serpentine as the source of Me(2+) to adsorb CO(2) in the simulating flue gas is introduced, which used the electrolyze NaCl solution to produce the HCl solution and NaOH solution. The HCl solution was used to dissolve Me(2+) from serpentine, and the NaOH solution was used to adsorb CO(2) in simulation smoke, then these two solutions were mixed to form MgCO(3) deposition at 358 K, which could be processed at relative low temperature and pressure. In order to further increase the solubility of Me(2+) from serpentine, the heat pretreatment of serpentine under nitrogen was investigated. The results indicated that the heat activation dramatically enhanced serpentine carbonation. XRD, TGA, FT-IR and ICP-AES analyses indicated that the best activation temperature was 650 degrees C, at which the crystalline features were changed from lizardite to amorphous followed the decomposition of hydroxyl groups. The dissolved capacity decreased with further increasing heat activation temperature, which might be related to the formation of a new crystalline feature. The XRD and TGA analyses showed that the solid product was mainly pure basic magnesium carbonate.
10.1016/j.cherd.2008.08.001

A new method for evaluation of gravity separation processes

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Mineral Processing and Extractive Metallurgy Review, TAYLOR & FRANCIS INC, PHILADELPHIA, 2009, Vol. 30(3), pp. 191-210

Over the years, different methods have been used to evaluate separation efficiency of gravity separation processes. In this paper, all these methods are reviewed and then critically evaluated for their application in the industry. Methods based on recovery of minerals are better than the other available methods. Among the recovery-based methods, those proposed by Lincoin and Gaudin probably addressed most of the important aspects of efficiency calculation. However, in these

two methods, the separation efficiency value is also a function of feed characteristics. Therefore, to evaluate the role of process efficiency without the influence of feed characteristics, a new method is proposed for gravity separation processes. The method has its application in process optimization.
10.1080/08827500802405756

Investigation of froth flotation for beneficiation of printed circuit board comminution fines

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Minerals Engineering, MAR, 2009, Vol. 22(4), pp. 378-385.

Froth flotation for beneficiation of printed circuit board comminution fines was investigated in this work, via reverse flotation under a scheme described as natural hydrophobic response. With no reagents, the scheme employed variation of kinetic parameters of airflow rate and impeller speed to optimize metallic enrichment of the sink. The impeller energy and aeration rate required to keep the pulp in suspension and avoid excessive turbulence were found to be much lower compared with conventional mineral flotation. The natural hydrophobic response was found to exist, and stable froth was observed even without the use of any frother. It was submitted that the dynamic froth stability observed is due to fine particle stabilization. Mass pulls obtained were high and cumulative mass pull under the varying kinetic regimes were found to fit very well to the general first order kinetics. The extents of fit, the sink enrichment and the recovery in respect of metallic values were assessed to evaluate the beneficiation performance. Many of the metallic elements were found to concentrate into the sink, while some prefer the froth phase. Notably, gold and palladium were among the best recovered to the sink: with about 64% recovery at enrichment ratio of 3.1 (676 ppm actual assay) for Au. The flotation scheme proved effective for PCB comminution fines, and performance improvement also looks very feasible.
10.1016/j.mineng.2008.10.007

An Analysis of Mass Balance and Fractional Particle Size Distributions of Coal and Magnetite in a Dense-Medium Cyclone Circuit

Celik, H.
International Journal Of Coal Preparation And Utilization, Vol. 29(2), Mar-Apr, 2009, pp. 68-83

In this study, a complete mass balance of magnetite and coal in the various parts of a dense-medium cyclone (DMC) circuit was determined and fractional size distributions of magnetite and coal were analyzed for the circuit. The DMC overflow product contained 71.34% of the feed coal, whereas 88.35% of the feed magnetite reported to the DMC underflow. The majority of the magnetite (about 86%) was

removed by the sieve bends in both the DMC underflow and overflow streams. Sixty-one percent of the raw coal within a size range of 0.50-20.00mm was recovered as clean coal with an average ash content of 15.30%. About 77% of the feed magnetite having a size range of 75-600m was obtained from the underflow of the drain-and-rinse screen belonging to DMC underflow.
10.1080/19392690902784812

Effect of Flotation on Preparation of Coal-Water Slurries

Ding, K.; Laskowski, J. S.
International Journal Of Coal Preparation And Utilization, Vol. 29(2), Mar-Apr, 2009, pp. 84-98

In order to study the effect of flotation reagents on the properties of coal-water slurry, a sub-bituminous coal was cleaned via either forward flotation or reverse flotation. The froth product from the forward flotation, obtained with the use of diesel oil and MIBC, and the tailings of the reverse flotation, carried out with dextrin-tannic acid depressants and dodecyltrimethylammonium chloride collector, were used in the preparation of coal-water slurries. It was shown that while it was possible to obtain the coal-water slurry with a high-solids content from the coal rendered hydrophilic (tailings from the coal reverse flotation), in the case of the hydrophobic product (froth product from the forward flotation) a dispersing agent was required to obtain the coal-water slurry of the same high-solids content.
10.1080/19392690902784846

Separation of silica from bauxite via froth flotation

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Minerals Engineering, MAR, 2009, Vol. 22(4), pp. 315-318.

This paper reports an innovative development: concentrating gibbsite via reverse froth flotation in order to obtain a metallurgical-grade bauxite concentrate. Tailings from an industrial plant have undergone attrition scrubbing and desliming; the quartz silica contained in the tailings has undergone flotation. Starch was used as a depressant, and ether-amine as the cationic collector. Optimum pH is around 10.0. In pilot plant scale, a metallurgical-grade concentrate was obtained by assaying 42.3% available alumina with an alumina/insoluble silica mass ratio of 11.1. It contained the gibbsite and the iron and titanium bearing minerals. The concentrate was further upgraded by magnetic separation, leading to 54.0% available alumina, with an alumina/insoluble silica mass ratio of 12.6 at an overall available alumina recovery of 69.3% in the final concentrate (non-magnetic product). 10.1016/j.mineng.2008.09.001

Application of Waste Sands for Making Industrial Floors

Glodkowska, W; Kobaka, J

Rocznik Ochrona Srodowiska, MIDDLE POMERANIAN SCI SOC ENV PROT, KOSZALIN, 2009, Vol. 11, pp. 193-206.

Concrete is the most commonly known composite material used in civil engineering, thus concrete production influences significantly the natural environment especially in developing countries. The main component of cement composite is aggregate which covers from 60% to 80% of cement composite volume. Global annual production of concrete, mortar and other cement based composites consumes 20 billion tonne of different aggregate. It means that about 3 tonne of aggregate is used per person per year. The production of ordinary concrete usually consumes coarse aggregate (e.g. gravel) and fine aggregate (e.g. sand) in weight proportion approximately equal to 3:1. If the weight proportion of the occurring of coarse aggregate and fine aggregate in a specific geographical region were close to 3:1, then the production of cement composites would be entirely balanced and would be carried out without any aggregate waste. Unfortunately, natural resources of coarse and fine aggregates can be found in very different weight proportions. For example, natural aggregates in Pomerania region in Poland are of glacial origin and they occur in a form of sands and all-in-aggregates. Production of ordinary concrete based on such, locally available fine aggregate is hindered. High transport costs of coarse aggregate from distant pit deposits (often over 200km) to the production facility, force producers to use the process of hydroclassification of natural all-in-aggregate in order to receive coarse aggregate. Approximately half of documented deposits of aggregate in the Pomerania region is constituted by deposits hydroclassified during the exploitation. Process of hydroclassification allows to divide all-in-aggregate into coarse aggregate and fine aggregate. Waste fine aggregate is a by-product of hydroclassification process. Because of a huge deficit of coarse aggregate in the region, coarse aggregate obtained during hydroclassification of all-in-aggregate is constantly being sold and always on demand enlarging heaps of waste sand. In the paper an issue of waste sand utilization was raised. Various civil engineering applications of waste fine aggregate cement composites have proved that meticulously made fine aggregate cement composite is characterized by satisfactory strength and durability in order to be applied in civil engineering as a standard construction material. One of examples how to resolve the waste sand utilization problem could be its application for the production of steel fiber reinforced mineral composites used for industrial floors. The authors introduced their tests results based on selected properties of fine aggregate fibrous composites with different amounts of steel fiber. The study is a small part of a broad research program.

SELECTIVE ABSTRACTS

Full-text Papers available in NML Eprints (http://eprints.nmlindia.org)

An Overview of Process Options and behavioral Aspects of the Copper values recovered from the Copper Bleed Stream of a Copper Smelter developed at the National Metallurgical Laboratory.

Agrawal, A and Bagchi, D and Kumari, S and Pandey, B D (2009)
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Mineral Processing and Extractive Metallurgy (Trans. IMM C). pp. 136-162.

In the present research, an effort has been made to prepare copper salt=powder from the copper bleed stream generated during the electrowinning of pure copper from the copper anode in a copper smelter. Various approaches have been opted for the complete recovery of copper values such as: evaporation–crystallization, electrolytic process, and direct hydrogen reduction.

http://eprints.nmlindia.org/5024/

Adsorption of oleate at fluorite as revealed by atomic force microscopy.

Chennakesavulu, K and Bhaskar Raju, G and Prabhakar, S (2009)
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International Journal of Mineral Processing, 90(1-4), pp. 101-104.

The adsorption of oleic acid / oleate on fluorite surface could be visualized using tapping mode of atomic force microscopy (AFM). The natural fluorite crystals were equilibrated with 10–3 to 10–7 M oleate solutions and their AFMimages at each concentration along with height profiles were recorded. Even at lowoleate concentration of 1×10–7 M, concomitant monolayer and bilayer structures were observed. It suggests that normal–normal bonding of hydrocarbon chains takes place before the surface is completely covered by themonolayer.Multi-layer adsorption of oleate was observed at oleate concentrations of above 10–4 M. The tapping mode AFM can be utilized to visualize the topography of surfaces adsorbed with surfactant molecules.

http://eprints.nmlindia.org/3185/

Prediction of separation performance of Floatex Density Separator for processing of fine coal particles.

Das, Avimanyu and Sarkar, B and Mehrotra, S P (2009)
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International Journal of Mineral Processing, 91 (1-2). pp. 41-49.

Mathematical description of separation principle in Floatex Density Separator has been established. Separation performance of the separator is described using a simple slip velocity model. Effects of suspension density and bed voidage are incorporated in this model using an averaging approach. The model is capable of describing the separation performance with reasonable accuracy regardless of the flow regime. The performance of the separator is simulated using the model. It is observed that both bed pressure and teeter water have substantial influence on the separation performance. It is also established that for good concentration effect a threshold bed pressure is required below which the size effects dominate the separation process resulting in classification. Very high bed pressure increases the misplacement of high density particles in the overflow stream. Effect of feed size distribution is also studied and it is observed that a narrow size distribution of the feed gives good concentration performance by reducing the size effect. The predicted results are in good agreement with the experimental observations.
http://eprints.nmlindia.org/122/

Mineralogy and Geochemistry of a low grade iron ore sample from Bellary-Hospet sector, India and their implications on beneficiation.

Rao, D S and Bhaskar Raju, G and Prabhakar, S and Subba Rao, S and Vijaya Kumar, T V (2009)
gbraju55@gmail.com
Journal of Minerals & Materials characterization & Engineering, 8 (2). pp. 115-131.

Detailed studies were conducted on iron ores of Bellary-Hospet sector using microscope, XRD, TG, and EPMA techniques. The results indicate that hematite is the major iron oxide mineral with minor amounts of goethite, magnetite, martite and limonite with quartz and clay as major gangue. There is no evidence of the presence of any iron silicate and iron carbonate minerals. Trace amounts of pyrite were observed under the microscope and is the only iron sulphide phase. Microscopic studies also indicated that most of the quartz grains are present as inclusions within the hematite and magnetite grains. XRD studies revealed hematite as the major mineral with subordinate amounts of goethite, quartz and kaolinite confirming to the microscopic findings. Qualitative mapping and quantitative EPMA studies on these ores indicated the presence of gibbsite as the only alumina bearing phase and apatite as phosphorous bearing mineral. Traces of alumina, present as solid solution in the iron oxide minerals, has also contributed Al2O3 to the ores. Electron microscopic studies revealed that gibbsite grains are in the size range of 10 to 50 microns and are intimately and intricately associated with the iron oxide phases. Major elemental analyses of 47 representative iron ore samples of various types were analyzed to deduce the source of silica and alumina's contributing phases in the ore and their interrelationships. The geochemistry data revealed negative correlation of Fe2O3 with silica and alumina thus indicating there is no iron

silicatephase as well as alumina contribution from iron oxide minerals in the form of solid solution is insignificant. Positive correlation of silica with alumina indicates that the clay is the major contributing mineral for both the silica and alumina phase and presence of gibbsite. The role of gangue minerals and the interrelationship of silica, alumina and iron oxide, with reference to beneficiation are discussed. Jigs and heavy media cyclones for this type of ores can be used but at the cost of poor yield because of complex nature of alumina distribution. As long as alumina and silica mineralization is not too fine and the ore composed of magnetite/hematite with coarse grained quartz, magnetic route is the most effective. Since the quartz grains are too fine and their distribution is very complex for the Bellary-Hospet sector ores, flotation in general and column flotation in particular seems to be more effective.
http://eprints.nmlindia.org/4026/

Nature of low-grade Indian iron ores and the prospects of their enrichment through gravity separation.

Roy, Subrata and Das, Avimanyu (2009)
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Minerals & Metallurgical Processing, 26 (3). pp. 141-150.

Soft laminated iron ore (SLO) having a higher hematite content and Martite goethite iron ore (MGO) having a higher goethite content were subjected to detailed characterization and beneficiation. The present research was designed to investigate if these abundant, low-grade ores can be enriched adequately using standard industry techniques. No significant enrichment of the ores using jigging operation on the coarse (-3,200 + 595 mu m) size fraction could be achieved. Good liberation was only attained in the 150 to 300 mu m particle size range in both cases. Desliming enriches the ground ores significantly. The effect of the feed size on the separation efficiencies of the ground ores were studied using flowing-film concentration on a Wilfley table. Better enrichment is obtained in the case of 150-mu m sized feed by tabling. The grade of SLO is improved from 56.14% to 66.51% Fe, while the Fe content of MGO is enriched from 55.16% to 65.83%. Substantial rejection of alumina and silica is also achieved. Due to the friable nature of MGO and the higher goethite content in it, the loss of Fe in the form of ultrafines is greater in this case compared to that of SLO.
http://eprints.nmlindia.org/3241/

Performance prediction of floatex density separator in processing iron ore fines – a relative velocity approach.

Das, Avimanyu and Sarkar, B and Biswas, P and Roy, Subrata (2009)
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Mineral Processing and Extractive Metallurgy (Trans. IMM C), 118 (2). pp. 78-84.

Effective use of a Floatex density separator (FDS), a continuous teetered bed separator, in beneficiating iron ore fines in terms of alumina and silica removal has been investigated. Particle behaviour in an FDS is described using steady state force balance on the particle. A relative velocity approach coupled with the mass balance has been adopted for theoretical performance predictions of multispecies particulate systems having density and size variations. Prediction of suspension density has been identified as most crucial due to the strong dependence of FDS performance on it. It was established that a threshold bed pressure exists below which the unit acts merely as a size classifier. Above this threshold pressure the bed develops significantly, formation of a proper fluidised suspension takes place and concentration effect dominates. Higher teeter water rates enhance hydraulic transport but reduce the yield to the underflow. Predicted separation performance has been validated for fines from one Indian iron ore. The effect of superficial teeter water velocity and bed pressure on process performance has been studied from a theoretical as well as an experimental stand point. Apart from the process variables, liberation characteristics of the ore have significant effect on the performance of the unit. It is established that the FDS has great potential to remove substantial alumina and silica even in single stage operation. This is very significant in an Indian context where high alumina in iron ore fines poses a major problem in downstream operations.
http://eprints.nmlindia.org/3228/

Banded Iron Formation to Blue Dust: mineralogical and geochemical constraints from the Precambrian Jilling-Langalata Deposits, Eastern Indian Craton.

Roy, Subrata and Venkatesh, A S (2009)
Applied Earth Science : IMM Transactions section B, 118 (3-4). pp. 178-188.

Numerous economic deposits of high-grade iron ores occur in the Singhbhum-Orissa Craton, in Eastern India. The deposits are mainly located in the Jilling-Langalata, Noamundi and Joda areas which are part of the eastern limb of the regional horseshoe shaped synclinorium, where millimetre to centimetre scale Archaean Banded Iron Formation units have been converted to steel grey, iron rich fine grained powder, known as Blue Dust. Field observations and subsequent laboratory investigations indicate that in this region, the Blue Dust deposits occur as pockets or lenses of varying dimensions and are randomly oriented. However, in most cases the Blue Dust deposits are found above the Fe-rich primary host rock known as Banded Haematite Jasper. Mineralogical observations indicate that the Blue Dust is mainly composed of haematite, martite and goethite while quartz and kaolinite are the gangue minerals. Silica removal is the primary control of iron enrichment. Geochemical and field observations indicate that the Blue Dust in these deposits is regarded to be of supergene-modified hydrothermal origin. In the first stage, the early hydrothermal process affects the primary unaltered Banded Iron Formation by simultaneously oxidising magnetite to martite and replacing quartz

with hydrous iron oxides. In the second stage, the supergene processes upgrade the hydrous iron oxides to fine grain microplaty haematite. The supergene process causes the leaching of remnant silica from hydrothermally upgraded iron ore under a suitable Eh and pH condition and leads to the formation of Blue Dust.
http://eprints.nmlindia.org/3171/

Nature of low-grade Indian iron ores and the prospects of their enrichment through gravity separation.
Roy, Subrata and Das, Avimanyu (2009)
Minerals & Metallurgical Processing, 26 (3). pp. 141-150.

Soft laminated iron ore (SLO) having a higher hematite content and Martite goethite iron ore (MGO) having a higher goethite content were subjected to detailed characterization and beneficiation. The present research was designed to investigate if these abundant, low-grade ores can be enriched adequately using standard industry techniques. No significant enrichment of the ores using jigging operation on the coarse (-3,200 + 595 mu m) size fraction could be achieved. Good liberation was only attained in the 150 to 300 mu m particle size range in both cases. Desliming enriches the ground ores significantly. The effect of the feed size on the separation efficiencies of the ground ores were studied using flowing-film concentration on a Wilfley table. Better enrichment is obtained in the case of 150-mu m sized feed by tabling. The grade of SLO is improved from 56.14% to 66.51% Fe, while the Fe content of MGO is enriched from 55.16% to 65.83%. Substantial rejection of alumina and silica is also achieved. Due to the friable nature of MGO and the higher goethite content in it, the loss of Fe in the form of ultrafines is greater in this case compared to that of SLO.
http://eprints.nmlindia.org/3241/

Extraction and separation of metals using LIX 84 AND D2EHPA diluted in kerosene from sulfate solution.
Kumar, Vinay and Kumar, Manoj and Jha, Manis K and Lee, Jae-chun (2009)
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Proceedings of EPD on Mineral, Metal and Materials Society, pp. 1089-1094.

The disposal of large quantities of electronic scraps gene-rated world wide is causing not only environmental problem but also loss of resources. Therefore, R & D efforts have been made to develop a suitable process for extraction and separation of metals viz. copper, zinc, cadmium and nickel expected from the leaching of e-scraps using solvent extra-ction process.Different process parameters viz.pH, aqueous to organic ratio, kinetics of extraction, extraction isoth-erm to establish stage requirement for extraction in conti-nuous mode etc have been studied to optimise the condition for the separation of metals. The studies showed the selec-tive extraction of copper after iron precipitation from the sulfuric acid leach solution of e-wastes containing ~1.0 g/L Cu and minor impurities with 2-hydroxy-5-nonylace-

tophenoneoxime (LIX 84) above pH 2.0 in single stage. A scheme for separation of cadmium, zinc and nickel has been proposed using di(2-ethylhexyl) phosphoric acid (D2EHPA) under controlled pH of the aqueous solution. The order of extraction was found to be Zn> Cd> Ni.