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A new method for quantitative petrography based on image processing of chemical element maps: Part I. Mineral mapping applied to compacted bentonites

Pret, D; Sammartino, S; Beaufort, D; Meunier, A; Fialin, M; Michot, LJ
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American Mineralogist, OCT, 2010, Vol. 95(10), pp. 1379-1388.

Most natural rocks or engineered materials display a multi-scale heterogeneity ranging from the nanometer to the centimeter. Their spatial textural heterogeneity can be approached from chemical element maps acquired using various techniques (SEM, EPMA, SXAM, synchrotron mu-XRF, TEM), depending on the chosen magnification. Chemical map processing that yields quantitative petrographic information is improved here according to newly developed mineral thresholding methods that accommodate mixtures and solid solutions. The complex case of an MX80 compacted bentonite is used as a test case. The 14 major chemical elements of this sample were mapped using an electron probe microanalyzer, and chemical map processing yielded a quantitative map of the 18 mineral species of bentonite with a spatial resolution of a few micrometers. The textural heterogeneity of the solid part of the sample is thus visualized and quantified on an area ranging between 0.1-1 cm(2). The method also provides a complete modal analysis of the sample. The methodology is expected to have broad applications in Earth and materials sciences. 10.2138/am.2010.3431

Results of remediation of hard coal overburden and tailing dumps after a few decades: Insights and conclusions

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Hydrometallurgy, OCT, 2010, Vol. 104, pp. 506-517

The historical hard coal mining area of the districts of Zwickau and Lugau/Oelsnitz in Saxony (Germany) is a source of heavy metals and arsenic polluting the adjacent ground- and surface waters. Some of the dumps are partially older than 150 years, and some of them were remediated more than 50 years ago. Today we still can learn

from the more or less successful remediation measures after some decades of application. In this paper, three different dumps are presented and differences between their remediation measures and long-term success are pointed out. As a result, especially a sealing and covering of a dump turned out as very successful for the prevention of AMD (acid mine drainage) generation. Thus, a reduction of the specific seepage water load of SO(4)(2-), Zn(2+), Ni(2+) and Cd(2+) up to 85%, 98.6%, 98.5% and 99.98%, respectively, compared to a revegetated, but not additionally covered dump could be achieved. The covered dump has been stable since more than 50 years; only a low pyrite oxidation grade was detected. But also the infiltration of oxygen consuming organic substance from the top of the dumps and/or by inflowing groundwaters makes a further contribution to the long-term stabilization of a former coal mining dump by keeping the redox potential of such a material quiet low. Microbial investigations resulted in increased counts of sulfate reducers depending especially on the availability of infiltrating organic substance. T. denitrificans seems to be abundant in a moderately acidic environment with nitrate infiltration and atmospheric input. A further utilization of such a remediated and revegetated area is possible, or it can be "given back" to the nature. By contrast, only revegetation without covering of a dump results in a long-term AMD generation of such a mining site.
10.1016/j.hydromet.2010.03.031

A modeling study of the impact of heterogeneous reactions on mineral aerosol surfaces on tropospheric chemistry over East Asia

Li, JW; Han, ZW

Particuology, OCT, 2010, Vol. 8(5), pp. 433-441.

Nine heterogeneous reactions (uptake of H2O2 HNO3 HO2 N2O5 NO2 NO3 O-3 OH and SO2 on mineral aerosol surfaces) are incorporated into a Regional Air Quality Model System (RAQMS) to investigate their impacts on tropospheric chemistry in East Asia during the dust storm period in March 2006 Comparison with observations shows the model system well represents the behaviors of the gaseous and aerosol species Most of the reaction probability gamma values used for this study are the best estimation specifically for dust samples from deserts of China derived from analysis of a number of recent laboratory studies There are large variations in gas and aerosol concentrations while taking heterogeneous reactions on mineral aerosol surface into account especially during dust storm events The domain-averaged monthly mean percentage changes in SO2 NO2 O-3 HNO3 NH3 total sulfate total nitrate and total ammonium concentrations are -44% -3 8% -2 1% -22 0% 12 7% 6 6% 26 1% and -9 5% respectively below 3 km These changes indicate the considerable perturbation of heterogeneous reactions on mineral aerosol surface to tropospheric chemical system and components The strength of heterogeneous reactions is determined by both reaction probability and gas precursor concentration Among the nine reactions dust uptakes of HNO3 SO2 and N2O5 exert relatively large influences on the other chemical components whereas the reactions regarding H2O2

HO2 and OH have little Impacts (C) 2010 Chinese Society of Particuology and Institute of Process Engineering Chinese Academy of Sciences Published by Elsevier B V All rights reserved. 10.1016/j.partic.2010.03.018

Fluoride toxicity in a chalcocite bioleach heap process

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Hydrometallurgy, OCT, 2010, Vol. 104, pp. 410-413

The importance of comprehensive laboratory evaluation for development of an ore body to commercial processing using biohydrometallurgy cannot be understated. Laboratory evaluation for a biohydrometallurgical process must include the microbiological component and definition of operating parameters for the engineers to design the commercial plant. Failure to meet commercial production at a mine site can be a consequence of incomplete understanding of biohydrometallurgical technologies for processing a specific ore. One example is the inability of a copper bioleach process to meet the design criteria in part because of lack of sufficient testing to demonstrate the ramifications of fluoride toxicity to the microbial component of the bioleach process. Laboratory research has demonstrated toxicity of low levels of fluoride to Acidithiobacillus species. However, laboratory determined toxicity values are not always relevant to field conditions at commercial bioleach operations. This is the case with fluoride toxicity where complexing reactions increase the amount of fluoride required for toxicity. Consequently, the toxic fluoride concentrations at field sites can be significantly higher than toxic levels reported in the laboratory, but still achieve concentration inhibitory for the microorganisms. (c) 2010 Elsevier B.V. All rights reserved.
10.1016/j.hydromet.2010.01.013

Biohydrometallurgical prospects

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Hydrometallurgy, OCT, 2010, Vol. 104, pp. 324-328.

Bioleaching, also referred to as minerals biooxidation, and bioremediation have been widely employed commercially for heap and dump bioleaching of secondary copper sulfide ores, sulfidic-refractory gold concentrates and treatment of acid rock drainage. Technical and commercial challenges, identified in this paper, remain for bioleaching of primary sulfides and complex ores. New frontiers for the technology exist in processing massive sulfides, silicate-locked minerals and in the more distant future in-situ leaching. Decommissioning of cyanide heap leach operations and stabilizing mine wastes using biotechnology are opportunities requiring intensive and focused research, development and engineering efforts. (c) 2010 Elsevier B.V. All rights reserved. 10.1016/j.hydromet.2010.03.021

Modelling of bioleach processes: Connection between science and engineering

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Hydrometallurgy, OCT, 2010, Vol. 104, pp. 404-409

This paper gives a brief introduction to the modelling of bioleach processes, developed from a careful analysis of the fundamental process steps at the gas-liquid, biological and mineral interfaces, and how these interact in a given reactor environment (tanks and heaps). The insights gained from such modelling work can guide both engineers in the optimisation of processes and scientist in directing their research at areas not yet well understood. From this perspective, some future directions of the bioleaching field are discussed. 10.1016/j.hydromet.2010.02.023

The effect of using different comminution procedures on the flotation of sphalerite

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Minerals Engineering, OCT, 2010, Vol. 23, pp. 1053-1057

High Pressure Grinding Rollers (HPGR) are known to reduce energy consumption and wear costs and improve the throughput in the circuit. It has been suggested that they can also modify the liberation characteristics of the ore. In the present study the effect of using conventional crushing as opposed to HPGR in combination with either dry or wet milling was investigated using a base metal sulphide, viz. sphalerite, in order to determine whether there may be an improvement in flotation performance following the use of different comminution procedures. It was found that, irrespective of the crushing procedure (HPGR or conventional), dry milling resulted in the highest grades and recoveries of zinc. These were typically 94% recovery at 40% grade. In order to gain an insight into the effect which these comminution procedures had on the ore, samples of feed and product were investigated using surface analytical techniques. Mineralogical analyses showed no differences in the liberation characteristics of sphalerite irrespective of the comminution procedures used. However, dry milling produced a lower d50. The paper proposes possible reasons to explain these observations.
10.1016/j.mineng.2010.08.001

Thermal coal products in South Africa

Steyn, M; Minnitt, RCA
Journal Of The South African Institute Of Mining And Metallurgy, OCT, 2010, Vol. 110(10), pp. 593-599

This article captures the intrinsic differences of thermal coal products, their utilization and their substitution characteristics. South Africa produces

approximately 245 million tonnes of coal annually. Eskom consumes 46% (approximately 112 million tonnes), 26% (approximately 65 million tonnes) is exported, and SASOL Synthetic Fuels consumes 18% (approximately 44 million tonnes) and a further 9% (approximately 22 million tonnes) is consumed by domestic users in various different industries. Marketing theory contributes significantly to understanding the importance of technical product and quality appreciation and comprehension, encompassing elements of price, distribution, and promotion. Coal product specification is determined by the inherent geology of a resource and the number of complex actions to market the product to a specific consuming market. Sampling, analyses, beneficiation application, and an array of parameters contribute to matching thermal coal products to the value-in-use it provides to the different markets and its consuming industries. Coal producers have come under increased scrutiny since South Africa has been experiencing electricity shortages since early 2008. General misunderstandings were declared on public forums and in the media. by both legislators and the South African public since a perception developed that South African coal producers are exporting coal that could be utilized by Eskom.

The potential of electrostatic separation in the upgrading of South African fine coal prior to utilization-a review

Bada, SO; Falcon, RMS; Falcon, LM

Journal Of The South African Institute Of Mining And Metallurgy, NOV, 2010, Vol. 110(11), pp. 691-702

Synopsis Coal is a complex mixture of organic and mineral constituents and is the most abundant resource of fossil energy in the world. In recent years, significant research into dry coal beneficiation has gained much attention, primarily due to the need to improve grades and reduce the environmental contaminants in coal without the use of water, and to achieve this in as cost-effective manner as possible, relative to wet beneficiation processes. This paper seeks to review the application of various electrostatic separators with their process principles, to draw comparisons between different dry beneficiation techniques with specific emphasis on the triboelectrostatic separation method, and finally to report the results of triboelectrostatic separation conducted on various South African coals. Previous research conducted on Indian, European and American coals has indicated that this technique is likely to lead to significant economic benefit through the reduction of ash content, NOx and more specifically SOx by separating out the liberated Fe-S-bearing minerals prior to utilization. The removal of the latter suite of minerals is also likely to significantly reduce or eliminate the emissions of associated trace elements, including mercury and arsenic. The research results reported in this paper indicate that the rotary triboelectrostatic process has the potential for significant upgrading of high ash pulverized South African coal. The impact of various operational parameters was investigated and key factors established for the optimum recovery of low ash and low sulphur fine coal.

Reverse jig separation of shredded floating plastics separation of polypropylene and high density polyethylene

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International Journal Of Mineral Processing, NOV, 2010, Vol. 97, pp. 96-99

A desktop type batch reverse jig and prototype bench scale continuous reverse jig were designed by installing a top screen to the chamber of the RETAC jig. Shredded plastics of polypropylene (specific density 0.91) and high density polyethylene (specific density 0.96) were used for the tests and operating conditions were investigated using a desktop type batch jig. Waveform and screen design affected the separation results. Wettability control of feed sample is also important and 100% separation was achieved for the top and bottom layer products. The prototype bench scale continuous jig could obtain a high grade product, 99% pure as a bottom product. (C) 2010 Elsevier B.V. All rights reserved.
10.1016/j.minpro.2010.08.007

Leeuwpan fine coal dense medium plant

Lundt, M; de Korte, GJ
Journal Of The South African Institute Of Mining And Metallurgy, SOUTH AFRICAN INST MINING METALLURGY, MARSHALLTOWN, NOV, 2010, Vol. 110(11), pp. 671-676

Synopsis Exxaro installed their first ultra fines treatment plant at Leeuwpan Coal mine. The plant is now fully operational and results already show that the plant has great potential. The plant was designed and installed by DRA. Several challenges were faced during the installation due to the space constraints in the Leeuwpan plant. Efficiency tests were conducted on both modules after commissioning and showed very promising results. A lower ash product with a higher yield can be produced with the fine coal dense medium cyclones compared to the spirals previously employed.

Arsenate removal from synthetic wastewater by adsorption onto fly ash

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Desalination, Nov-30, 2010, Vol. 263, pp. 58-63.

In this work, the removal of arsenate from synthetic wastewater by adsorption onto a coal combustion fly ash (CCA) has been experimentally studied. To this aim, a multiple analysis that included the evaluation of metal releases in aqueous solution, the assessment of arsenate adsorption capacity and a possible beneficiation treatment has been performed. The release of different metallic ions (mainly Ca, Al. K, and Si) was observed, including arsenic itself whose total content on CCA resulted to be around 0.05 mg/g. Arsenate adsorption isotherms on raw CCA at

constant temperature (20 degrees C) have been determined in two synthetic arsenic aqueous solutions, a distilled water and a mineral water simulating a groundwater. In both the experimental conditions, CCA shows almost the same arsenate adsorption capacities. In order to increase CCA adsorption capacity and to simultaneously remove the arsenic originally present on CCA, a HCl treatment has been performed; the treated sample showed a higher adsorption capacity, likely related to a surface oxidation. Finally, the effect of equilibrium pH on arsenate adsorption on both raw and treated CCA samples has been investigated. A speciation analysis of arsenate ions revealed that for each investigated pH, the treated CCA sample showed the highest adsorption capacity.
10.1016/j.desal.2010.06.035

Modeling of particle fluid interactions in a flowing film concentrator

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International Journal Of Mineral Processing, NOV, 2010, Vol. 97, pp. 7-19

In an effort to test the extent to which fundamental fluid mechanics can provide a prediction of particle separation in a flowing film concentrator, a study on a simple parallel-sided channel has been carried out using glass beads at various particle concentrations and flow rates. The actual particle separation taking place was compared to predictions made by first describing the slurry flow based on the Prandtl's mixing length approach. Particle concentration distributions were described using Hunt's sediment transport model. Settling velocities of particles in water were calculated using either the Richardson and Zaki or Brauer and Thiele models. The latter takes into account particle size and density distributions and solids volumetric concentration. The resulting predictions of particle separation are remarkably good.
10.1016/j.minpro.2010.07.002

Thermal insulating foamy geopolymers from perlite

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Minerals Engineering, NOV, 2010, Vol. 23(14), pp. 1146-1151

Geopolymerization is an emerging technology which utilizes solid aluminosilicate raw materials that are easily soluble in caustic solutions, in order to produce inorganic polymers with excellent physical, mechanical and thermal properties. In this paper is demonstrated the ability of geopolymerization technology for production of thermal insulating foamy inorganic polymers utilizing as solid raw material ultrafine perlite which is a by-product from comminution and sizing operations of perlite exploitation. Hydrogen peroxide is used as a chemical blowing agent for the foaming of inorganic polymers. The effect of addition of the blowing

agent on the thermophysical properties of thermal insulating materials is demonstrated and these properties are compared with the ones of the commercial thermal insulating materials indicating the high potentiality for the development of this new family of inorganic polymeric materials. (C) 2010 Elsevier Ltd. All rights reserved. 10.1016/j.mineng.2010.07.015

Use of SWCCs to describe the dewatering of product coal

Williams, DJ

Unsaturated Soils: Experimental Studies In Unsaturated Soils And Expansive Soils

4th Asia Pacific Conference on Unsaturated Soils, NOV 23-25, 2009, Newcastle, AUSTRALIA, CRC PRESS-TAYLOR & FRANCIS GROUP, BOCA RATON, 2010, pp. 233-238.

Australian product coals are becoming finer-grained, mainly due to improvements in the performance of ultra-fine coal recovery methods. The finer the product coal size fraction, the more capacity it has to store water during beneficiation and the higher the pressure required to facilitate dewatering to meet the specified moisture. Following the removal of the pressure applied to facilitate dewatering, the particular product coal size fraction is left under a suction equivalent to that applied pressure, providing it with the potential to re-wet on the stockpile under moist conditions. During the dewatering process, the product coal is unsaturated. The relationship between applied pressure (or the equivalent suction felt on the removal of this pressure) and moisture content for a particular product coal size fraction is described by the Soil Water Characteristic Curve (SWCC) of the material, based on unsaturated soil mechanics principles. Such curves have been obtained for different product coal size fractions, from which the effectiveness of dewatering under a range of applied pressures can be estimated. Moisture content versus time data for ultra-fine and fine product coal samples under a constant applied suction have also been obtained for use in estimating the extent of dewatering achievable for a given residence time in a particular piece of dewatering equipment. The SWCCs can be used to supplement conventional methods in deciding the most appropriate dewatering equipment required to obtain a given moisture content for a particular product coal size fraction.

Beneficiation of stockpiled fluidized bed coal ash in road base course construction

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Construction And Building Materials, NOV, 2010, Vol. 24(11), pp. 2072-2078.

The presented paper investigates the potential for the utilization of unprocessed, as excavated (i.e. unground), stockpiled coal combustion fluidized bed ash in road

base course construction. In addition to functioning as a stabilizer of the fines in the stockpiled material, this ash also permits treating the stockpiled ash agglomerates as an aggregate. Both untreated and cement-treated mix designs were evaluated. The laboratory program included unconfined strength measurements, triaxial, volumetric swell, and moisture susceptibility testing protocols performed on cylindrical specimens compacted at their optimum moisture content. The results have shown that, without breaking down the agglomerates by grinding, the unstabilized stockpiled ash possesses very little residual cementitious activity; whereas, if treated with small amounts of cement (3%), it meets the required strength criteria for cement-treated base courses while minimizing the volumetric swell characteristics.
10.1016/j.conbuildmat.2010.04.055

The Effect of Vibration on Dry Coal Beneficiation in the Reflux Classifier

Macpherson, S. A.; Galvin, K. P.
International Journal Of Coal Preparation And Utilization, Vol. 30(6), Nov-Dec, 2010, pp. 283-294

This article examines the application of dry beneficiation technology to the separation of coal and mineral matter in a novel air-fluidized bed. The Reflux Classifier (RC) is an innovative design that incorporates an inclined zone above a conventional fluidized bed to achieve increased segregation rates and a higher throughput than separators with an equivalent footprint. In this study, the effectiveness of magnetite and sand as dense media for the separation of coal in an air-fluidized RC was evaluated. The effect of vibration on the separations obtained using both these media was also examined. The coal separation results are reported and compared with coal washability data. 10.1080/19392691003776814

Economic Challenges in High-Ash Indian Coal Preparation

Mohanta, S.; Chakraborty, S.; Meikap, B. C.
International Journal Of Coal Preparation And Utilization, Vol. 30(6), Nov-Dec, 2010, pp. 295-309

The desired coal quality is not same for all the consumers. This quality may be limited to the maximum ash content, Useful Heat Value (UHV), size, or it may be its price. In some cases it is difficult to predict the economic feasibility and to maintain the optimum operating parameters for the washing equipments to achieve this quality. In this article, a methodology is presented to quantify the economic feasibility and to determine the optimum operating parameters accordingly. But in actual practice, these operating parameters vary within certain ranges and affect the product quality. This uncertainty in product quality has been quantified by using a Monte-Carlo-based simulation method. To illustrate, six coals of different characteristics are considered. The result leads to a conclusion that optimum

operating conditions for different quality are quite different. This method can be used to determine the optimum operating parameters and to predict the economic feasibility in different situations. 10.1080/19392699.2010.483421

A Modified Godbert Apparatus for Determining Optimum Level of Beneficiation for Indian Non-Coking Coal for Power Generation

Singh, K. M. P.; Chattopadhyay, U. S.; Charan, T. Gouri; Haldar, D. D.
International Journal Of Coal Preparation And Utilization, Vol. 30(6), Nov-Dec, 2010, pp. 310-321

The characteristics of coal depends on different parameters like rank, moisture, mineral matter content, macerals composition, etc. The combined effect of these characteristics governs the combustion behavior of coal in the furnace. The Indian ROM coals contain higher inherent mineral matter and a majority of these coals are used for power generation without any beneficiation; even though the environmental gazette notification of the Govt. of India requires all coal suppliers to install coal washeries. Combustion behavior of coal is evaluated by one of the following techniques: i.e., TGA, drop tube furnace, fuel efficiency test rigs, etc.; however, all these following techniques are costly and time consuming. The Godbert apparatus, which is low-cost simple equipment, can be used to evaluate the combustion behavior of coals. The minimum ignition temperature (the lowest temperature at which an ignition/explosion is observed as a flame) was determined for the ROM coal and density separated/various ash-content fractions up to 700 degrees C. The results indicated that the coal containing up to 58% ash showed good flame/burning behavior. This study should provide guidance to coal washery operators to determine at what ash level the coal should be washed so that it can give better combustion rather than taking the ash value of 34% set up by the Indian Government. 10.1080/19392699.2010.495619

Potential of Removing Trace Elements from a Turkish Lignite

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International Journal Of Coal Preparation And Utilization, Vol. 30(6), Nov-Dec, 2010, pp. 322-330

Lignite is a significant source for producing electricity in Turkey. However, the hazardous trace elements content, namely, vanadium (V), chromium (Cr), copper (Cu), arsenic (As), thorium (Th), and uranium (U), are much higher than those observed around the world. In this article, the potential of removing the trace elements from the Lignite obtained from the Soma mine using the gravity separation principles is discussed. The float-sink studies conducted using heavy liquid of 1.3 and 1.9 specific gravities identified that removal of the trace elements from the Soma lignite ranged from 15% to 83%.
10.1080/19392699.2010.517229

Online Analysis of Coal on A Conveyor Belt by use of Machine Vision and Kernel Methods

Aldrich, C.; Jemwa, G. T.; van Dyk, J. C.; Keyser, M. J.; van Heerden, J. H. P.

International Journal Of Coal Preparation And Utilization, Vol. 30(6), Nov-Dec, 2010, pp. 331-348

The application of machine vision systems to measure particle size distributions has among other things been driven by sophisticated control systems used to monitor and control mills and other ore-processing systems. Machine vision is nonintrusive and offers reliable online measurements in potentially harsh environments. Although considerable advances have been made over the last decade, reliability of measurements with segmentation algorithms is still an issue, particularly where lighting conditions may vary, fines are present, or heterogeneous particle surfaces may result in irregular reflection of light. In practice the alternative to online measurement of particle size distributions is sieve analysis, which is slow and tedious and not suitable for control purposes. The efficient preparation and quality control of coal are important for stable and effective operation of the Sasol (R) FBDB Gasification Process. The operation of these gasifiers depend among other on melting properties and composition of the ash, thermal and mechanical fragmentation, and caking properties of the coal, as well as the particle size distribution of the coal. Although many of these properties can be assessed in some way to expedite process improvement, particle size distributions are difficult to estimate beforehand from feedstocks, since these distributions may change significantly during the feeding process, or by insufficient screening, resulting in an access/increase of fine coal to gasification. The ability to measure these distributions online would therefore play a crucial role in continuous process improvement and real-time quality control. The objective of this project is to explore the use of image analysis to quantify the amount of fines (6mm) present for different coal samples under conditions simulating the coal on conveyor belts similar to those being used by Sasol for gasification purposes. Quantification of the fines will be deemed particularly successful, if the fines mass fraction, as determined by sieve analysis, is possible to be predicted with an error of less than 10%. In this article, kernel-based methods to estimate particle size ranges on a pilot-scale conveyor belt as well as edge detection algorithms are considered. Preliminary results have shown that the fines fraction in the coal on the conveyor belt could be estimated with a median error of approximately 24.1%. This analysis was based on a relatively small number of sieve samples (18 in total) and needs to be validated by more samples. More samples would also facilitate better calibration and may lead to improved estimates of the sieve fines fractions. Similarly, better results may also be possible by using different approaches to image acquisition and analysis, but discussion of these falls outside the scope of the present article. Most of the error in the fines estimates can be attributed to sampling and to fines that were randomly obscured by the top layer (of larger particles) of coal on the belt. Sampling errors occurred as a result of some breakage of the coal between the sieve analyses and the acquisition of the images. The percentage of the fines obscured by the top layer of the coal probably caused

most of the variation in the estimated mass of fines, but this needs to be validated experimentally. Preliminary studies have indicated that some variation in the lighting conditions have a small influence on the reliability of the estimates of the coal fines fractions and that consistent lighting conditions are more important than optimal lighting conditions.
10.1080/19392699.2010.517486

Recovery of enriched lead–silver residue from silver-rich concentrate of hydrometallurgical zinc smelter

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Hydrometallurgy, Volume 105, Issues 1–2, December 2010, Pages 127-133, ISSN 0304-386X, http://dx.doi.org/10.1016/j.hydromet.2010.08.010.

During the conventional zinc hydrometallurgical process operated in olden days prior to jarosite process, lead and silver reported in the neutral leach residue along with zinc ferrite. Lead and silver values from the zinc plant leach residue were recovered by a froth flotation process to obtain a silver-rich concentrate. This work deals with an alternative and innovative process to treat this silver-rich concentrate to produce an enriched lead–silver residue which can be consumed in lead smelter. The process involves the treatment of silver concentrate generated in the flotation circuit by acid-roasting followed by moderate temperature-water leach to solubilize zinc and iron completely thereby enriching lead and silver values in the leach residue. This residue contained high levels of silica which was removed by alkali roasting with caustic followed by water wash. Silica content dissolves into solution phase thereby generating a residue rich in lead and silver values. This residue was suitable for treatment in lead smelter to produce lead and silver metal. Based on the experimental results, a conceptual flowsheet was developed.

Improvement of energy efficiency of rock comminution through reduction of thermal losses

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The principal objective of this work was to develop a thermal imaging technique to measure the radiant heat coming from rock particles during or immediately after crushing, with the purpose of minimising energy losses while maintaining the efficiency of rock crushing. The main goal of the work was energy optimization of crushing in High Pressure Grinding Rolls (HPGR). We were able to perform reproducible measurements of the temperature increase that occurs during transient events such as dynamic rock breakage and HPGR crushing. Results obtained show that with an increase of energy introduced, there is an increase in the maximum temperature along the fractured surface as well as increases in the overall amount of thermal energy. Results obtained during HPGR testing clearly indicate that there is an optimum intensity of pressure to which rock needs to be exposed. Any further increase in pressure, results in only a marginal increase in fragmentation and a

significant increase in unproductive heating of rock. We were also concerned about the effect of the size of particles coming into the HPGR. The fraction of new fine material (fines) produced during HPGR crushing is much higher in the case of feed with a narrow size distribution, i.e. without preexisting fines. Significantly, improved performance is achieved with a reduced amount of net comminution energy. Observed relative crushing inefficiency of feed with a wide fragment size distribution (containing fines and coarse particles), is due to a large amount of pre-exiting fines, which clog the pore space between coarser fragments. In the compressed zone of the HPGR this creates approximately hydrostatic compressive loading conditions, which require much higher pressure (i.e. energy) to cause breakage of coarser particles. Experimental results indicate that up to 40% of energy can be saved through optimization of the applied pressure and modification of feed fragments size distribution.
10.1016/j.mineng.2010.08.019

Removal of Arsenic from Synthetic and Natural Groundwater Using Acid-Activated Laterite

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Environmental Progress & Sustainable Energy, JOHN WILEY & SONS INC, HOBOKEN
DEC, 2010, Vol. 29(4), pp. 457-470

Acid-activated laterite (AAL) is used to remove arsenic from synthetic and natural groundwater Physicochemical characteristics of AAL, such as BET (Brunauer-Emmett-Teller) surface area, pore volume, pore volume distribution, zero point of charge, and chemical composition, are studied and compared with raw laterite (RL). The BET surface area and pore volume of AAL are obtained as 45.4 +/- 2.7 m(2) g(-1) and 0.063 +/- 0.007 mL g(-1), respectively. Zero point of charge of AAL is found to be 5.70 +/- 0.22. Arsenite and arsenate adsorption on AAL are examined under varying process parameters such as adsorbent dose, contact time, temperature, particle size, initial arsenic concentration, and competitive ions in batch mode. Arsenic adsorption capacity of AAL increases by two- to threefold compared with RL. The kinetic data fit better to pseudo-second-order model. Transport properties, such as external mass transfer coefficient and effective pore diffusivity of arsenic species, are obtained from shrinking core model fit to experimental kinetic data. Continuous fixed bed column mode adsorption of arsenic on AAL is performed. About 200 bed volume (21 L) of arsenic contaminated groundwater (total arsenic: 378 +/- 8.9 mu g L(-1)) has been treated at a breakthrough concentration of 50 mu g L(-1). of arsenic by using column height of 20 cm (weight of adsorbent: 125 g). (C) 2010 American Institute of Chemical Engineers Environ Prog, 29: 457-470, 2010
10.1002/ep.10434

Systems modelling for effective mine water management

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Environmental Modelling & Software, DEC, 2010, Vol. 25(12), pp. 1664-1671

Concerns about the difficulties in securing water have led the Australian coal mining industry to seek innovative ways to improve its water management and to adopt novel strategies that will lead to less water being used and more water being reused. Simulation tools are essential to assess current water management performance and to predict the efficiency of potential strategies. As water systems on coal mines are complex and consist of various inter-connected elements, a systems approach was selected, which views mine site water management as a system that obtains water from various sources (surface, groundwater), provides sufficient water of suitable quality to the mining tasks (coal beneficiation, dust suppression, underground operations) and maintains environmental performance. In this paper, the model is described and its calibration is illustrated. The results of applying the model for the comparison of the water balances of 7 coal mines in the northern Bowen Basin (Queensland, Australia) are presented. The model is used to assess the impact of applying specific water management strategies. Results show that a simple systems model is an appropriate tool for assessing site performance, for providing guidance to improve performance through strategic planning, and for guiding adoption of site objectives.
10.1016/j.envsoft.2010.06.012

A study of the vanadium species in an acid leach solution of stone coal using ion exchange resin

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Hydrometallurgy, DEC, 2010, Vol. 105, pp. 176-178

The species of vanadium extracted by a weak base anion resin D314 from sulphuric acid leach solution of stone coal was investigated. The saturated adsorption capacity of vanadium on the resin was found to be up to 501 mg/mL wet resin with a distribution ratio of 950 at pH = 3-4 and 15 degrees C using static adsorption method. Vanadium was adsorbed in the form of V(10)O(28)(6-) and HV(10)O(28)(5-). The study provides the theory and fundamental basis for the industrial application of weak base resins for extraction of vanadium from acid leach solution of stone coal.
10.1016/j.hydromet.2010.07.001

Spreadsheet-based modeling of liner wears impact on charge motion in tumbling mills

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Minerals Engineering, DEC, 2010, Vol. 23(15), pp. 1213-1219

Grinding remains the major constituent of the total cost of processing minerals in most applications. Charge motion is one of the key parameters affecting grinding efficiency and mill power draw. Although there have been numerous investigations on the effect of liner design on charge motion, the effect of charge profile due to liner wear during mill operation along the mill length has not received much attention. In this research, Powell's analytical approach to calculate the charge trajectory with respect to the liner profile was used to develop a software based on Microsoft Excel (c). As a case study, the liner wear profile of the Sarcheshmeh copper complex SAG mill was used to model the liner wear rate and calculate the changes of lifter face angle and lifter height during mill operation. Results were then used to determine charge motion in the SAG mill at any given operation time. The results indicated that after 4000 h of operation the lifters face angle increased from 14 degrees to 47.1 degrees and the height of lifters decreased from 15.2 to 5.8 cm. Modeling charge motion in the mill after 3000 h of operation showed 340 difference between the maximum and minimum of angles of impact along the mill length due to the nonuniform wear profile. It was also found that the variation in the pattern of the charge motion depends on the mill working hours and the distance of the desired point from the feed end. It was determined that the ratio of spacing to the height of lifters (S/H) plays an important role in the grinding efficiency and throughput. After 4000 h of operation. S/H ratio of the Sarcheshmeh SAG mill increased from 1.7 to 4.6.

10.1016/j.mineng.2010.08.013

Study on the phosphate removal from aqueous solution using modified fly ash

Ke Xu, Tong Deng, Juntan Liu, Weigong Peng

Fuel, Vol.89(12), December, 2010, pp. 3668-3674,
http://dx.doi.org/10.1016/j.fuel.2010.07.034.

In this work the fly ash was modified by sulfuric acid for the removal of phosphate. It was found that modification of fly ash could significantly enhance the phosphate immobilization ability of the fly ash. The specific surface area of the fly ash increased from 8.8 to 32.5 m2/g after treated with sulfuric acid. The modification of the fly ash also resulted in the mobilization of acid-soluble metal ions due to partial or complete dissolution of the metals under the acidic conditions. Both adsorption and precipitation contributed to the removal of phosphate by the modified fly ash but precipitation was a major mechanism of phosphate removal. The experimental results showed that adsorption of phosphate by the modified fly ash was rapid, the removal percentage of phosphate could reach maximum in 5 min. In the range of 5–9, pH did not significantly affect the removal of phosphate and the removal percentage of phosphate increased with the increase of adsorbent dosage. The adsorption of phosphate by the modified fly ash could be described well by Langmuir isotherm equation, the Langmuir constant Q0 was 9.15 mg g−1. The XRD patterns and the SEM images of modified fly ash

after sorption revealed that CaHPO4 · 2H2O was formed in the removal of phosphate. In addition, phosphate also formed precipitate with aluminum and iron.

Determination of the reactive component of fly ashes for geopolymer production using XRF and XRD

Ross P. Williams, Arie van Riessen

Fuel, Volume 89, Issue 12, December 2010, Pages 3683-3692, ISSN 0016-2361, http://dx.doi.org/10.1016/j.fuel.2010.07.031.

Geopolymers are a class of versatile materials that have the potential for utilisation as a cement replacement, fireproof barriers, materials for high temperatures, and biological implant applications. This study investigated methods for determining the formulation for manufacturing geopolymers made with fly ash from coal-fired power stations. The accepted method of determining the formulation of geopolymers to get the desired matrix chemistry uses the bulk composition of the feedstock materials. This formulation method is widely used in investigations using feedstock materials that almost completely react during processing. It is widely considered that amorphous components of fly ash are the reactive components in the geopolymerisation reaction. However, quantification of the amorphous components is challenging and generally avoided with the concomitant problem that the formulation is far from optimum. For the work presented here, the composition of the amorphous part is determined accurately and this information utilised to synthesise geopolymers. The bulk composition is first determined using X-ray fluorescence spectroscopy (XRF) and then the amorphous composition determined using XRF and quantitative X-ray diffraction (QXRD). Formulating the mixture based on amorphous composition produced samples with a significantly higher compressive strength than those formulated using the bulk composition. Using the amorphous composition of fly ash produced geopolymers with similar physical properties to that of metakaolin geopolymers with the same targeted composition. We demonstrated a new quantitative formulation method that is superior to the accepted method.

A new predictive model of lifter bar wear in mills

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Minerals Engineering, DEC, 2010, Vol. 23(15), pp. 1174-1181.

The cost of mill relining and the influence of the liner profiles on mill performance provide a strong motivation to improve liner selection. However, the capability to predict liner life and progressive profile is poorly developed in the industry. A new model has been developed to predict the rate of liner wear based on the main parameters affecting the wear process such as: ore type, relative velocity between the ore and the liners, liner hardness and friction conditions. The resultant model is capable of determining the wear as a function of mill operating and discharge

conditions based on the variation of specific gravity of mill contents, geometrical characteristics of the mill and mill velocity. The results from this model are in good agreement with the measured data from the SAG mill at Sarcheshmeh Copper Complex, Iran. (c) 2010 Elsevier Ltd. All rights reserved.
10.1016/j.mineng.2010.07.016

Experimental and numerical simulation studies of the fluidization characteristics of a separating gas-solid fluidized bed
Zhao, YM; Tang, LG; Luo, ZF; Liang, CC; Xing, HB; Wu, WC; Duan, CL
Fuel Processing Technology, DEC, 2010, Vol. 91(12), pp. 1819-1825.

Gas-solid fluidized bed separation expands the choices of highly efficient dry coal beneficiation methods The hydrodynamics of 0 3-0 15 mm large Geldart B magnetite powder were studied using a combination of experimental and numerical methods to optimize the design of the solid medium used in the fluidized bed The results show that the Syamlal-O Brien drag model is suitable for simulating the bed and it is verified that simulated and experimental results are consistent with each other If the static bed height is no more than 300 mm then the bed height has minimal effect on the fluidization characteristics As the superficial gas velocity increases the bed activity is improved However at the same time the uniformity and stability of the bed drop Therefore the gas velocity should be adjusted to no more than 2 OU(mf) The density of the Geldart B bed is uniform and stable which indicates a relatively high fluidization quality Furthermore compounded medium solids consisting of <0 3 mm magnetite powder with a 03-0 15 mm particle content of 65 25% and <1 mm fine coal were used in a pilot gas-solid fluidized bed of 5-10 ton/h capacity The pilot bed was used to separate 50-6 mm coal This test resulted in the coal ash content being reduced from 23 74% to 11 79% with a probable error E of 007 g/cm(3) and a recovery efficiency of 98 26% This indicates that the bed has good separating performance Nevertheless to increase the applicability of the separating bed a further study emphasizing a decrease in the lower size limit of the magnetite powder should be performed (C) 2010 Elsevier B V All rights reserved
10.1016/j.fuproc.2010.08.004

Experimental observations of lifter parameters and mill operation on power draw and liner impact loading
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Minerals Engineering, DEC, 2010, Vol. 23(15), pp. 1182-1191.

In mineral processing the mill power plays a major role in the economics of the process and is a critical design criterion. The mill power is influenced by a range of parameters such as: charge and slurry filling, number and geometry of lifters, and mill speed. Deriving the optimum conditions of these parameters should lead to efficient mill operation. Additionally, the optimum utilization of the impact loads that are affected by charge and slurry filling, number of lifters, geometry of lifter and mill

speed should result in increased milling efficiency. In this work the influence of these operating parameters were investigated using a laboratory experimental mill. It is found that the power, are affected by number of lifters, lifter height, mill charge and mill speed. Overall the results showed that increasing the mill velocity, number of lifters, and height of lifter and significantly decreasing the mill charge filling results in a higher impact value and impact frequency that may also increase overall efficiency. A simple linear regression relationship has been demonstrated for mill power as a function of lifter spacing (S/H) and mill speed. These parameters give an indication of the possible optimum mill operating conditions in an idealised condition.
10.1016/j.mineng.2010.07.017

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

Jha, Manis K and Kumari, Archana and Choubey, Pankaj K (2010) *E-waste recycling: alternative metal resources.* Mineral and Metal Review (5). pp. 50-53.

With the advancement in living standards and economical growth, the demand and supply for electrical and electronic goods have seen a quantum jump with its fascinating techno-logical innovation and alluring features. This has resulted in tremendous and incredible increase in the sale and production of electrical and electronic equipments(EEE).The old models are replaced rapidly by the latest and advanced ones which have generated a large amount of E-wastes, commonly known as the Waste Electrical and Electronic Equipments (WEEE).Basically, any electrical and electronic appliance that has reached its end of life are categorised as WEEE.
http://eprints.nmlindia.org/2957/

Acharya, S and Jena, M S and Mohanty, J K (2010) *Aqueous alkaline processing of chromite mine overburden.* In: Proceedings of the XI International Seminar on Mineral Processing Technology (MPT-2010), Dec 2010, NML Jamshedpur, India.

The Sukinda Chromite Mine Overburden (COB) waste contains mainly FeOOH in addition to minor amounts of Ni and Co associated respectively in FeOOH and MnO2 matrices. The other gangue minerals of COB are hematite, quartz, altered chromite, etc in the finely isolated dispersed forms. At present, COB is considered as a source for Ni and Co as there is no other specific Ni-source in India. The COB may also be considered as a very low grade iron ore which may be exploited in the future. Similar to Ni-laterites, the COB also attempted for beneficiation-metal extraction with some success, however, such processes also produce huge COB processed waste containing almost all the original iron values. The direct aqueous processing route appears to be attractive due to the fine size as well as low nickel and high water contents of COB, as such or as its wet concentrates. The Aqueous Alkaline Processing (AAP) of COB is explored here mainly for facilitating iron mineral phase

changes similar to bauxite digestion under mild conditions. Under such redox conditions, the reactive iron minerals are likely to transform with minor Co-MnO2 changes. Many other elements, such as Al, Mg, Si, Cr, etc., also influence the process mineralogy. By the recent process mineralogical, intensification techniques and reaction dynamics synergies, the COB-AA pre-treatment and down-stream sequential and simultaneous tests need evaluation to facilitate process evolution. In sum, the AAP opens up options and possibilities for COB prospecting. http://eprints.nmlindia.org/2589/

Anupam, A and Singh, G and Raghav, P K and Suresh, N (2010) *Studies on beneficiation of BHQ samples by different methods.* In: Proceedings of the XI International Seminar on Mineral Processing Technology (MPT-2010), Dec 2010, NML Jamshedpur, India

Experiments have been carried out to beneficiate BHQ samples collected from two different states of the country viz. Karnataka and Orissa by different techniques such as jigging, magnetic separation and using hydrocyclones after their characterisation studies. Results of these tests have clearly indicated that it is possible to beneficiate the BHQ's of both the states to a certain extent and can only be used to mix with high-grade haematitic iron ores. This would be helpful in conservation and utilisation of rich grade ores. Characterisation studies performed indicated that both the ores require fine grinding to a size of 200mesh to achieve effective liberation. The tests conducted on Barbil area BHQ sample resulted in an upgradation of iron content from a feed value of 42.8% Fe to a maximum of 56.8% Fe by magnetic separation with a yield of around 41%. Similarly, Bellary-Hospet sector ore has indicated that it is possible to increase the iron content from a feed assay value of 35% iron to as high as 55% iron with a yield of 20–24%. More details on the experiments performed and the results obtained are discussed in the paper. http://eprints.nmlindia.org/2412/

Aruna, V A J and Goswami, S N and Bawane, P R and Ram, Mohan and Gundewar, C S (2010) *Enhancing chalcopyrite flotation by tackling hydrophobic silicate gangue.* In: Proceedings of the XI International Seminar on Mineral Processing Technology (MPT-2010), Dec 2010, NML Jamshedpur, India

The Khetri Copper concentrator of M/s Hindustan Copper Limited, encountered with the problem of voluminous black froth, while treating copper ore from Banwas mine. The copper concentrate of the plant assayed 16.19% Cu, and 19.57% Acid insoluble with ~89% Cu recovery. Mineralogical studies revealed that the plant concentrate consists of ~45% chalcopyrite, 10–15% quartz, ~5% mica, 15–20% amphibole, 10–15% pyrite and pyrrhotite, 2–3% magnetite and ~5% other minerals. In order to find a solution to the black froth problem, and to improve the Cu grade and recovery, ROM copper ore sample from Banwas mine was sent to RODL, IBM, Ajmer by M/s HCL, Khetri. Bench scale flotation studies carried out at plant grind of 65.9% < 75 μm, under optimized reagent dosage, at dilute pulp density yielded a II cleaner

concentrate assaying 28.81% Cu, 7% acid insoluble with 92.4% Cu recovery. The wt% yield was 6.0. The grade and recovery achieved is much better than that was stipulated by M/s. HCL, Khetri. The study revealed that it is possible to control silicate gangue minerals by slight modifications of the flotation parameters under the existing plant practice conditions. http://eprints.nmlindia.org/2360/

Barik, Anil (2010) *Effective management of coke oven solid waste and by-products in steel plant.* In: Proceedings of the XI International Seminar on Mineral Processing Technology (MPT-2010), Dec 2010, NML Jamshedpur, India.

The Iron & Steel Industry in general is one of the major contributors of environmental pollution due to the complexity of operations. Starting from mining of iron ores and fluxes and their beneficiation to coke making, iron making, steel making and rolling, various solid, liquid and gaseous pollutants are liberated which contribute to pollution. In an integrated steel plant where coke & coke oven gas are the major source of energy. Right from the receipt, unloading handling, crushing carbonization and subsequence coke handling dust & breeze is generated. The process of charging coal inside the oven, pushing & coke quenching operation generates lot of waste into kind of hot air forms, dust, breeze, coke smaller freedom. In India there is too much scope of effective management of Coke Oven solid wastes and by-products which can solve some extent, the shortage of coking coal problem for Iron and Steel Industries particularly for Blast furnace process of Iron making. This paper outlines an insight into some proven technology, process for effective management of Coke Oven solid waste and by-products. http://eprints.nmlindia.org/2668/

Baruah, B P and Khare, Puja and Dutta, D K and Dutta, N N (2010) *Nagaland coals: suitability as an energy source.* Proceedings of the XI International Seminar on Mineral Processing Technology, I . pp. 64-68.

Northeast Indian coals have immense potential for energy, power and other value added products. In comparison to the country's total deposit, the reserve though less, deserves attention owing to different physico-chemical characteristics and non-availability of good quality coal in the country. The state of Nagaland forms a part of the northern extension of the Arakan-Yoma range which has undergone orogenic upheavals during the Cretaceous and Tertiary period. The state has a good deposit of high sulfur coals, lying unexploited industrially so far. In the present investigation, a systematic study on Nagaland coals has been done to explore their suitability as a source of energy. Coal samples from different coalfields have been analyzed for proximate, ultimate, TGA, composition of ash, and petrographic constituents. The swelling and caking indices have been determined. The fouling and slagging indices of these coals have also been reported. The Nagaland coals have high sulfur content similar to those of the other tertiary coals and low ash fusion temperature range, for which they are not suitable for the power generation with the conventional combustion systems, however could be suitable for combustion with FBC

techniques, which operate at lower temperature (≤ 850°C) with in-situ desulphurization mechanism. These coals also show characteristics of non-caking and swelling in general. http://eprints.nmlindia.org/2286/

Behera, R K and Rout, K and Das, N N (2010) *Mineralogical characterization and sorption properties of goethite rich iron ore from daitari, Orissa, India.* Proceedings of the XI International Seminar on Mineral Processing Technology (MPT-2010), I . pp. 16-23.

The present study was an attempt to find alternative uses of goethite rich iron ore, usually not used as raw material for iron extraction, as an adsorbent for removal of anionic contaminants from water. Mineralogical characterization by optical microscope, XRD revealed the presence of substantial amount goethite in the iron ore which was also supported from the TG-DTA and FT-IR results. On heating in air, the goethite content was completely converted to hematite at 400°C. The sorption behaviour of the untreated (GRI-0) and heat treated iron ore were studied using aqueous phosphate solution as the adsorbate with respect to effect of pH, initial phosphate concentration, amount of adsorbent, interfering anions and heat treatment. Phosphate uptake was seen to increase with increasing temperature of heat treatment, attains a maximum value at 300°C and thereafter decreased on further increase of temperature. The experimental equilibrium adsorption data were fitted well to Langmuir isotherm model. The complete desorption of adsorbed phosphate at pH ≥ 12.0 indicated the adsorption of phosphate was reversible and may be reused further. The results obtained could be useful for considering GRI-0 as adsorbent for removal of phosphate ions from contaminated water bodies. http://eprints.nmlindia.org/2278/

Besra, L and Sengupta, D K and Roy, S K (2010) *Influence of flocculant overdosing on solid/liquid separation properties.* In: Proceedings of the XI International Seminar on Mineral Processing Technology (MPT-2010), Dec 2010, NML Jamshedpur, India.

The concentration of flocculant plays an important role in deciding the success or failure of solid/liquid separation process of suspended industrial wastes. A starvation dosage leads to incomplete separation whereas excess dosage been invariably found to hinder filtration and dewatering behaviour. The operating personnels often tend to overdose a flocculation and dewatering process in an industry without realizing the consequence of such overdosing. This paper makes in attempt to study the result of an anionic, cationic and nonionic flocculant overdosing by studying the influence of unadsorbed or physisorbed flocculant on filtration and dewatering characteristics of kaolin suspension. The estimation of unadsorbed flocculants have been done by measuring the desorption of the respective flocculants on washing after their equilibrium adsorption. Removal of the unadsorbed flocculants that do not participate in the flocculation process, by washing has led to a substantial improvement in filtration behaviour evident by the

reduction in specific resistance of the cake to filtration (SRF). The flocculation and dewatering results have been explained in terms of the nature of polymer adsorption and conformation. It has been shown that cationic flocculant, which adsorbs predominantly by physisorption, and is in most coiled form after adsorption is most efficient in enhancing filtration behaviour. On the other hand, non-ionic polyacrylamide flocculant, which is predominantly chemisorbed on kaolin and exhibits a more stretched conformation, is most suitable for enhancing sedimentation rate. The anionic flocculant, for which the conformation is most stretched, exhibits lowest sedimentation rate and poor filtration behaviour. In either case, removal of the excess unadsorbed flocculant from the liquid leads to improvement in filtration behaviour. http://eprints.nmlindia.org/2373/

Bharti, Amishi and Kumar, Gautam and Sinha, Moni and Chakraborty, D S (2010) *Characterization of sinter return fines.* In: Proceedings of the XI International Seminar on Mineral Processing Technology (MPT-2010), Dec 2010, NML Jamshedpur, India.

Sintering is agglomeration of fine grained iron ore for blast furnace burden preparation. During the sinter transportation process fine sinter (–5 mm) is produced which cannot be charged in the blast furnace as high percentage of fines creates gas flow problem in blast furnace. The screened sinter is recycled to the raw material bedding and blending plant. The productions of these fines therefore result in loss of revenue for the sinter plant. In SP#4 around 22–25% of the return fines are generated, which is much higher than the world average of 15%. The aim of this project is to study the composition and phase chemistry of return fines. Iron ore sinter samples were collected from sinter plant of Tata Steel. Different size fractions of the return fines were subjected to chemical analysis and characterization study. It was observed that there is difference in chemistry (mainly Alumina content) as well as in phase percentage of the different size fractions of the return fines. http://eprints.nmlindia.org/2485/

Borah, Sarat Ch and Das, Manash R and Tamuly, Chandan (2010) *Characterization of graphite deposits of Arunachal pradesh.* In: Proceedings of the XI International Seminar on Mineral Processing Technology (MPT-2010), Dec 2010, NML Jamshedpur, India.

Graphite, being one of the important non-ferrous minerals and having applications in various important industries, will find increased consumption in the coming years. Graphite, a mineral of pure carbon, is one of the most versatile elements in industry, because of its varying physical properties and characteristics. It is a crystalline form of carbon and a good conductor of heat and electricity and a good lubricant. It is also used in nuclear reactor as moderator. India has a large deposition of graphite minerals out of which about 43% are found in Arunachal Pradesh. However, compared to the rest of the country, the North-East Region and particularly Arunachal Pradesh has not attracted attention till date for detail investigation for

characterization, beneficiation, prospecting and/or exploitation of the mineral resources including graphite. Bulk graphite sample were collected from different location of Arunachal Pradesh were crushed to all below 12 mm size. A representative sample was obtained by quartering and coning of the entire crushed sample, was subjected to sieving to obtain different size fractions of the graphite sample. The carbon content of the representative graphite sample was found to be 7–16% by CHN analysis of the different locations. The chemical analysis result shows that the fixed carbon content of the graphite sample found to be 5–10%. The chemical analysis, powder XRD and FTIR characterization indicated the presence of the silica, aluminium oxide, iron oxide, Ca, Mg etc in the raw graphite sample collected from Arunachal Pradesh. http://eprints.nmlindia.org/2277/

Chakraborty, Debarun and Goswami, M C and Bhagat, R P (2010) *Effect of process variables on sintering indices in relation to high LOI hematite ore fines of Gua mines.* In: Proceedings of the XI International Seminar on Mineral Processing Technology (MPT-2010), Dec 2010, NML Jamshedpur, India.

The strength parameters of sinter namely, Tumbler Indexes (TI), Reduction-Degradation Index (RDI) and Reducibility Index (RI) are key properties of sinter that influence the performance of blast furnace when used as burden. The contributing factor to the sinter quality could be the mineralogical composition of the sinter which is decided by the sinter chemistry and other process parameters. Besides the quality parameters of sinter, the effectiveness of the sintering process is determined by the productivity of the sintering machines. The process variables and the characteristics of ore fines do have significant influence on the sinter quality and its productivity .The present paper reports the effect of certain process variables on the sintering indices in relation to high LOI content beneficiated ore fines from Gua mines of SAIL. Pot sintering studies were carried out at NML using the beneficiated goethitic hematite ore from Gua mines of Jharkhand, India. The ore contains Fe -61.26, Silica-2.56%, Alumina-2.74%, LOI-6.27%. Raw materials namely limestone, dolomite, coke breeze were collected from Bokaro Steel Plant of SAIL and prepared according to the existing practice of the sinter plant of SAIL. The sinter basicity (CaO/SiO_2) was kept as variable having the values ranges from 1.6 to 2.6%. The MgO content of the sinter was also varied from 0.8% to 1.6%. The sinter quality parameters were evaluated according to the Indian standards. The effect of process variables namely basicity, bed height, MgO content of sinter, on the Vertical Speed of Sintering (VSS)[productivity], and quality parameters of sinter was investigated. The study shows that the amount of solid fuel and the moisture content, had inter-influencing effect on the sintering indices. Coke breeze at 5% of the raw mix and moisture content in between 5.5% to 5.8% seems to be optimum for an acceptable strength (TI) of sinter and in relation to RDI of sinter. More of desired mineral phases, calcium ferrites etc. do occur in the sinter when the process sinter was not over fused or under fused. The speed of sintering decreases, while the yield and strength of sinter increases with increase in bed height from 400 mm to 500 mm.The reduction parameters also improve which signifies a change in sinter mineralogy. More of

calcium ferrites and magnetite phase is observed as the bed height increases. http://eprints.nmlindia.org/2487/

Chandraprabha, M N and Natarajan, K A (2010) *Biomodulation of mineral surfaces for selective separation of pyrite from chalcopyrite: a ftir study.* In: Proceedings of the XI International Seminar on Mineral Processing Technology (MPT-2010), Dec 2010, NML Jamshedpur, India.

This paper discusses the utility of FTIR spectra in understanding the mechanism of selective separation of chalcopyrite from pyrite after biomodulation using Acidithiobacillus ferrooxidans cells. Consequent to interaction with bacterial cells, pyrite remained depressed even in presence of collector while chalcopyrite exhibited significant flotability. FTIR spectra indicated that the major species formed when pyrite and chalcopyrite were interacted with an aqueous solution of potassium ethyl xanthate was dixanthogen and copper (I)alkyl xanthate respectively. The observed difference in the flotability of the two minerals after interaction with the cells and collector is explained based on FTIR studies. http://eprints.nmlindia.org/2650/

Chatterjee, Amit and Raj, Manish (2010) *How the steel industry can get the best out of Indian coal.* Proceedings of the XI International Seminar on Mineral Processing Technology (MPT-2010), 1 (Section 6). pp. 411-418.

Coal, particularly coking coal is a vital raw material for the steel industry, since coke plays a key role in blast furnace ironmaking. Efforts are always made to reduce the consumption of coke in blast furnaces by injection of non-coking coal through the tuyeres. This automatically imposes severe restrictions on the quality of blast furnace coke. Furthermore, for coal injection to be effective, the injected coal has to be carefully selected so that it does not drastically alter the conditions prevailing in the blast furnace raceway. The quality of blast furnace coke depends on: the properties of the coal blend used, the process used for cokemaking including the technique of pre-carbonisation employed (if any), and to a lesser extent, on post-carbonisation operations. The influence of the properties of coking coal on blast furnace coke and the parameters involved in the choice of non-coking coal for coal injection are discussed in this paper. In India, there is dearth of both coking as well as non-coking coal suitable for the steel industry. Intensive efforts in terms of coal selection, up-gradation by beneficiation, etc. are required to optimise the properties (particularly the ash content) of Indian coal. In addition, in order to produce high grade coke from weakly coking Indian coking coals, blending with low ash imported coal of high rank is essential. The cost incurred on imported coal can be controlled by paying simultaneous attention to the preparation of indigenous coals. http://eprints.nmlindia.org/2386/

Chattopadhyay, U S and Gouri Charan, T and Kabiraj, S K and Haldar, D D (2010) *Multi product beneficiation of non-coking coal from eastern coalfields—a case study.* In: Proceedings of the XI International Seminar on Mineral Processing Technology (MPT-2010), Dec 2010, NML Jamshedpur, India.

The wide variations in nature and type of Indian coals formed during lower Gondawana period and categorized as high ash due to its typical mineral matter association with the organic matrix call for suitable beneficiation techniques as the preferred option for quality upgradation. The huge available resources of non coking coal of Eastern Coalfields Limited, a subsidiary of Coal India Limited are being presently used for power generation. Options may be looked into for the utilization of these coals in industries like sponge iron, cement etc., after judicious beneficiation. In this paper, an attempt has been made to focus the eco-friendly approach for total utilization of the 'high ash' non coking coal of Eastern Coalfields Limited. The paper highlights detailed investigations carried out on high ash non-coking coal sample having about 40% ash content, by systematic washability investigations followed by computer simulation of washability data for prediction of practical yields at 20% ash level by heavy medium separation processes respectively. The concept basically involves multi product beneficiation of raw coal to two/three saleable products at different ash levels, specifically suitable for industries like, Cement and FBC Power Plants. http://eprints.nmlindia.org/2401/

Chawngte, Rimi Lalrinpuii and Khatri, Varsha (2010) *Prospect of non/heat recovery coke oven plant in India.* In: Proceedings of the XI International Seminar on Mineral Processing Technology (MPT-2010), Dec 2010, NML Jamshedpur, India.

Low Ash Metallurgical Coke is required for metallurgical and chemical industries and is used as the primary fuel. The industrial consumers of LAMC include integrated steel plants, industry/foundries producing Ferro Alloys, Pig Iron, Engineering Goods, Chemicals, Soda Ash and Zinc units etc. Therefore, our main emphasis lies in the manufacturing methods or techniques of coke and industries adopting it. The importance of Coke in blast furnaces is that coke is primarily used to smelt iron ore and other bearing materials, acting both as a source of heat and as a chemical reducing agent to produce pig iron or hot metal. It has been observed that about 33% of total investment is made in the coke plant in iron making. Basically, there are mainly two types of coke oven plants, viz., By-product coke oven plants and Non/Heat Recovery Coke Plants. In this paper, elaborate discussion has been made regarding the suitability of the Non/Heat Recovery Coke Oven Technologies in our country. The technologies which are famous and widely adopted in India for coke making are Jewell Thompson Technology, Chinese Technology, Kumbharaj Technology and Dasgupta Technology. In Non/Heat Recovery Coke Oven, the waste heat from waste gas of coking can be fully utilized in power generation, resulting in better coke quality and low emission levels. Moreover, this paper will embody the details of some Coke Plants in India which have adopted Non/Heat Recovery Coke Ovens. The salient features of the above four technologies as well as the comparison

between By-product Coke Ovens and Non/Heat Recovery Coke Ovens plants are highlighted. On the basis of detailed analysis, the advantages and disadvantages of these technologies are envisaged and some recommendations have been made in this paper. http://eprints.nmlindia.org/2393/

Choubey, Pankaj K and Jha, Manis K and Kumar, Vinay and Jeong, Jinki and Lee, Jae-chun (2010) *Leaching studies for the recovery of tin from the solder of waste printed circuit boards.* In: Proceedings of the XI International Seminar on Mineral Processing Technology (MPT-2010), Dec 2010, NML Jamshedpur, India.

Printed Circuit Boards (PCBs) are one of the important components of electrical and electronic equipments, which contain valuable, precious and hazardous metals besides the other materials such as plastic, glass etc. Large quantities of waste PCBs from different equipments are generated due to the replacement of old one with the launching of new and efficient models with advance features. The recycling of such waste materials is necessary to conserve the limited resources and also to protect the environment. Present paper is focused on the recovery of tin from solder material used in PCBs for fixing the various electronic components such as capacitor, resistor, connectors etc. Metals layers of PCBs are separated by swelling of the resin using organic solvent as an alternative traditional mechanical pre-treatment process. The main focus of the paper is the leaching of lead and tin from epoxy resin obtained after the liberation of thin metal sheet from organic swelled PCBs. Therefore, the leaching studies were carried out with pure tin metal and solder materials (52.6 % Sn and balance Pb) under varying hydrochloric acid concentration, temperature at fixed pulp density 10 g/L. The experimental data indicated that the 88.1% pure tin was dissolved with 9M HCl at 90°C within leaching time 1hr 15 min, however percentage dissolution was found to increase up to 98% with increase in leaching time to 2 hrs 45 min. The dissolution of tin from the solder was found to be 99.99% with 5M HCl at 90°C in 1hr 15 min. The kinetics of leaching of tin from solder was studied in hydrochloric acid. Leaching reaction followed "film diffusion control dense shrinking sphere model" with rate equation $1-(1-X)2/3 = Kct$. The optimized condition obtained from these studies will be useful for the removal of tin from solder material of waste PCBs and lead metal remained in the residue could be leached out by nitric acid for safe disposal or utilization of resin residue to the environment. http://eprints.nmlindia.org/2590/

Das, Manash R and Sarma, Jyotirmoy and Sarma, Namrata and Mahiuddin, Sekh (2010) *Characterization and ion specificity of the iron ore beneficiation waste.* In: Proceedings of the XI International Seminar on Mineral Processing Technology (MPT-2010), Dec 2010, NML Jamshedpur, India.

Low-grade iron ore fines and slime contain ~ 58% iron and high amount of alumina containing gangue minerals. Beneficiation of low-grade iron ore fines and slime using surface-active agent produces a reasonably stable suspension. To recover

water from the suspension and to reduce the volume of the tailing pond, flocculation of suspended gangue minerals is essential. The gangue minerals in the dispersed phase were characterized by XRD and FTIR and found to be chlorite, kaolinite, hematite, goethite, aluminosilicate minerals as major phases. The influence of inorganic anions (Cl–, I–, and SO42–) and divalent cations (Ca2+) on the zeta potential and the isoelectric point of dispersed phase of iron ore slime in aqueous medium have been studied. The ion specificity an ubiquitous phenomena has been observed in the beneficiation waste. http://eprints.nmlindia.org/2368/

Das, Suchandan K and Kumari, Preeti and Bhattacharyya, K K and Singh, Ratnakar (2010) *A mathematical model to characterize separation behavior of a spiral for processing iron ore using a mechanistic approach.* In: Proceedings of the XI International Seminar on Mineral Processing Technology (MPT-2010), Dec 2010, NML Jamshedpur, India.

Spirals are probably the lowest capital cost mineral concentrator available today. Combined with their low operating cost, they have continued widespread use. An attempt has been made to develop a mathematical model to simulate the particle and flow behavior in a iron ore processing spiral. The modeling framework addresses three main components of the spiral process, namely, geometry of the spiral and its trough, fluid motion along the curvilinear path of the spiral and principal forces acting on a particle. These components have been integrated seamlessly by assuming that the particles eventually attain dynamic equilibrium in the forward longitudinal direction and static equilibrium in the transverse direction. The resulting force function provides a spectrum of the particles' radial location on the trough according to their size and relative density. The model predicts relative density distribution as a function of equilibrium radial position for different particle sizes. It also computes particle size variation as a function of equilibrium radial position for various values of relative density. Sensitivities of radial equilibrium distribution of particle size and relative density with respect to pitch and width of the spiral and also mean flow depth have been analyzed. Simulation results have been validated and found to be in good agreement with published data. The model provides an analytical tool for better understanding of the separation behavior of particles in a spiral for processing iron ore. http://eprints.nmlindia.org/3548/

Das, Suchandan K and Kumari, Preeti and Bhattacharyya, K K and Singh, Ratnakar (2010) *A multi-input multi-output artificial neural network model to predict the separation characteristics of iron ore by a magnetic separator.* In: Proceedings of the XI International Seminar on Mineral Processing Technology (MPT-2010), Dec 2010, NML Jamshedpur, India.

Due to the paramagnetic properties of hematite ore, its magnetic susceptibility naturally increases in an increasingly powerful magnetic field. One of the most popular and effective technique utilized in fine iron ore recovery is the Wet High Intensity Magnetic Separation (WHIMS). A Multi-Input-Multi-Output (MIMO),

multilayer perceptron (MLP) based neural network model has been developed to predict the output parameters grade and recovery to characterize the separation behavior of a WHIMS system for processing iron ore in the particle size range of 75~300 μm. The input parameters in the Artificial Neural Network (ANN) model comprises of feed composition, %Fe, %SiO2, %Al2O3 and process parameters such as particle size, pulp density and magnetic field intensity. The neural network architecture has been optimized using highly effective Broyden-Fletcher-Goldfarb-Shanno (BFGS) network optimization algorithm to minimize the training error within few training cycles. The model is based on the data generated from WHIMS experimental investigations. There has been a very good agreement between the optimized model predictions with the measured values pertaining to recovery and grade during magnetic separation. http://eprints.nmlindia.org/2383/

Eslamian, Atiye and Rezai, Bahram and Mohammad, Reza Aslani (2010) *Study and prediction of a relationship between particles shape characteristics of minerals and their flotation kinetics.* Proceedings of the XI International Seminar on Mineral Processing Technology, I . pp. 43-46.

Distribution of particle size and shape are of great importance to mineral industries. Morphological and shape properties of particles, affects next processes such as flotation. On the other hand, crushing and grinding are factors that cause changes in the physical and chemical properties of materials under processing, such as size and shape distributions. Shape properties have been stated in terms of shape descriptors such as elongation and roundness by measuring on the projections of particles using scanning electron microscope. The floatability and wettability characteristics of particles were determined by flotation technique using the laboratory flotation cell. Results show that recovery rate of particles in flotation method will vary with elongation and roundness; there is a predictable relationship between particle shape characteristics, including elongation (E) and roundness (R), and flotation kinetics (k) as followed: k ∝ a[R]b and k ∝ a[E]bWhere a and b, are constant values, [E], [R], are mathematical operators that may be different for each mineral. http://eprints.nmlindia.org/2282/

Gouri Charan, T and Haldar, D D and Nagnoor, P C (2010) *Studies on the cleaning potentialties of IB valley coal by washability investigations.* In: Proceedings of the XI International Seminar on Mineral Processing Technology (MPT-2010), Dec 2010, NML Jamshedpur, India.

India has about seven percent of the world's proven coal reserves. More than 50% of the total energy requirements in India are met from coal. It is estimated that the reserves are enough to meet India's needs for more than 50 years. But, Indian coals, contain high ash wherein the extraneous material was intimately mixed in the coal matrix during the formation stage, causing a high level of impurities in the run-of-mine (ROM) material. These coals possess difficult to very difficult washability characteristics. Beneficiation of high-ash non coking coals of India has become the

prerequisite for improving the overall economics and efficiency of all the downstream processes. This article describes the washability characteristics of a typical non coking coal from the Ib Valley Coalfields aiming at 34% ash level in the clean coal as per the stipulations laid by environmental gazette notification of the Government of India. Conventional float-and-sink testing was used to determine the yield of clean coal. A suitable flow scheme for beneficiation of the non-coking coal was suggested. http://eprints.nmlindia.org/2389/

Haldar, D D (2010) *Beneficiation of non-coking coals: basic concepts and technology routes.* In: Proceedings of the XI International Seminar on Mineral Processing Technology (MPT-2010), Dec 2010, NML Jamshedpur, India.

Coal is the most important primary source of commercial energy in India. The importance of coal is bound to increase for the coming years with the growth of coal consuming industries. Power sector is the most potential consumer of the non-coking coal, consuming more than 70% of the total coal production of the country. With increasing consumption, coal will continue to enjoy a prime position in the overall energy scene in India. Many coal consuming plants including the power plants obtain coal from more than one source and the coal is of varying quality and size. Due to the fluctuations in the grain size distribution, top size, ash and moisture content in the coal fed to the thermal power plants, it is not possible to ensure adequate homogenization of coal quality in the absence of proper and adequate blending facilities at the power plant end. In view of the above situation, beneficiation of power coal appears to be the only solution to reduce ash of the coal and the quantity of coal to be transported, mainly by rail thus reducing demand for railway rakes and resulting in overall savings in expenditure of freight. The purpose of beneficiation of non-coking coal is not only to reduce its inert content for transportation or to minimize abrasive materials but mainly to improve its combustion qualities. The combustion properties of coal like heating value, volatile matter content, char characteristics, abrasivity, etc. Since clean and efficient combustion is on demand today, optimization of such quality parameters for the purpose of beneficiation is felt necessary to impart desired qualities to the beneficiated coal. The geological reserves of non-coking coal, its grades with characterization, consumption of the coal by various industries, characteristics of coal for various end users like power, sponge iron and cement industries has been discussed. The concept of preparing Indian non-coking coals conceived by Erstwhile Central Fuel Research Institute, particularly for non-coking coal has been discussed. The technology routes for the upgradation of the non-coking coals by different processes has also been discussed in brief. The address ends with a comparative statement of using various washing systems in terms of feed size, Ecart probable values, cost of investment, power consumption, etc. and concluding remarks. http://eprints.nmlindia.org/2387/

Ismail, A K (2010) *Energy saving during alum production from kaolin with coproduction of alumina-silica composites from process silica wastes.* In: Proceedings of the XI International Seminar on Mineral Processing Technology (MPT-2010), Dec 2010, NML Jamshedpur, India.

Egypt is among few countries producing aluminum sulphate alum for water purification from domestic kaolin (35% A12O3) as bauxite, the conventional raw material for alum production with 60% A12O3 is not available. The technologies applied are energy intensive require calcination prior to sulphuric acid leaching or direct leaching under high pressure and high temperature. In view of energy crises, direct leaching of kaolin with sulphuric acid in presence of fluosilicic acid disposed from phosphatic fertilizers industry was tried and the optimum conditions of producing drinking water alum were determined, thus the energy intensive calcination or pressure leaching steps could be canalled leading to improvement of production economics. Silica disposed after the leaching process is used to produce alumina- silica composites such as mullite 2 A12O3. 3 SiO2 through alkaline dissolution of silica and mixing of the produced sodium silicate with sodium aluminate produced from sodium carbonate thermal treatment with aluminum dross disposed from aluminum smelters. Controlled co-precipitation of the composite from mixture of the two solutions was achieved and X-ray investigation proved the formation of mullite phase. The Project has great impact on energy saving and economization of water treatment technology in addition to converting the industrial wastes to value added products—Waste to Wealth W2W. http://eprints.nmlindia.org/2488/

Jha, G S and Chattopadhyay, P C and Prasad, P S and Mitra, A N and Maji, S C and Gouri Charan, T and Haldar, D D (2010) *Washability studies and characterization of cleans of coking coal sample from BCCL, CIL, India.* In: Proceedings of the XI International Seminar on Mineral Processing Technology (MPT-2010), Dec 2010, NML Jamshedpur, India.

Coking coal is an essential prerequisite for production of Iron & Steel through blast furnace route. Systematic R&D studies on the availability of desired quality coking coal from indigenous resources have become imperative to minimize the dependence on imported coals. The Low Volatile Coking Coal (LVCC) constitutes about 50% of the total coking coal reserves in India. These coals are characterized by high ash content and difficult in cleaning potential. The present paper highlights the R&D investigations carried on a typical LVC coal of Bharat Coking Coal Limited. The run-of-mine (ROM) coal was crushed to 75 mm and detailed float and sink tests were carried out on the fraction 75–0.5mm basically to study the cleaning potentiates of the coal on washing. The coal fines were subjected to standard laboratory flotation tests to study the flotation behavior. Combined cleans was generated at 17.5% ash level and characterized for finding its utilization in metallurgical industries. The characterization studies revealed that the coal after suitable beneficiation may be used as a blendable coal for metallurgical purposes. http://eprints.nmlindia.org/2396/

Joseph, P F and Prasad, V G K and Janarthanan, A J and Chandrasekar, V (2010) ***Environmental management in beach sand mining and processing—a role model.*** **In: Proceedings of the XI International Seminar on Mineral Processing Technology (MPT-2010), Dec 2010, NML Jamshedpur, India.**

IREL, Chavara is engaged in the mining and processing of beach sand heavy minerals from the coastal belts of Kerala. Our unit produces minerals like Ilmenite, Rutile, Zircon and Sillimanite that find use in various applications like Paint Industry, Welding Electrodes, Ceramics, Foundry etc. Mining is carried out by dredging and beach washing collection in some of the thickly populated areas posing its own environmental issues. IREL, Chavara follows unique Environmental Management Plan to mitigate environmental issues like erosion, formation of sinkholes, loss of bio-diversity, contamination of soil, ground water and surface water from mining processes. Normally, additional forest logging is done in the vicinity of Mines to increase the available room for the storage of the created debris and soil which may cause environmental damage and affect the health of the population. In this regard, Dredge mining does not generate any effluent and tailings are not stored. The dredged-out area is refilled and leveled with mineral-free tailings sand where the background radiation is significantly reduced to make it safer for the local inhabitants. Resettlement colonies are developed over the refilled areas with improved infra-structural facilities like drinking water, power supply, roads etc. Thus, we return the mined-out area back to the locals with value-addition. We also ensure development of a green-belt on the colonies by supplying free coconut saplings thereby preserving the ecosystems. Modern technology is incorporated to mitigate and reduce noise pollution, dust pollution and visual pollution. Measures towards reduction of carbon foot-print like introduction of "Elemental Chlorine-free Technology (ECF)" made paper, installation of a 3 KW Solar Photo-Voltaic (SPV) Power Plant as part of green building, using solar water heaters and bio-gas plants for meeting the heat energy requirement in Canteen and Guest House are being undertaken. Modern Effluent Treatment Plant that employs skimming, aeration and filtration is commissioned as part of our overall waste oil management program to reclaim the waste oil generated at garages and workshops. Bio-medical waste from our dispensary is segregated and disposed as per provisions of the bio-medical waste rules. http://eprints.nmlindia.org/2674/

Joseph, P F and Prasad, V G K and Janarthanan, A J and Viswanath, R V (2010) ***Wet high intensity magnetic separation: efforts taken to adapt the machine to the mineral separation plant of IREL, chavara.*** **In: Proceedings of the XI International Seminar on Mineral Processing Technology (MPT-2010), Dec 2010, NML Jamshedpur, India.**

Magnetic separation has long been used to upgrade and beneficiate a wide variety of industrial minerals. Advances in both wet and dry magnetic separators over the years has broadened their use, and questions are often raised about which separation technique or equipment type is most appropriate for a particular operation. Minerals separation based on magnetic susceptibility differences in

particles is accomplished wet or dry, at various intensities and in different basic machine configurations. The following types of industrial magnetic separators used in a modern mineral sands plant: – Wet high-intensity electromagnetic separators (WHIMS) – Wet low-intensity drum separators (LIMS) – Dry high intensity induced roll magnetic separators (IRMS) – Dry low intensity drum-type separators or 'scalper' magnets – Dry high-intensity rare-earth drum (RED) separators, and – Dry high-intensity rare-earth roll (RER) separators The selection of magnetic separation technology depends on many processing factors, including particle size, and the specific assemblage of minerals and grades as well as their corresponding magnetic susceptibility. Additionally, production and marketing factors must also be considered. http://eprints.nmlindia.org/2350/

Jyoti, Divya and Rath, R K and Mohanty, Sunati and Singh, Ratnakar and Bhattacharyya, K K (2010) *Beneficiation of a finely disseminated low-grade iron ore by froth flotation.* In: Proceedings of the XI International Seminar on Mineral Processing Technology (MPT-2010), Dec 2010, NML Jamshedpur, India.

The gradual depletion of high-grade iron ores due to extensive utilization has necessitated the exploitation of low/off grade iron ore reserves of India. Beneficiation of low grade iron ore is required to make it suitable for industrial usage. The low grade iron ore mined from Gua mines contains 57.6% Fe. At coarser size, liberation of gangue from iron ore is not efficient, so it is needed to ground the ore to fine size. The ground material is de-slimed using a hydro cyclone and the underflow product was subjected to reverse flotation. In the flotation experimentation, the main variables investigated were collector dosage, pH, percent solids, depressant concentration and frother concentration. Results of these studies show that froth flotation can be used for beneficiation of low grade iron ore to produce a concentrate suitable for pellet feed for iron making. http://eprints.nmlindia.org/2414/

Kar, A K and Rath, R K and Mohanta, M K and Singh, Ratnakar and Kumar, Anil (2010) *Characterisation and surface chemical studies on ultrafine iron ore.* In: Proceedings of the XI International Seminar on Mineral Processing Technology (MPT-2010), Dec 2010, NML Jamshedpur, India.

During the wet processing of iron ores, a substantial amount of slimes are generated. The slime contains very fine iron bearing mineral particles which are difficult to remove and cause environmental pollution when discharged. In this paper, an attempt was made to study the settling and dispersion behaviour of the very fine iron ore mineral particles which is treated as waste in the presence of different reagents. The waste material contains of 52.56% Fe which is significant from iron content view point. Characterisation studies such as size analysis, mineralogical and XRD of the overflow sample of hydrocyclone was carried out and discussed. The sample was very fine in nature (90% below 17.32 μm) and the major minerals were seen as

hematite and goethite while the major impurity was found to be quartz as confirmed by the mineralogical investigation. Surface chemical studies show that the isoelectric point (iep) was at pH 6.75. Tannic acid, starch show a good dispersant property with higher turbidity value upto a time period of 20 minutes, whereas CMC show a faster settling of the sample for the same time period with low turbidity value. Tannic acid shows low settling behaviour corroborating the supernatant turbidity value. There is good correlation between zeta potential and the supernatant turbidity value. Starch with 50 ppm gives a good recovery of 79.82% by weight with a Fe content 55.52%. http://eprints.nmlindia.org/2367/

Kenzhaliev, B K and Abdykirova, G Zh. and Zhapbasbaev, U K and Beisembaeva, G Zh. and Suleimenov, E N (2010) *Development of new modifying reagent- assisted technology for rebellious gold-bearing ores processing.* In: Proceedings of the XI International Seminar on Mineral Processing Technology (MPT-2010), Dec 2010, NML Jamshedpur, India.

Due to ever-aggravating depletion of grade raw materials reserves lean persistent ores are involved in processing operations. Fine gold impregnations in sulphides and rock-forming minerals require increased volumes of rock masses to be mined and processed. Also, before to start dressing processes such raw materials shall be subjected to finish grinding, i.e., gravitation, flotation, cyanide leaching etc., that results in decreasing technological parameters and excess consumption of toxic flotation reagents. http://eprints.nmlindia.org/2365/

Kopparthi, Prasad and Gupta, Ashiwanit Kumar and Banerjee, P K (2010) *The effect of softening recycled water on coal flotation.* In: Proceedings of the XI International Seminar on Mineral Processing Technology (MPT-2010), Dec 2010, NML Jamshedpur, India.

Mineral processing plants usually operate with water in a closed circuit mode. For this large quantities of water have to be recycled from various unit operations continuously. To compensate natural losses small quantity of fresh make up water is added into the circuit. As a result of recycling, a gradual build up of residual concentrations of flotation reagents (frothers, collectors, coagulates) takes place in the water and the concentration levels of the contaminants increases. The recycled water contains higher amounts of dissolved components and hardness than the fresh water, due to the recirculation. The use of recycle water in flotation has significant effect on the selectivity of the flotation process since the dissolved compounds, both inorganic as well as organics alter the chemistry of the system radically. It has been observed that flotation of coal has resulted into nine to thirteen units drop in yield compared to DM water. This may be due to the many of these ions are acting as depressants. The presence of certain alkali earth metal ions (e.g., Ca ++, Mg ++) could adversely affect flotation as they precipitate sparingly soluble hydroxyl complexes on the coal surface and change its surface charge. The effectiveness of the flotation process can be increased by reducing the dissolved ions in the

recycled water through softening process. By softening process the total hardness of the recycle water can be reduced from 743 ppm to 8 ppm. In softening process the concentrations of alkali earth metals were also replaced by sodium ions. It has been observed that the flotation yield increases by more than five units by treating the recycled water to the softening process. If this softening process is included in the coal preparation plant there could be significant improvement in the flotation yield and conservation of the natural resources. http://eprints.nmlindia.org/2395/

Kumar, Pawan and Sah, Rakesh and Vidyadhar, A and Das, Avimanyu (2010) ***Dry beneficiation of coal fines using air table.*** **In: Proceedings of the XI International Seminar on Mineral Processing Technology (MPT-2010), Dec 2010, NML Jamshedpur, India.**

Wet processing of coal requires a large quantity of water. Waste generated from wet process ties up a significant amount of water and land. The slurry ponds also pose serious problems in case of dam failure. Dry beneficiation is coming up to be considered a feasible alternative, at least in coal preparation. Air table works on shallow bed fluidization principle in combination with the principles of a settling in wet shaking table separating the particles on the basis of specific gravity. It was observed that particles above 1 mm size cannot be effectively separated in air tables. For reasonably good separation the feed must have a narrow size range. Ultrafine particles are likely to be lost. The performance is affected by several process variables such as feed flow rate, air flow rate, deck eccentric speed, side tilt and end raise. The optimization of the process in terms of the operating variables has been performed in the present work using statistically designed experiments. The separation performance is influenced by a strong interdependence of the process variables. A mathematical model for the yield and ash content of the clean product was developed. In the present work, coal from Kuju area with a feed ash of 34.2% was used as the feed material. The product ash was reduced to 30.15% with a yield of 66% at a side tilt of 30 mm and 18.3 Hz eccentric speed expressed in terms of frequency. It was found that size also plays a dominant role. A narrower size range of feed gives better separation. It was observed that a small change in side tilt and eccentric speed affects the yield significantly. The separation efficiency is governed mostly by air flow rate and end-raise. However, the characteristics of coal play a major role with respect to dry beneficiation. http://eprints.nmlindia.org/2391/

Kumar, Shivesh and Rath, R K and Singh, Ratnakar and Kumar, Anil (2010) ***Separation of iron bearing minerals from slime by flotation.*** **In: Proceedings of the XI International Seminar on Mineral Processing Technology (MPT-2010), Dec 2010, NML Jamshedpur, India.**

In India, the beneficiation of high grade and medium grade iron ore is limited to mainly washing scrubbing followed by classification, which results in unprecedented generation of slime. The generation of slime is estimated to the tune of 15-20% of the total material mined. The slime contains good amount of iron values

in it, which need to be recovered effectively for their usage from material management as well as the environmental nuisance viewpoints. The possibility of recovering valuable iron present in slime using reverse flotation is reported in this study. The sample was first deslimed prior to flotation using classification to remove ultrafines. The deslimed product was subjected to reverse cationic flotation using Cetyl Trimethyl Ammonium Bromide (CTAB) collector for the gangue mineral and starch as depressant for iron oxide. Bench scale flotation experiment was performed by changing operating parameters such as collector concentration, depressant, dispersant concentration, pH and solid-in pulp concentration and impeller rotation. The results showed that CATB has a stronger collecting power to gangue at a dose of 1.5 kg/ton at natural pH, with 46.94% yield having 64.5% iron which can suitably be used for iron making through pelletisaiton. http://eprints.nmlindia.org/2363/

Kumar, Vinod and Jadhav, G N and Khosla, N K and Mehrotra, S P (2010) ***Implication of process mineralogy for beneficiation of low grade iron ore resources containing high alumina from eastern part of India.*** **Proceedings of the XI International Seminar on Mineral Processing Technology, I . pp. 82-91.**

Total estimated reserve of iron ore in India is around 23 billion tonnes with annual consumption of about 100 million tonnes, while the anticipated demand by next two years is likely to increase by 150 million tonnes/annum. It is estimated that proven metallurgical grade ore is going to sustain the production of iron for another 30–35 years only. Depletion of high grade reserves coupled with increasing market pressure and the threat of environmental pollution has made to realize the need to exploit large tonnage of low grade iron ores for sustainable development. High alumina content in the low grade iron ore has been a major concern to the iron ore industries in their large scale utilization as it increases fuel consumption, slag volume, forms a viscous slag, decreases the furnace productivity and has adverse effect on sinter strength. Additionally, iron ore contains a host of other deleterious elements such as silica, phosphorous and sulfur and their removal are essential before feeding to the blast furnace. Selection of beneficiation methods depends on the level and nature of the gangue and the form of its dissemination, as well as the gangue and the impurities encapsulated in the structure of ore assemblages. The present paper deals with the characterization and beneficiation of high alumina iron ores from Noamundi Mines of Jharkhand, where environmental friendly methods will be studied for their sustainable exploitation. Low grade iron ores (hard laminated ore, lateritic ore, limonitic and shaly ore) from the selected deposit was investigated following physical beneficiation processes. The microscopy, petrography and ore mineralogical characterization will be investigated of various mineral beneficiated ores. Investigations suggest that iron ore samples were composed of hematite (two generations), goethite (two generations) and limonitic material (younger generation) in association with major gangue minerals such as clay minerals (kaolinite, gibbsite), cryptocrystalline silica (jasper, chert) and crystalline quartz as well as apatite. The ores were subjected to comminution to smaller size followed by Enhanced Gravity Separation (EGS), and magnetic separation (WHIMS). Hard

laminated ore, inspite of the complex nature, shows good separation by both MGS (Multi Gravity Separator) and WHIMS (Wet High Intensity Magnetic Separator), especially for smaller size, where as in case of shaly ore and limonitic ore, iron bearing minerals report to tailing in the form of fine locked particles even in finer size ranges. Use of advanced gravity and magnetic separation techniques of beneficiation resulted in cleaner concentrate containing around 66% Fe at 60% recovery by weight for hard grade ores. However, in reference to shaly ore and limonitic ore, desired grade of concentrate was not obtained which was attributed to their complex nature and intricate ore-gangue association. This research work reiterates that the role of ore-gangue mineralogy is very useful in evaluating the separation efficacy of beneficiation processes. http://eprints.nmlindia.org/2289/

Kumari, Neha and Vidyadhar, A and Konar, J and Bhagat, R P (2010) *Beneficiation of iron ore slimes from Karnataka through dispersion and selective flocculation.* In: Proceedings of the XI International Seminar on Mineral Processing Technology (MPT-2010), Dec 2010, NML Jamshedpur, India.

During the wet processing of iron ores, substantial amount of fine particles/slimes is generated in downstream which need to be recovered effectively for their usage and beneficiation. The present paper describes the beneficiation studies of Iron ore slime from Karnataka, India through dispersion and selective flocculation in presence of surfactants and polymers with a view to produce pellet grade fines. The slime sample had a feed grade of 63.84% total Fe, 2.64% Silica and 3.98% alumina. Detailed characterization data indicated that 76 Wt% of the sample was below 49 micron size. XRD analysis indicates that the sample constituted hematite and goethite as in major phase whereas magnetite, kalonite and silica in minor phase. The zeta-potential data indicates that the iep is about 5.1. The dispersion studies of the fine iron ore particles were carried out with sodium hexa meta phosphate (SHMP), tetra sodium pyrophosphate (STPP) and Dispersant N6, a low molecular weight anionic poly-acrylamide polymer. The effect of process parameters pulp density, types of reagents and their dosage on the separation index following dispersion was studied. The selective flocculation studies were carried out on fully dispersed slime sample using modified starch and polyethylene oxide as selective flocculant. The results show that about 95% recovery could be achieved through the separation following dispersion with the enhancement of Fe grade from 1.5 wt. % to 2 wt. %. http://eprints.nmlindia.org/2409/

Mehta, K D and Das, Chitrangada and Kumar, Rakesh and Pandey, B D and Mehrotra, S P (2010) *Effect of mechano-chemical activation on bioleaching of Indian Ocean nodules by a fungus.* Minerals Engineering, 23 . pp. 1207-1212.

The effect of mechano-chemical activation of Indian sea nodules, while recording the zeta potential, particle size distribution and surface area, on the bio-dissolution of metals by Aspergillus niger has been investigated. Activation is a term used to indicate what takes place when increasing grinding time does not result in

significant change in particle size but rather results in the accumulation of energy that may lead to the development of lattice defects within the particles that can aid biological attack. It was observed that the mechano-chemical activation improved the bio-dissolution of metals such as copper, nickel and cobalt from the sea nodules at initial pH in the range 4.0–5.0. With 10 min milling of particles of 75 μm size, 86% material was reduced to 10 μm size with a change in zeta potential from −18 to −34 mV. Above 95% copper, nickel and cobalt each was leached out in 15 days time from the nodules activated for 10 min at 5% (w/v) PD and 35 °C temperature with initial pH of 4.5; the biorecovery being almost similar when the material was activated for 30 min. In the case of nodules without activation, 89% metal bioleaching was achieved in 25 days time at an initial pH of 4.5 under this condition. The mechano-chemical activation of sea nodules has thus influenced the bio-dissolution process, while providing a wider pH range available for processing of nodules with the involvement of organic acids such as oxalic and citric generated from the fungus. http://eprints.nmlindia.org/1975/

Manju, M S and Savithri, S (2010) *Three dimensional cfd simulation of pneumatic coal injection in a direct reduction rotary kiln.* In: Proceedings of the XI International Seminar on Mineral Processing Technology (MPT-2010), Dec 2010, NML Jamshedpur, India.

The pneumatic coal injection and combustion process in a commercial rotary kiln is modeled in this work using a two phase flow theory approach. The physical and chemical phenomena of the turbulent reacting flow is simulated using a multiphase Eulerian-Lagrangian CFD approach where the gas phase is treated as a continuous phase and the pulverized coal particles are tracked in the flow field in a Lagrangian way. Three-dimensional, steady-state Reynolds averaged Navier-Stokes equations closed by the k-ε turbulence model are solved for the turbulent gas flow, including mass, momentum, turbulence kinetic energy, turbulent dissipation rate, enthalpy, and a number of gaseous species mass fractions. All the relevant phenomena like coal devolatilization, homogeneous volatile combustion, heterogeneous char reaction, particle dispersion and radiation are included in the mathematical model proposed in this work and the commercial CFD code ANSYS-CFX 11.0 is used to obtain the numerical results. Effect of various operating parameters such as initial air and particle velocity, and particle size on the distribution of injected particles along the axial length of the kiln and thermal load provided by them has been analyzed. http://eprints.nmlindia.org/2381/

Mehta, K D and Das, Chitrangada and Pandey, B D (2010) *Reductive leaching of valuable metals from indian ocean nodules by bacillus circulans.* In: Proceedings of the XI International Seminar on Mineral Processing Technology (MPT-2010), Dec 2010, NML Jamshedpur, India.

In the present investigation B. circulans, a heterotrophic microorganism has been used for the recovery of copper, nickel and cobalt from Indian Ocean nodules. The

organism after reviving in growth medium and gradual adaption on sea nodules, was used for the bioleaching studies in shake flasks under a range of conditions such as pH, pulp density, particle size of nodules and temperature. The leaching of metals was found to be 92% Cu, 73% Ni, 72% Co, 38% Mn and 17% Fe in 25 days at 5% (w/v) pulp density (PD), 2 pH and 35°C. XRD identification of the leach residue showed the presence of some lower and mixed oxidation phases of manganese and some unaltered iron phases. Surface morphology of the bioleach residue was examined by SEM. The process may be accompanied by direct enzymatic action of bacteria leading to reduction of Mn (IV) to Mn (II) and Fe (III) to Fe (II) releasing the valuable metals from the host lattice for leaching in acidic conditions. http://eprints.nmlindia.org/2606/

Mohanty, Sunati and Nayak, B and Bhattacharyya, K K (2010) *High intensity magnetic separation of iron ore slime and its limitations.* In: Proceedings of the XI International Seminar on Mineral Processing Technology (MPT-2010), Dec 2010, NML Jamshedpur, India.

India is endowed with large reserves of high grade hematitic iron ores. However, steady depletion of these iron ores is now a concern forcing to develop beneficiation strategies to utilize low grade iron ores. In India, iron ores are generally washed to remove the high alumina containing clayey matter. Conventionally, after washing, the lumps are directly fed to blast furnace and the fines are used after agglomerating them into sinter. However, the slimes are being rejected in the tailing ponds. These slimes in most cases contain substantial iron values in the range of 54–58% Fe. Therefore, it is imperative to recover iron values from these slimes because of high demand on the good grade iron ores day-by-day. Also, it is expected that the iron bearing minerals will be in liberated state in the slime because of their fine particle size and will be amenable to beneficiation. National Metallurgical Laboratory is engaged in developing strategies for beneficiating iron ore slimes and during one such beneficiation studies, the slimes were processed through gravity and magnetic methods of separation. The slime under investigation contains Fe 58.64%, SiO2 3.41%, Al2O3 4.85% and LOI 7.57%. The mineralogy of the slime sample though indicated that hematite is the major iron bearing phase, goethite also occurs in substantial quantity. A systematic study on this slime sample using wet high intensity magnetic separation at higher intensities was carried out and the products were analyzed both chemically and mineralogically. The results indicated that stage wise magnetic separation with increasing intensity improves the total iron recovery. However, increasing the intensity over 1.31 Tesla again deteriorates the grade of the product. The results of this investigation are presented in this paper. http://eprints.nmlindia.org/2351/

Onal, Guven and Acarkan, Neset and Bulut, Gulay and Gul, Alim (2010) ***Recovery from complex ore by floatation.*** **In: Proceedings of the XI International Seminar on Mineral Processing Technology (MPT-2010), Dec 2010, NML Jamshedpur, India.**

The lead-zinc ore sample containing 3.45% Pb, 3.15% Zn, 12.2 g/t Au and 256 g/t Ag was subjected to this experimental study and taken from Bolkardağ-Niğde, south eastern part of Anatolia. According to the mineralogical studies, the representative ore sample contains primarily native gold, electrum, native silver, and argentojarosite as gold and silver minerals, cerusite, anglesite, galena, pyromorphite, mimetite and plumbojarosite as lead minerals, smithsonite, hydrozincite, hemimorphite, adamite and sphalerite as zinc minerals, limonite, hematite, goethite, pyrite, magnetite and siderite as lead minerals and quartz, feldspar, albite and muscovite as gangue minerals. Beneficiation of complex lead and zinc ore was investigated using flotation method. Various parameters such as particle size, flotation stages, collector type, collector amount, control reagents were investigated to recover of gold and silver bearing minerals. At the end of the experimental studies, the flotation experiments performed with Aero 208 + Aerophine 3418 A (350 + 350 g/t) collectors at pH 4.5 gave the best result. –38 microns particle size and 1000 g/t of Na2SiO3 as depressant were used at these conditions. At the end of the experiments, a process was designed for evaluation of the ore. According to the process, a concentrate having 920 g/t Au and 10100 g/t Ag can be obtained with the recoveries of 54.1% and 31.1%, respectively. http://eprints.nmlindia.org/2359/

Pani, Santosh and Dey, Shobhana and Mohanta, M K and Singh, Ratnakar (2010) ***An approach for recovery of iron values from slimes.*** **In: Proceedings of the XI International Seminar on Mineral Processing Technology (MPT-2010), Dec 2010, NML Jamshedpur, India.**

In India iron ores processing industries play a vital role in Indian economy. During washing and processing of iron ores, slimes less than 0.15 mm are generated and discarded into the tailing pond. These slimes need processing as they cannot be used directly in blast furnaces. In the present investigation, typical iron ore slime sample containing 59.22% Fe, 4.76% SiO2 and 4.57% Al2O3 was taken. The desliming operation was carried out by using 2" Mozley hydrocyclone. The process variables used to attain the optimum condition of desliming include spigot opening, feed pressure and diameter of vortex finder maintaining the pulp density at 10% solid. The deslimed sample was treated by different techniques including enhanced gravity separator to achieve iron concentrate with 65% Fe so that it can be used for steel making through pelletization. The yield of the flotation concentrate is about 54% with 65% Fe. To improve the yield, the over flow from 2" hydrocyclone and the rejects from flotation were processed to recover the iron values. The final concentrate is 74% yield with 64.8% Fe, 1.7% SiO2 and 1.8% Al2O3. http://eprints.nmlindia.org/2418/

Prasad, A B Krishna and Ravindran, Indira and Ravi, B P and Haran, N P and Majumdar, A (2010) *Optimization flotation studies on a phosphorite sample from Jhamarkotra, Udaipur district, Rajasthan, India.* In: Proceedings of the XI International Seminar on Mineral Processing Technology (MPT-2010), Dec 2010, NML Jamshedpur, India.

The consumption of sodium oleate collector and depressant phosphoric acid was exceeding the design test values by 30% in a phosphorite flotation plant at Jhamarkotra. Extensive flotation tests on typical mill feed sample (High pressure roll crusher—screen circuit) were conducted using plant's reagents simulating plant conditions. Controlled closed circuit grinding minimizing slimes generation, thick pulp conditioning with just starvation dosages of sodium oleate collector in bulk flotation of phosphates and carbonates, intensive thick pulp conditioning with phosphoric acid for selective depression of phosphates from collector coated alkaline earth salt minerals at pH 5, followed by differential flotation of carbonates were found to be critical, for process selectivity and reduction in dosages of sodium oleate and phosphoric acid by 60 and 30% respectively. Concentrate assaying >32% P2O5, with >80% P2O5 distribution meeting specification was obtained with 0.34Kg/t sodium oleate, 4.3Kg/t phosphoric acid and 10 Kg/t sulphuric acid simulating the plant flow sheet, for adaptability in the plant. http://eprints.nmlindia.org/2433/

Raghu Kumar, C and Tripathy, Sunil Kumar and Mohanan, Srijith and Venugopalan, T and Suresh, N (2010) *Evaluation of floatex density separator performance using silica sand.* In: Proceedings of the XI International Seminar on Mineral Processing Technology (MPT-2010), Dec 2010, NML Jamshedpur, India.

The Floatex Density Separator (FDS) is an enhanced hydraulic classifier which utilises both size and specific gravity for the particle classification. In the present investigation, effect of process variables such as teeter water flow rate, set point, and feed rate on performance of FDS in terms of yield to underflow, cut size (D50), separation efficiency (Ep) has been evaluated and discussed. It is observed from the studies that teeter water has more pronounced effect on yield to underflow and cut size where as separation efficiency is more influenced by the set point. http://eprints.nmlindia.org/2430/

Rajak, K K and Yadav, B K and Mandal, R B and Saxena, V K and Mandre, N R (2010) *Bio-desulphurization of makum (Assam) coal.* In: Proceedings of the XI International Seminar on Mineral Processing Technology (MPT-2010), Dec 2010, NML Jamshedpur, India.

In the present study an attempt has been made to carry out investigation on bio-desulphurization of high sulphur coal. For this purpose, coal containing high sulphur has been obtained from Makum area of Assam. Initially, the samples received were subjected for detailed characterization studies including proximate and ultimate

analysis to ascertain various constituents such as C, H, N, S, ash percentage and moisture content etc. Further, the experiments were carried out to study the desulphurization using a bioreactor for a period of 15 days at 32°C with initial pH 2.5 in presence of thermophilic microbes. During the studies different parameter such as variation of pH, reduction of sulphur, ash and nitrogen were analysed. From the studies it was possible to reduce 53.64% Ash, 42.15% Nitrogen and 8.62% Sulphur over a period of 15 days. http://eprints.nmlindia.org/2608/

Rama Murthy, Y and Rao, Chenna B and Kapure, Gajanan and Tathavadkar, V (2010) ***New prospective for the utilisation of Indian lateritic chromite overburden.*** **In: Proceedings of the XI International Seminar on Mineral Processing Technology (MPT-2010), Dec 2010, NML Jamshedpur, India.**

Nickel laterites form ~75% of known nickel resources whereas majority of nickel is produced from sulphide sources. Nickel bearing laterite and chromitiferous overburden are the only source of nickel available in India. In India, 5,000,000T of such overburden is generated each year in addition to the 140,000,000T that has already been accumulated over several years of mining and it is estimated to increase with the consumption of chrome ore. With the depletion of sulphide deposits and for the future supply of nickel, the industry must develop for the utilization of laterite ore bodies, especially limonite deposits. In this study, the recovery of nickel associated within the goethite was attempted by employing combination of physical and pyro-metallurgical route from the lateritic ore received from Sukinda region of India. The rejects of the beneficiation process contains chromite which can be used as a feed for the ferro chrome plants. Through physical beneficiation the iron enrichment achieved was 52.74% with a weight percent recovery of 59.67% having Ni-0.9% from the feed assaying 46.73% Fe (T), 0.76% Ni. This beneficiated overburden was used as a feed for the production of pig iron nuggets. Composite pellets of overburden containing lime and coal were reduced at 1400°C for the production alloy pig iron nuggets. The nuggets produced from this route contain C~ 3%, Ni~1.7%, Cr~1.5% and Fe-Rest. Recoveries of iron, chromium and nickel are >95%, >95% and ~30%, respectively. http://eprints.nmlindia.org/2349/

Rao, B Ashwath and Kumar, Abhishek and Sinha, S N (2010) ***A study of froth flotation of coal using artificial neural networks.*** **In: Proceedings of the XI International Seminar on Mineral Processing Technology (MPT-2010), Dec 2010, NML Jamshedpur, India.**

Froth flotation has been widely used in concentration of few ores and Coals. Artificial Neural Networks (ANNs) based on models inspired by our understanding of the structure and function of the biological neural networks hold the key to the success of solving intelligent tasks by machines. A comparative study of various artificial neural networks for the efficient concentration of coal in froth floatation method is discussed. The main difficulty in each of the pattern recognition techniques is that of

choosing an appropriate model and selecting appropriate parameters for the concentration process. The parameters used in computing chosen from a pool of available parameters so that the stability and convergence of the network is achieved with minimum effort. It must also be possible to determine the parameters with minimum cost at a speedy rate. This paper touches on models for activation and synaptic dynamics in each of the feed forward artificial neural networks. The feedforward network structure is found to be suitable for this pattern classification task as this structure supports mapping input parameter set to an output pattern. Samples of training and test data are taken and the network is trained on the training data. By computing the output for input test data in various networks, the effectiveness of various networks is analyzed. http://eprints.nmlindia.org/2376/

Rao, K Eswara and Ramesh, M and Suresh, K and Krishna, V Rama and Rao, D V Subba and Chaudhuri, S and Chattopadhyay, U S and Sharma, K K and Gouri Charan, T and Haldar, D D (2010) ***Laboratory flotation studies of imported coking coal fines.*** **In: Proceedings of the XI International Seminar on Mineral Processing Technology (MPT-2010), Dec 2010, NML Jamshedpur, India.**

India is importing coking coal from various countries mainly to cater the needs of various industries. One of the supplies from Khazikistan having good coking coal reserves are yet to be fully exploited. Froth flotation studies were carried out on the coal fines generated by crushing the ROM coal to 50 mm. Froth flotation tests were performed with standard dosages on raw coal fines and also on the different size fractions. This article describes the flotation characteristics of a typical coking coal from the coalfields of Khazikistan aiming at 10% ash level in the clean coal. Laboratory flotation tests were used to determine the yield of clean coal of 77% at 10% ash content. The coking propensities of the clean coal strongly support its use as blendable coal for the metallurgical purposes. http://eprints.nmlindia.org/2390/

Rao, K Hanumantha (2010) ***Revisiting sulphide mineral flotation: a few priorities and directions.*** **In: Proceedings of the XI International Seminar on Mineral Processing Technology (MPT-2010), Dec 2010, NML Jamshedpur, India.**

Scientists and technologists in world over are making large efforts to streamline the conventional technological schemes of ore processing, in particular froth flotation towards reducing overall costs, limiting the use of dangerous substances, decreasing waste streams and improving waste disposal. Hitherto, search for such innovations has been performed mainly empirically and there is an urgent need to shift these technologies to be more innovative and effective. Understanding of the fundamental concepts of aquatic chemistry of minerals–selective adsorption and selective redox reactions at mineral–solution interfaces would impact innovating conventional flotation process. Molecular-level knowledge and coherent understanding of minerals contacted with aqueous solutions is required which underlie great opportunities in controlling mineral–solution interfaces towards the grand challenge of tomorrow's science and mineral processing technology.

Aqueous redox chemistry of sulphides and adsorption mechanisms, the problems of metal sulphides selectivity against pyrite and fine particle flotation have been highlighted and discussed in the light of literature. The requisite knowledge and research needs to address these issues have also been briefly presented. http://eprints.nmlindia.org/2598/

Rao, M S and Ram, Mohan and Gundewar, C S (2010) *Process development for recovery of chromite values from COB plant tailing samples collected from various operating plants in Sukinda.* In: Proceedings of the XI International Seminar on Mineral Processing Technology (MPT-2010), Dec 2010, NML Jamshedpur, India.

India has reserves of chromite around 213 million tonnes located in the regions of Orissa, Bihar, Karnataka, Maharashtra and Tamil Nadu where Orissa contributed the largest share distributed in three districts mainly Jajpur, Cuttack and Keonjhar. There are 34 beneficiation plants put up in the country out of which six are captive and twenty eight are non-captive beneficiation plants. The general beneficiation process adopted by Indian Chrome ore beneficiation plant is gravity separation techniques like Floatex density separation, spiraling, hydrocycloning, tabling, etc. The plant tailings in most of COB plants in India is around 40% of ROM treated. These tailings contain lot of chromite values in fine form due to friable nature of chromite. Taking into consideration the importance of recovering valued chromite from fine tailing and their environmental impact as generation of this fines is of huge quantities generated by Indian COB plants, the Ore Dressing Division of Indian Bureau of Mines, Nagpur, conducted detailed mineralogical characterization studies on these plant tailing samples. Based on the characterization studies a beneficiation process route was evolved by deploying various equipments like conventional cyclones, stub cyclones, floatex density separator, etc. for improving the recovery of fine chromite concentrate from plant tailings of operating plants in Sukinda. http://eprints.nmlindia.org/2354/

Rath, R K and Mohanty, S and Mohanta, M K and Singh, Ratnakar and Bhattacharyya, K K (2010) *Efficacy of enhanced gravity separator in processing indian iron ore slime.* In: Proceedings of the XI International Seminar on Mineral Processing Technology (MPT-2010), Dec 2010, NML Jamshedpur, India.

The slime sample was subjected to concentration using Falcon concentrator for their enrichment. The effects of three important variables, eg bowl rotation frequency, back water fl ow rate and per cent solid were studied on the process performance. Increasing the rotation of the Falcon bowl, enable more material to the underflow by increasing the yield, whereas, the iron content decreases steadily with increasing the rotation of the bowl. The increase in the back water flow effectively removes the clay materials from the underflow at the expense of the yield. Similarly, increasing the per cent solid concentration in the feed produces a better product both in terms

of yield and Fe content. Results show that EGS/Falcon can be used for processing Indian iron ore slime and producing pellet grade concentrate. http://eprints.nmlindia.org/4273/

Rath, R K and Mohanty, Sunati and Mohanta, M K and Singh, Ratnakar and Bhattacharyya, K K (2010) *Enhanced gravity separator in processing Indian iron ore slime.* In: Proceedings of the XI International Seminar on Mineral Processing Technology (MPT-2010), Dec 2010, NML Jamshedpur, India.

The present practice of beneficiation of iron ores in India produces lumpy ores (for blast furnace), classifier fines (for sinter plant) and slimes (Below 150 mm) which are stored in tailings pond. the estimated generation of slimes is 10-25% of the iron ore mined amounting to 18 million tonnes per year. Besides the loss of iron ore mined amounting to 18 million tonnes per year. Besides the loss of iron values, it poses environmental hazard. From resource management view point and also from environmental management view point, processing of the slime is inevitable. In the present paper, the slime sample was subjected to concentration using enhanced gravity separator such as Falcon concentrator for its enrichment. The effects of major important variables e.g., bowl rotation frequency; back water flow rate, % solid and mesh of grind of feed sample were studied on the process performance. increasing the rotation frequency of the Falcon bowl, enable more material to the underflow by increasing the yield, whereas, the iron content decreases steadily. The increase in the back water flow effectively removes the clay materials from the underflow at the expense of the yield. Similarly, increasing the % solid concentration in the feed produces a product marginal higher yield with decrease in Fe content. With increase in mesh of grind of the feed sample, Falcon produced a better grade concentrate at the expense of the yield due to better liberation at the finer size. Results show that EGS/Falcon can be used for processing Indian iron ore slime and producing pellet grade concentrate. http://eprints.nmlindia.org/4275/

Rath, R K and Mohanty, Sunati and Singh, Ratnakar and Nayak, B and Bhattacharyya, K K (2010) *Beneficiation response of a low grade iron ore from eastern India for the production of sinter and pellet feed.* In: Proceedings of the XI International Seminar on Mineral Processing Technology (MPT-2010), Dec 2010, NML Jamshedpur, India.

Iron ore quality in India over the period of time, is getting lesser and less in iron content due to continual increase in consumption of good grade ores. There is an urgent need to look for the use of low grade iron ores to meet the current demand. In the present paper, beneficiation response of a low grade iron ore from Eastern India for the production of sinter and pellet feed has been investigated. 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. However, below 300 µm the liberation suddenly

improves reaching about 70% below the size fraction 250 µm and about 80% liberation is achieved below 150 µm. Keeping in mind to produce sinter fines, the ROM material was stage crushed to pass 6.3 mm and the product was subjected to washing, scrubbing followed by screening. Beneficiation studies such as jigging, tabling and WHIMS were carried out on different screened products and results are discussed. A total of ~28% with Fe > 65% sinter material and 50% with Fe > 64.5% pellet material could be achieved from low grade iron ore using the present flowsheet. http://eprints.nmlindia.org/2352/

Sah, Rakesh and Dey, S K and Vidyadhar, A and Das, Avimanyu (2010) ***Investigation on the applicability of advanced gravity separation for cleaning semi coking coal fines.*** **In: Proceedings of the XI International Seminar on Mineral Processing Technology (MPT-2010), Dec 2010, NML Jamshedpur, India.**

The beneficiation of fine coal from Kuju area in a teeter bed separator has been studied in the present investigation. This coal is of particular interest in view of the fact that it is a high ash, semi-coking coal and the clean coal can be used as metallurgical coal after blending with coking coal. The ash content of the feed coal is 36%. Only 4% of the material is less than 150 micron while nearly 60% of the material is larger than 0.5 mm. The washability characteristics indicate that the coal may be a good candidate for beneficiation using gravity methods in spite of a high ash level. Nearly 40% yield is possible theoretically at a target product ash of 15% using gravity separation. A set of 29 experiments was performed in floatex density separator (FDS) according to the Box-Behnken design of experiments to establish the influence of operating variables such as teeter water flow rate, bed pressure, feed flow rate and pulp density on the separation performance. A target product ash of 23% was used for this feed coal in a single stage cleaning. The performance was characterized in terms of the mass yield of clean coal and its grade (ash content). It was observed that at a higher bed pressure and higher teeter water the grade was poorer due to increase in the suspension density. The optimum conditions for maximum yield were observed at 5.41 KPa of bed pressure, 15 lpm of teeter water flow rate, 80 kg/hr of feed rate and 29.7% solids in the feed pulp. The maximum mass yield at the optimum conditions was found to be 64.3% in a single stage cleaning in the FDS. The cut point density was observed to be 1.57 at the optimum conditions. The applicability of the FDS for physical beneficiation of this coal sample has been established. A second stage of cleaning in the FDS or another unit operation would bring the ash level down to 17% for blending with metallurgical coal and use in the blast furnace. http://eprints.nmlindia.org/2402/

Sahu, B K (2010) ***Optimal liberation of ore minerals for ore beneficiation.*** **In: Proceedings of the XI International Seminar on Mineral Processing Technology (MPT-2010), Dec 2010, NML Jamshedpur, India.**

Ore minerals are normally complexly interlocked with adjacent gangue and/or ore minerals in most ores. Optimal liberation of ore minerals is essential for low-grade ores, so that maximal profits can be made by marketing such beneficiated ores by removing gangues after crushing these ores. Cost minimization for liberation is useful to achieve maximum profit for beneficiated ores through recovering as much ore minerals (in weight fraction) as feasible using statistical size distributions of ore minerals and gangue minerals, separately. Ore and gangue minerals are usually having log-normal size distributions, in 3D space, on weight frequency basis which have different (size) means and (size) variances as well as different weight proportions (fractions) in the ores. However, since the price of marketable ores is often several times (or several tens/hundreds of times) that of the crushing cost for liberation, optimal crushing size is calculable from the actual size distributions of ore and gangue minerals in the ore. But, the measured sizes (circle radii or semi-intercepts) in 2D on thin/polished sections are not the true size distributions of ore and gangue minerals on weight basis in 3D space, and thus probabilistic corrections as proposed by author[1–3] and transformation of corrected number frequency moments to equivalent 3D sphere size moments on weight frequency basis[1–3] are essential to compute the true optimal libration size (on weight basis) for crushing the ores for ore beneficiation purposes. http://eprints.nmlindia.org/2276/

Sen, P K (2010) *Exergy analysis of mineral processing flow sheets: implications in process design.* In: Proceedings of the XI International Seminar on Mineral Processing Technology (MPT-2010), Dec 2010, NML Jamshedpur, India.

Exergy analysis can be used to assess and improve energy systems through more meaningful system analysis than a simple energy balance. Mineral processing operations including both physical and chemical pre-concentration stages have not generally been subjected to rigorous exergy analysis procedures. Standard thermodynamic software such as Factsage is used for easy estimation of exergy of a mineral resource. The methodology developed has been validated. Stream calculation procedures have been outlined. The application of the developed procedure is illustrated by two types of processing flow sheets, namely those applying standard crushing-grinding-beneficiation concepts (copper, iron and zinc) and those which deal with chemical beneficiation (alumina). Copper ore beneficiation flow sheets are more efficient than upstream processing of the concentrate. For iron ores, the processing flow sheets should be so designed to further increase the high exergetic efficiencies through waste stream reductions. Chemical beneficiation of alumina ores needs major improvement of exergy efficiencies. It is emphasized that in process dissipation exergy and the exergy discharge loss have different influences on the environment. This should be duly considered in flow sheet design in addition to development of exergy accounting procedures. http://eprints.nmlindia.org/4124

Sengupta, A K and Banerjee, T H and Ram, Mohan (2010) *Beneficiation of iron ore fines from mine rejects.* In: Proceedings of the XI International Seminar on Mineral Processing Technology (MPT-2010), Dec 2010, NML Jamshedpur, India.

Katni area in M.P. is bestowed with some of the sporadic iron ore deposits akin to blue dust. These deposits are invariably associated with highly weathered schist and BHQ (Banded Hematite Quartzite) formations. Both these formation encounter concentrated and thick pockets of iron ore fines assaying in the range of 60 to 63% Fe (T) which are selectively mined and sold to various industries in the country. However, the intervening thinner and leaner mineralized zone having contamination of host rock and assaying in the range of 50 to 55% Fe (T) are dumped/ stacked separately at the mine site on account of lack of market. Lot of iron values are locked up in these reject dumps stacked over the years and is causing huge environmental problem of air and water pollution, thereby resulting in silting of fields in the near vicinity of mine area. Characterization of such mine rejects revealed that extensive weathering makes the deposits very soft and fragile and susceptible to produce extreme fine grained dusty material. The textural disposition of the available minerals i.e., hematite and its associated silicate gangue, are extremely fine grained where 60 to 70% of fines falls below 75 μm (remaining below 20 μm). Recovery of valuables from such fine size materials is evolved at minus 30 mesh (0.5 mm) size using hydro-cyclone and/or stub cyclone followed by WLIMS. The process route produced marketable grade iron concentrates from both the formations (BHQ and Schist) assaying +63% Fe (T) with 75 to 90% Fe recovery (%Wt. yield 75 to 80) and 65% Fe with 80% iron recovery (%Wt. yield 69.0) in Schist formation alone. The evolved flow-sheets are simple and cost effective and paved the way for the recovery of iron values from the dump rejects of both BHQ and Schist formations. One lessee has commercialized the process developed by IBM. http://eprints.nmlindia.org/2406/

Sharma, Abhishek and Rai, Nandani (2010) *Effect of burnt lime addition on sintering of iron ore fines.* In: Proceedings of the XI International Seminar on Mineral Processing Technology (MPT-2010), Dec 2010, NML Jamshedpur, India.

In the worldwide iron making industry, sinter constitutes the major component in the metallic burden of most of the blast furnaces as it has numerous properties which lead to reduced coke rate, increased productivity, better heat transfer and permeability, elimination of raw flux, narrowing of softening and melting zones and better quality of hot metal. The sintering process is greatly influenced by the physico-chemical properties of raw materials used, whose characteristics change from time to time. Earlier, industrial trails were carried out to test, develop, evaluate and improve various operational parameters of the sintering process. However, due to frequent change in the raw material characteristics and proportioning such evaluations become more complex and pilot scale sintering studies have become more popular. Moreover, cost and time involved, along with less precision, do not

often permit industrial experiments. In Bhilai Steel Plant, Steel Authority of India Limited, a pilot sintering unit has been established in order to conduct experiments for subsequent application in industrial sinter manufacturing. Studies were taken up to assess the effect of burnt lime addition in sinter-mix on sintering process of iron ore fines. The results found have been encouraging with significant increase in productivity. http://eprints.nmlindia.org/2486/

Sharma, Mamta and Singh, A K and Choudhury, Nandita and Bhattacharyya, K K (2010) *Petrography of beneficiated heat altered coals from damodar valley coalfields, India.* In: Proceedings of the XI International Seminar on Mineral Processing Technology (MPT-2010), Dec 2010, NML Jamshedpur, India.

In Indian coalfields huge amount of naturally baked coals occur in various parts of the country and do not find judicious utilization potential in industries due to heterogeneously intermixed mineral matters with organic matrix. The macerals and their heat altered products occur in the form of isotropic and anisotropic carbons in association of some proportions of partially unaltered macerals. This ratio changes in different seams based on quality of original coal, tectonic conditions and pressure-temperature conditions prevailing in the coal seams during magma induration in the form of concordant sills and discordant dykes. In the present paper two case studies have been presented having different types of parent coals to observe the potential of beneficiation techniques for liberation of mineral matters and different carbon forms. In one case study Burragarh colliery in Jharia Coalfield having coking coal derived natural cokes and in another case samples were drawn from Damagoria colliery, which inhabits semi-coking coals. In the washed fractions at 50,25,13,06,03,0.5 mm at specific gravities 1.40 to 2.0, detailed petrographic studies including microtextures and microstructures were carried. Yield of washed coals and contents of macerals in both the case studies were found different. As a result their industrial utilization potential is also different. http://eprints.nmlindia.org/2284/

Shukla, S and Bhunia, Kamalendu and Kundu, G and Mukherjee, D (2010) *Study of liquid phase mixing characteristics in flotation column.* In: Proceedings of the XI International Seminar on Mineral Processing Technology (MPT-2010), Dec 2010, NML Jamshedpur, India.

The column flotation cell is widely used for beneficiation of coal fines and other minerals where recovery of the product is linked to the process kinetics which in turn depends on mixing characteristics of the cell. Present work is undertaken to study the effect of various process variables on liquid phase residence time distribution using coal fines. In addition with the help of published data a generalized correlation to predict the effect of various operating variables on column mixing characteristics has been developed. The correlation shows better fit than previously published correlations. http://eprints.nmlindia.org/2361/

Singh, K M P and Udayabhanu, G and Gouri Charan, T and Haldar, D D (2010) ***Flocculation studies on non-coking coal fines using suitable reagents.*** **In: Proceedings of the XI International Seminar on Mineral Processing Technology (MPT-2010), Dec 2010, NML Jamshedpur, India.**

Presently, in India about 120 million tonnes of non coking coals are being washed annually to cater the needs of various user industries. The coal washeries generate coal fines about 10 to 15% of the feed coal and these fines create various problems like settling in thickeners, water pollution, etc. The non-coking coal fines are normally not beneficiated and these are recovered by thickening with the help of flocculants of different trade names to achieve clarified water for recycle/reuse. There is lack of systematic studies on the effect of flocculants, its types and dosages etc, on settling rate, turbidity etc. Attempts have been made in the present paper to highlight these effects of flocculants on the sedimentation rate etc. http://eprints.nmlindia.org/2366/

Sinha, K M K and Sharma, T and Haldar, D D (2010) ***Effect of ash of raw and beneficiated coal as well as operating variables on gasification process.*** **Proceedings of the XI International Seminar on Mineral Processing Technology (MPT-2010), 1 (Section 6). pp. 498-501.**

Coal is a major source of energy. It accounts for 23% of primary energy production and 39% of electricity generated in the world. India is blessed with a lot of coal around 277 Bt which is a cheap and abundant resource but the associated mineral matter creates problem during combustion by generating air and soil pollutants. The problem may largely be reduced by adopting an alternative route i.e. gasification of coal which produces syngas comprising carbon monoxide and hydrogen, may be used for generating power, making steel, chemicals, liquid fuels, fertilizers etc. In this paper, gasification kinetic studies have been made using high ash raw as well as beneficiated coal having different ash percentages by changing operating variables viz. flow rate of gasifying agent, time and temperature. On the basis of experimental results, a regression model has been developed to predict the gasification performance. http://eprints.nmlindia.org/2398/

Sinha, Manish K and Sahu, S K and Meshram, Pratima and Pandey, B D and Kumar, Vinay (2010) ***Extractive separation and recovery of hydrochloric acid and iron values from spent pickle liquor.*** **In: XI International Seminar on Mineral Processing Technology (MPT-2010), 15 - 17 December, 2010, NML, Jamshedpur.**

The present study deals with the solvent extraction of hydrochloric acid from spent pickle liquor with two branched chain isomers of tertiary alkyl amine, viz. tri-iso-octyl amine (TiOA) and tris(2-ethylhexyl) amine (TEHA), in absence and presence of di 2-ethylhexyl phosphoric acid (HDEHP) and recovery iron from acid free pickle liquor by solvent extraction with Versatic 10 acid as extractant in kerosene. Extraction of hydrochloric acid increased with the increase in extractant

concentration, and the acid extracted into the organic phase appears to be associated with one mole of extractant in each cases. The Mc-Cabe Thiele plot indicated that the complete extraction of acid can be achieved in a single and two stages at a phase ratio of O/A = 2.5:1 and 3:1 with 50% TiOA and TEHA, respectively. Whereas in presence of HDEHP the complete extraction of hydrochloric acid achieved in three stages at phase ratio of O/A=5:1. The acid loaded into TEHA + HDEHP and TiOA + HDEHP could be easily stripped with water, whereas the stripping efficiency of the loaded TiOA and TEHA was poor with water. The reason for easy stripping of acid in presence of HDEHP has also been discussed. From acid free raffinate upto 80% iron was extracted using 30% Versatic 10 acid at a phase ratio of O/A=5:1. McCabe Thiele plot for iron showed that iron can be completely recovered in three stages with 30% Versatic 10 acid at a phase ratio of O/A=3.5:1. Loaded iron in the organic phase was easily stripped with dilute sulfuric acid.

http://eprints.nmlindia.org/2310/

Sontakkey, V A and Rao, M S and Ram, Mohan (2010) ***Development of simple process flowsheet for a silica sand sample to produce high grade silica sand concentrate from Ratnagiri district, Maharashtra.*** **In: Proceedings of the XI International Seminar on Mineral Processing Technology (MPT-2010), Dec 2010, NML Jamshedpur, India.**

The production of silica sand in India is 3921 thousand tonnes. Andhra Pradesh, the leading producer accounted for 55% production followed by Rajasthan, Maharashtra and Gujarat. Since last few years due to market trend and more demand in domestic industries like glass, ferro-silicon, iron and steel, refractory, foundry, ceramic, etc. there is steep increase in the production of silica sand (rise of about 48% in production was reported from that of previous year). Iron being the most deleterious element in glass manufacturing industry, attempts were made on a high iron bearing silica sand sample with a view to reduce the Fe2O3 content to ≤0.04% with maximum SiO2 recovery. The Ore Dressing Division of Indian Bureau of Mines, Nagpur conducted a detailed study on the sample and a simple eco-friendly beneficiation process route was evolved by deploying various equipments like attrition scrubber, vibrating screen (wet), magnetic separator, etc. The silica sand sample studied from Ratnagiri region contained mostly quartz as the principal valuable mineral, other minerals present in the sample in minor to trace amounts are mica, amphibole, tourmaline, rutile, iron oxides, zircon and feldspar. The sample assayed 98.312% SiO2, 0.28% Fe2O3, 0.028% TiO2, 0.61% Al2O3, 79 ppm Cr2O3, 0.023% CaO, 0.01% MgO, 0.077% K2O and 0.23% LOI. On wet screening cum attrition scrubbing of –30 mesh fraction followed by magnetic separation of deslimed sand (–30+100 mesh) fraction produced a silica sand concentrate (non-mag) assaying 99.42% SiO2, 0.042% Fe2O3 with wt.% yield 86.4. This concentrate confirms to the specification for Grade I silica sand for use in glass making.

http://eprints.nmlindia.org/2346/

Sriamoju, S K and Suresh, A and Lingam, R K and Ray, Tathagata and Dash, P S and Banerjee, P K (2010) *Determination of diffusion coefficient for coal leaching process.* In: Proceedings of the XI International Seminar on Mineral Processing Technology (MPT-2010), Dec 2010, NML Jamshedpur, India.

Coal leaching process has tremendous applications in the field of thermal and metallurgical industries. Coal leaching with alkaline solution removes silica, alumina and other acidic, ash bearing minerals present in the coal. Leaching with caustic soda has a better effect on the leaching process. In order to improve the leaching kinetics, development of the reaction kinetics is required. Indian coals are of drift origin and the mineral matter present in the coal is embedded inside the organic matter and hence, leaching is reaction controlled followed by diffusion controlled process. For studying the kinetics of the process, shrinking core model was adopted. Coal leaching kinetics at different alkali concentration was studied and diffusion coefficient is determined at room temperature. By using parametric estimation method, diffusion coefficient value obtained (DAe) is 1.2 × 10–10 m2/min and the silica and alumina rate constants are 4 × 10–6 mol/m2.min and 8 × 10–6 mol/m2.min respectively for the leaching of coal with 10% (w/w) caustic solution. http://eprints.nmlindia.org/2392/

Subramanian, S and Chockalingam, Evvie and Braun, J J (2010) *Studies on acid production potential of mine tailings and bioremediation of acid mine water from an abandoned indian copper mine.* In: Proceedings of the XI International Seminar on Mineral Processing Technology (MPT-2010), Dec 2010, NML Jamshedpur, India.

Acid Mine Drainage (AMD) is a perennial problem particularly in abandoned mines, occurring due to the oxidation of sulphidic mine wastes. AMD is usually characterized by high concentration of dissolved metal ions, sulphate and low pH. The acid production potential of a typical copper mine tailings has been determined. The efficacies of substrates such as the bark of Eucalyptus tereticornis (Sm.) and red mud are assessed for the removal of metal ions such as iron, zinc and copper from acid mine water obtained from an abandoned copper mine. With respect to tree bark as an adsorbent, about 96% of Fe, 75% of Zn and 92% of Cu could be removed from the acid mine water with an attendant increase in the pH value by two units. Almost complete removal of Fe2+ (98%), Fe3+ (99%) and Cu2+ (97%) and a significant removal of Zn2+ (84%) was achieved from acid mine water at pH 2.3 using red mud. A noteworthy feature was the concomitant increase in pH from 2.3 to 7.6 with the increase in red mud loading under appropriate conditions. The free energy of adsorption of the metal ions onto tree bark and red mud is found to be negative in both the cases, while the adsorption process is exothermic for tree bark and endothermic in nature for red mud. The adsorption process is found to adhere to the Lagergren pseudo-first order rate equation. The filtrate obtained after treatment of red mud with synthetic acid mine water supplemented with carbon and nitrogen sources served as a successful growth medium for the sulphate reducing bacteria namely Desulfotomaculum nigrificans (Dsm. nigrificans) and facilitated sulphate

reduction. The possible mechanisms of metal ion and sulphate removal from acid mine water using tree bark and red mud are discussed.

http://eprints.nmlindia.org/2601/

Suresh, A and Ray, T and Dash, Pratik S. and Banerjee, P K (2010) *Coke property prediction from coal blend properties using ANFIS model.* In: Proceedings of the XI International Seminar on Mineral Processing Technology (MPT-2010), Dec 2010, NML Jamshedpur, India.

The present study is aimed to fulfill the need of a model which will predict the coke properties from coal blend characteristics so that optimisation of coal blends for producing desired quality of stamp charged coke can be achieved with lesser number of carbonisation tests. In this work, the functional relationship between the coal blend properties (ash, volatile matter, average vitrinite reflectance, crucible swelling number, total reactives, vitrinite distribution (V9-V13) and Basicity Index) and the corresponding coke properties such as coke strength after reaction (CSR) and Coke Reactivity Index (CRI) have been mapped using a non-linear system identification technique namely, Adaptive Network-based Fuzzy Inference System (ANFIS). The model has been trained and tested with the help of 67 number of experimental data sets produced using 7 kg carbolite test oven. It has been found that the developed ANFIS model successfully predicts the CSR and CRI. Also the effect of the number of fuzzy rules (M) on the model performance has been investigated to predict the properties and to correlate the above relationship. The developed model could be applied in the area of coal blend design.

http://eprints.nmlindia.org/2378/

Tripathi, Avinash and Agrawal, Ashish and Gupta, V K (2010) *Development of a mathematical model for simulation of coal crushing in a Hammer mill.* In: Proceedings of the XI International Seminar on Mineral Processing Technology (MPT-2010), Dec 2010, NML Jamshedpur, India.

Using the basic size-mass balance size reduction model for a continuous crushing operation and invoking the concept of a perfectly mixed system, a mathematical relationship has been obtained between the feed and product size distributions for a hammer mill. The model parameters 'breakage distribution function' for different size fractions of a Prime Coking Coal and an imported coal were determined by conducting appropriate tests in a laboratory hammer mill. Using data generated in the Rourkela Steel Plant on a Production hammer mill, variation of the second set of model parameters, 'absolute rate of breakage of particles of each size class', with coal feed rate to the mill was established. Analysis of the data generated in the plant has shown that only +10 mm particles of the imported coal broke faster than the PCC particles of the same size. The developed mathematical model can be used to stimulate the performance of the crushing plant in respect of the effect of feed size distribution and feed rate, and for taking control action for keeping the product

fineness constant by adjusting the coal feed rate to the hammer mill. http://eprints.nmlindia.org/2377/

Tripathy, Sunil Kumar and Ramamurthy, Y and Sahu, G P and Panda, Lopamudra and Singh, Virendra and Tathavadkar, V (2010) ***Influence of shaking table process parameters on concentration of chromite plant tailings.*** **In: Proceedings of the XI International Seminar on Mineral Processing Technology (MPT-2010), Dec 2010, NML Jamshedpur, India.**

Conventional chromite beneficiation plants of India discards large tonnage of chromite values as plant tailing. In the present investigation, a typical chromite beneficiation plant tailing of Sukinda region has investigated by using wet shaking table for the effective utilisation of the natural resource. In this context, the effect of different process variables such as wash water flow rate, deck tilt angle and feed flow rate has analysed. The interactional effects between different process variables has analysed in terms of 3D response surface plots. It was found that the Cr2O3 content has improved to 61.37% from a feed assaying 24.26%. It was envisaged that deck tilt angle has influence major on both grade and recovery of concentrate fraction of shaking table and in case of interactional effects, the interaction between deck tilt angle and feed flow rate has major influence compared to the others. Second order quadratic equations have developed for the prediction of grade and recovery of concentrate fraction of shaking table. http://eprints.nmlindia.org/2358/

Tripathy, Sunil Kumar and Ramamurthy, Y and Sahu, G P and Tathavadkar, V (2010) ***Ultra fine chromite concentration using spiral concentrator.*** **In: Proceedings of the XI International Seminar on Mineral Processing Technology (MPT-2010), Dec 2010, NML Jamshedpur, India.**

The conventional chromite beneficiation circuit utilises spiral concentrator for recovering chromite fines and as its efficiency decreases with respect to the decrease in particle size. Pilot scale studies have been performed to understand the effect of different process parameters which influence the separation of ultra fine chromite fines from a typical plant tailing. The process parameters of spiral concentrator such as feed rate (m3/hr), feed pulp density (% solids by weight) and splitter position (cm) are considered for the study. Splitter position has major influence on both grade and recovery of the concentrate fraction of spiral concentrator. Maximum grade of 48.54% Cr2O3 can be achieved in the concentrate fraction of spiral concentrator with 20.41% Cr2O3 recovery. Performance of spiral concentrator at different combination of process parameters was analysed with 3D surface plots. http://eprints.nmlindia.org/2347/

Vaish, A K and Nayak, B and Goswami, M C and Singh, S D and Singh, D P and Gupta, R C (2010) ***Magnetite ore of nagaland—its mineralogy and reduction***

***kinetics.* In: Proceedings of the XI International Seminar on Mineral Processing Technology (MPT-2010), Dec 2010, NML Jamshedpur, India.**

The magnetite body near Pokphur in the Kiphere district of Nagaland is geologically quite different and a rare type of occurrence associated with ophiolite. Mineralogical studies reveal the presence of magnetite, chromite and hematite followed by goethite, ilmentite, trevorite, pentlandite and millerrite. Magnetite grains are weathered to various degrees and sometimes fractured. Reduction studies indicate that in gas-solid system considerable reduction of magnetite ore takes place in initial 60 minutes, further the rate of reduction becomes slow. In gas-solid system the percentage reduction of magnetite ore is considerably more compared to solid-solid systems. http://eprints.nmlindia.org/2665/

Vidyadhar, A and Singh, A K and Srivastava, A and Nayak, B and Rao, K V and Das, Avimanyu (2010) *Beneficiation of banded hematite quartzite from meghatuburu mine, eastern India.* In: Proceedings of the XI International Seminar on Mineral Processing Technology (MPT-2010), Dec 2010, NML Jamshedpur, India.

The present paper describes the beneficiation of Banded Hematite-Quartzite (BHQ) from Meghatuburu mine, India. In general, BHQ ores contain around 30–38% Fe, 45–50% SiO2 and 1–2% Al2O3 and hence can hardly be used in steel making. However, if they are beneficiated and enriched to around 64% Fe, which is possible only in fine size range, they can be utilized in a pelletization plant. The feed sample assayed 37.52% Fe, 42.23% silica and 0.82% alumina. Microscopic studies reveal that the silica bands contain some hematite and the hematite bands are also not free from silica. It was observed from the liberation data that reasonable degree of liberation is achieved only below 150 micron size. Beneficiation studies using various unit operations such as hydrocyclone, falcon concentrator, Low Intensity Magnetic Separation (LIMS), Wet High Intensity Magnetic Separation (WHIMS) and flotation etc. were carried out to develop a suitable process flowsheet as a step towards the up-gradation of iron values and to reduce the gangue content. The separation techniques were selected based on particle size and properties for effective separation. The developed process flowsheet gives the desired enrichment of the BHQ ore at reasonable yield. Two-stage classification in a hydrocyclone yields a coarse product with 47% Fe with a yield of 75% was obtained. The hydrocyclone overflow contained only about 28% Fe and hence, was rejected. The cyclone underflow was treated in falcon concentrator and a product with 53% Fe was obtained. The falcon underflow was treated in LIMS. The non-magnetic stream from LIMS was treated in WHIMS and a concentrate of about 57.3% Fe with a yield of 32.2% was obtained. Reverse flotation of the WHIMS concentrate was performed using starch as depressant for iron minerals, calcium chloride to activate silica, cationic collector dodecyl amine hydrochloride and MIBC as frother at a pH of 10.5–11.0. Final concentrate of nearly 64% Fe with a yield of 28% was achieved using the developed flowsheet. http://eprints.nmlindia.org/2413/

Vijaya Kumar, T V and Subba Rao, S and Bhaskar Raju, G and Shivakumar, S and Raman, Uma (2010) *Development, testing and plant trails of single reagent system for coal flotation.* In: Proceedings of the XI International Seminar on Mineral Processing Technology (MPT-2010), Dec 2010, NML Jamshedpur, India.

Flotation is an important means of upgrading the fine fraction of raw coal, typically particles finer than 0.5 mm. Due to increased use of highly mechanized mining techniques large quantities of fines (< 0.5 mm) are being generated. These fines presently account for approximately 20–30% of the total plant feed. More than 140 million tones of fine coals are beneficiated by flotation worldwide annually. In coal flotation, reagents are required to enhance the hydrophobicity of coal surface. In addition to hydrophobic character, the selectivity, proper froth structure, stability and less sensitive to water chemistry are important. Water insoluble hydrocarbons are widely used as collectors in coal flotation. These collectors are basically non-polar oils like diesel, kerosene, etc. along with some frothers. Thus, it is necessary to add collector and frother separately in coal flotation. It is generally accepted that in coal flotation a single reagent system is more advantageous than the present practice of two reagent system. National Metallurgical Laboratory is involved in the flotation of coal fines using alternative single collector systems to developed specially replace fuel oils and frothers. For this purpose NML has entered into an agreement with M/s Somu Organo-Chem Pvt. Ltd. (SOCPL) Bangalore, a leading reagent manufacturer. Under this collaboration M/s SOCPL developed reagents and NML evaluated their selectivity index and application in coal flotation. Among many reagents developed and evaluated one best reagent was selected and full scale plant trails were conducted. The paper deals with the results obtained with several reagents in the laboratory and the plant trails.

http://eprints.nmlindia.org/2370/

Ziaja, Dieter and Saraswat, Nikhil and Ognyanova, Albena (2010) *Beneficiation of indian iron ore lumps and fines by using underbed air–pulsated BATAC jigs.* In: Proceedings of the XI International Seminar on Mineral Processing Technology (MPT-2010), Dec 2010, NML Jamshedpur, India.

After setting a target of 100 MT/yr of Steel by 2012, Indian Steelmakers and Iron Ore producers are already struggling due to the depleted grade of Iron Ore available in India. The main impurities dominating the Indian Iron Ores are SiO2 and Al2O3 which should be reduced with an economical method of Beneficiation. Jigs are the earliest type of process equipments employed in mineral separation but the newly developed under bed pulsated BATAC Jig has considerable advantages over its counterparts. There are various types of BATAC Jigs available for Lump and Fines such as Lump Ore (2 products/3 products) Jig and Fine Ore (2- product) Jig. A South African iron ore producer recently commissioned a 10 Mtpa-capacity greenfield Iron Ore beneficiation plant with 2 Lump Ore BATAC Jigs and 2 Fine Ore with a combined capacity of 1240 tph at Assmang Khumani Iron Ore Mine in Northern Cape, South

Africa. The Concentrate contains a Fe grade of > 66%. A further capacity expansion project to 16 Mtpa product is currently underway using 3 more BATAC jigs. The first large scale Iron Ore Jig beneficiation plant in India was commissioned in 2006 at Noamundi in the state of Jharkhand. Tata Steel is already operating a 300 tph Fine Ore BATAC Jig Iron Ore Plant there. Patnaik Minerals also followed the pattern and started constructing 100 tph Fine Ore Jigging Plant at Joda, Jharkhand. There are different combinations possible in which unit operations can be arranged which include Jigs as the heart of the beneficiation process. These various types of flow sheets provided this beneficiation method with an advantage over other unit operations. Lessons learned and best practices regarding equipment selection and operation acquired during the last 10 years are summarized to define potential BATAC Jig applications in Iron Ore. Finally, field experiences and results are analyzed to establish the best strategy to fit specific Indian Iron Ore conditions. http://eprints.nmlindia.org/2417/