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A preliminary study of particle separation in spiral concentrators using DEM

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International Journal Of Mineral Processing, Apr-28, 2010, Vol. 94, pp. 192-195.

Spirals are used for gravity concentration of minerals and of late these have been extensively and effectively used for iron ore processing. Their widespread use is mainly due to lower capital cost and higher efficiency to treat feed material in the size range of 3 mm to 45 μ m. Although operating a spiral is quite simple its design is quite challenging for specific applications. Here we have made an attempt to develop a simulation tool based on the discrete element method (DEM) to understand the separation process in spiral and later use it for design purpose. We report preliminary results of simulation as to the splitter position on the spiral trough for maximum separation efficiency. It is observed that separation efficiency is maximum corresponding to a specific radial position and height of the splitter location. (C) 2010 Elsevier B.V. All rights reserved. [10.1016/j.minpro.2009.12.005](https://doi.org/10.1016/j.minpro.2009.12.005)

A Novel Combined Flowsheet of Beneficiation and acid leaching under high pressure for complex Lead-zinc Ores

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Powder Technology And Application Ii, China International Powder Technology and Application Forum

APR 01-03, 2009, Beijing, PEOPLES R CHINA, TRANS TECH PUBLICATIONS LTD, STAFA-ZURICH, 2010, Vol. 92, pp. 13-21.

The run-of-mine of complex lead-zinc ores in Yunnan contains 3.26% lead and 2.54% zinc. When traditional selective flotation flowsheet was adopted, 3.77% yield and 61.92% grade of lead concentrate as well as 5.65% yield and 38.67% grade of zinc concentrate were achieved. Simultaneously, 72.39% lead recovery and 3.83% zinc grade in lead concentrate as well as 80.64% zinc recovery and 6.39% lead grade in zinc concentrate were obtained. Lead concentrate and zinc concentrate obtained from selective flotation contain each other severely, resulting in low recovery of lead

and zinc and severe loss of metal, which influences subsequent smelting flowsheet. In addition, due to requirement of large amount of depressant and activator while separating lead and zinc in the process of mineral processing, the cost is very high and the compositions of tail water which can not be recycled by the plant are very complicated. For the combined flowsheet of beneficiation and metallurgy, bulk flotation flowsheet was adopted. Therefore, 11.22% yield of combined lead and zinc concentrate with 25.55% lead grade, 18.33% zinc grade and 86.36% lead recovery were obtained. Gravity separation technology was utilized to separate combined concentrate of lead and zinc. After selecting out part of high quality lead concentrate, the remaining combined concentrate of lead and zinc was treated by acid leaching under high pressure. The final leaching efficiency of zinc was able to reach 97%. The new combined flowsheet has lots of advantages such as shorter flowsheet of beneficiation, simpler reagents, more direct reuse of backwater and higher recovery of metals. [10.4028/www.scientific.net/AMR.92.13](http://dx.doi.org/10.4028/www.scientific.net/AMR.92.13)

Leaching of vanadium from LD converter slag using sulfuric acid

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[Hydrometallurgy](#), APR, 2010, Vol. 102, pp. 14-21

In order to extract vanadium from LD (Linz-Donawitz) converter slag of steelmaking plant, an alkaline roasting-acid leaching study was carried out and the effect of different parameters on the kinetics of vanadium dissolution was determined. The leaching residue was characterized by XRD, XRF and SEM/EDX analyzer. The maximum vanadium recovery of ca. 95% was achieved at the optimum leaching condition of 70 degrees C, S/L: 1/15, acid concentration: 3 M and leaching time: 150 min. It was shown that particle size has a significant effect on the dissolution of vanadium and maximum extraction was achieved at the finest size of below 0.850 mm. Dissolution of vanadium in sulfuric acid showed that there are two stages in the kinetics of leaching. In the first 15 min, a sharp increase in the amount of vanadium extracted was observed and at longer times, leaching became slower. Shrinking core model (SCM) was used to describe the kinetics of the slag acid leaching. SCM equations were modified to represent the long time leaching process in which the initial recovery of vanadium (at the beginning of long term period) is not zero. It was found that the kinetics of leaching at low temperature is controlled by chemical reaction for both short and long leaching periods. Rate of leaching is controlled by solid product diffusion regime at high temperature. [10.1016/j.hydromet.2010.01.006](http://dx.doi.org/10.1016/j.hydromet.2010.01.006)

Recovery of metals from spent lithium-ion battery leach solutions with a mixed solvent extractant system

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[Hydrometallurgy](#), APR, 2010, Vol. 102, pp. 37-42

A mixed extractant system has been developed for the separation and purification of cobalt and lithium from spent lithium-ion battery leach solutions. The addition of Acorga M5640 to the longest 801 organic solution generated a significant pH isotherm shift for copper with a $\Delta \text{pH}(50)$ value of 3.45. As a result, the separation of iron(III), copper and aluminium from cobalt, nickel and lithium could easily be realised with the mixed extractant system. The McCabe-Thiele diagrams at an A/O ratio of 2:1 and pH 4.0 showed that three theoretical stages are needed for the extraction of iron, copper and aluminium. The extraction kinetics of iron(III) and copper was rapid, but the extraction kinetics of aluminium was slow. With the increase of temperature from room temperature to 40 degrees C, the aluminium extraction kinetics increased substantially. It is therefore recommended that the metal extraction should be carried out at 40 degrees C. The stripping kinetics of aluminium and copper was rapid, but iron cannot be stripped effectively. Thus an organic bleed may be required to remove the iron with higher acid concentration in the strip solution. It is proposed that in the mixed organic system, longest 801 played a role of extractant and Acorga M5640 a synergist for copper extraction. A process flowsheet is proposed for recovering cobalt and lithium from spent lithium-ion battery leach solutions using the mixed longest 801 and Acorga M5640 system in the first solvent extraction circuit, and Cyanex 272 in the second solvent extraction circuit. The advantage of this process is that pure cobalt and lithium products could be obtained. Crown Copyright (C) 2010 Published by Elsevier B.V. All rights reserved. [10.1016/j.hydomet.2010.01.007](https://doi.org/10.1016/j.hydomet.2010.01.007)

A new approach to mining method selection based on modifying the Nicholas technique

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Applied Soft Computing, 2010, Vol. 10(4), pp. 1040-1061.

The main purpose of this paper is to represent a solution to the problem of mining method selection (MMS) in mining projects. To this aim, the well-known MMS technique of Nicholas has been modified so that in addition to eliminate its defects, it would be possible for mining engineers to easily assign their engineering judgments to unsteady and uncertain characteristics of mineral resources. So, in order to resolve the problems of weighting of the Nicholas technique, analytic hierarchy process (AHP) as the most similar multi-criteria decision making (MCDM) tool to Nicholas technique was applied. Due to inability of crisp numbers for assigning of decision maker (DM) judgments to ambiguities of mineral resources, trapezoidal fuzzy numbers also were used for better modeling of those ambiguities. Moreover, a two-step algorithm containing hierarchical technical-operational model (HTOM) and also hierarchical economical model (HEM), inspired by Nicholas technique, was proposed. These models include some new criteria which are added to the Nicholas technique. Therefore using fuzzy AHP (FAHP), mining alternatives are firstly ranked based on HTOM and then, the most profitable of those alternatives is

selected by the HEM. As a case study, the north anomaly of Choghart iron mine was used to compare the proposed approach with the Nicholas technique. The results indicated that the proposed approach eliminated the problems of Nicholas technique. Proposed approach also introduces a profitable mining alternative to start the mining operations. It should be applied to avoid further feasibility studies in mining projects. [10.1016/j.asoc.2009.09.002](https://doi.org/10.1016/j.asoc.2009.09.002)

Myco-hydrometallurgy: Coal model for potential reduction of preg-robbing capacity of carbonaceous gold ores using the fungus, *Phanerochaete chrysosporium*

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[Hydrometallurgy](#), APR, 2010, Vol. 102, pp. 66-72

During the cyanidation process for gold extraction, natural carbonaceous matter (CM) present in refractory gold ores adsorbs dissolved aurocyanide complexes, thereby reducing gold extraction - a phenomenon known as preg-robbing. The natural CM consists mainly of elemental carbon, humic acids and hydrocarbons, and coal can be used to model the behavior of CM. In this study, samples of lignite, sub-bituminous, bituminous and anthracite coals were used as surrogate materials to test the capability of the fungus *Phanerochaete chrysosporium* to reduce the preg-robbing capacity of CM. By utilizing several growth media including glucose, millet and wheat bran it was established that millet and wheat bran provided the best environment for fungal growth and biomodification of coal. As-received, control and bio-treated coal samples were subjected to gold adsorption tests and the results indicate that *P. chrysosporium* can decrease the gold adsorption ability of coal by over 90% depending on the growth media used. Reduction in gold adsorption was more pronounced in anthracite due to its high ability to adsorb gold in the as-received form. The results demonstrate a potentially effective alternative pretreatment process that utilizes the fungus, *P. chrysosporium*, in reducing preg-robbing in gold extraction. [10.1016/j.hydromet.2010.02.007](https://doi.org/10.1016/j.hydromet.2010.02.007)

Bioleaching of metal ions from low grade sulphide ore: Process optimization by using orthogonal experimental array design

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[African Journal Of Biotechnology](#), ACADEMIC JOURNALS, VICTORIA ISLAND, May, 2010, Vol. 9(19), pp. 2801-2810.

The present work was aimed at studying the bioleachability of metal ions from low grade sulphide ore containing high amount of carbonaceous materials by selected moderately thermophilic strain of acidophilic chemolithotrophic bacteria, *Sulfobacillus thermosulfidooxidans*. The bioleaching process was optimized by constructing L(25) Taguchi orthogonal experimental array design and optimization

of variable proportions of process parameters. Five factors were investigated and twenty five batch bioleaching tests were run under lower, medium and higher levels of these factors. The parameters considered for shake flask leaching experiments were initial pH (1.8, 2, 2.5, 3, 3.5), particle size, (50, 100, 120, 200, 270 μm), pulp density (1, 5, 10, 15, 25%), temperature (40, 45, 47, 52, 57 degrees C) and agitation (100, 120, 180, 220, 280 rpm). Statistical analysis (ANOVA) was also employed to determine significant relationship between experimental conditions and yield levels. The experimental results for selective leaching showed that under engineered leaching conditions; pH 1.8, particle size 120 μm , pulp density 10%, temperature 47 degrees C and agitation 180 rpm, the percent bioleachabilities of metals were Zn 72%, Co 68%, Cu 78%, Ni 81% and Fe 70% with an inoculum size of $1.0 \times 10^7/\text{mL}$.

Dual energy X-ray transmission sorting of coal

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Journal Of The South African Institute Of Mining And Metallurgy, SOUTH AFRICAN INST MINING METALLURGY, JUL, 2010, Vol. 110(7), pp. 371-378.

Dual energy X-ray transmission (DE-XRT) sorting is a recent development in the range of sensor-based sorting technologies available today. DE-XRT is particularly suitable for dry coarse coal beneficiation in the size range -120 mm +12 mm. In this paper, we describe the technology and show the results of a number of test runs conducted on different types of coal from the USA and South Africa. The results have shown that DE-XRT is an effective technology not only for deshaling of coal and removing pyritic sulphur but also for separating coal and torbanite. The use of dry deshaling methods will be more important as water availability becomes a greater concern. DE-XRT is one such technology which will be incorporated in future dry coal processing plants.

Efficient Recovery of Combustibles From Coking Coal Fines

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Mineral Processing And Extractive Metallurgy Review, TAYLOR & FRANCIS INC, PHILADELPHIA, 2010, Vol. 31(4), pp. 236-249

The processing of three Indian coking coal fines with feed ash values of 25.12% (S1), 22.97% (S2), and 30.38% (S3) was studied. Substantial improvement in the overall recovery of combustible could be obtained by splitting sample S1, exhibiting good washability but poor release behavior, into a coarser and a finer fraction and treating them by gravity and Jameson cell flotation, respectively. Sample S2 had over 70% of the material below 100 μm and had excellent release characteristics. The Jameson cell flotation indeed resulted in very high recovery of combustibles at the desired target ash values and split processing was not required for this sample.

The floatability and washability characteristics of sample S3 indicated that gravity-based methods might improve combustible recovery in terms of theoretical yield at the desired product ash values. A combination of spiral concentration of the coarser fraction and froth flotation of the finer fraction using a Jameson cell showed some improvement in the combustible recovery of this sample. It was established in this study that if the floatability is poor or moderate, then split processing improves coal cleaning performance. Flotation alone may be recommended only when samples exhibit excellent floatability. [10.1080/08827508.2010.508827](https://doi.org/10.1080/08827508.2010.508827)

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

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International Journal of Coal Preparation and Utilization, 2010, Vol. 30(6), 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](https://doi.org/10.1080/19392699.2010.495619)

Fluidization characteristics of magnetite powder after hydrophobic surface modification

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Enhancing the surface hydrophobicity of the medium solids is an effective method of increasing gas-solid fluidized bed applicability to dry beneficiation of feed stocks with different external moisture contents. Exploratory experiments determined that

stearic acid was appropriate to use as the modifying agent of magnetite powder. Magnetite powder with a hydrophobic surface was prepared with a reagent dosage of 1.5% by wt., a slurry concentration of 15% by wt., a temperature of 60 degrees C and an agitation time of 40 min. The effects of the modification on the fluidization characteristics of the resulting magnetite powder were studied. The results show that modification increases the minimum fluidization velocity but does not apparently change the bed pressure distribution. The uniformity of the bed density is enhanced to a certain degree, indicating an improved fluidization quality. As external moisture of feed-coal increases the fluidization performance of both unmodified and modified magnetite powders decreases gradually. However, when the external moisture content was 4% (the upper limit) the modified magnetite powder still showed good fluidization performance. The upper limit for external moisture content of feed-coal was increased by 100%. (C) 2010 Elsevier B.V. All rights reserved. [10.1016/j.minpro.2010.02.009](https://doi.org/10.1016/j.minpro.2010.02.009)

Impact of iron sulfide transformation on trichloroethylene degradation

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Geochimica Et Cosmochimica Acta, Apr, 2010, Vol. 74(7), pp. 2025- 2039

Trichloroethylene (TCE) is one of the most common and persistent groundwater contaminants encountered at hazardous waste sites around the world. A growing body of evidence indicates that iron Sulfides play an important role in degrading TCE in natural environments and in engineered systems designed for groundwater cleanup. In this study, we investigate transformation processes of iron Sulfides and consequent impacts oil TCE degradation using batch experimental techniques, transmission electron microscopy (TEM), X-ray diffraction (XRD), and X-ray absorption spectroscopy (XAS). Our results show that mackinawite is highly reactive toward TCE and no detectable mineralogical changes were detected during the course of reaction. However, freeze-dried FeS transformed to a mixture of mackinawite and greigite during the freeze drying process, with further mineralogical changes during reaction with TCE to lepidocrocite, goethite and pyrite.

Newly formed lepidocrocite is a transient phase, with conversion to goethite over time. TCE transformation kinetics show that freeze-dried FeS is 20-50 times less reactive in degrading TCE than non-freeze-dried FeS, and the TCE degradation rate increases with pH (from 5.4 to 8.3), possibly due to an increase of surface deprotonation or electron transfer at higher pH. Results suggest that freeze drying could cause FeS particle aggregation, decreased surface area and availability of reactive sites; it also could change FeS mineralogy and accelerate mineral transformation. These aspects could contribute to the lower reactivity of freeze-dried FeS toward TCE degradation. Modeling results show that FeS transformation in natural environments depends on specific biogeochemical conditions, and natural

FeS transformation may affect mineral reactivity in a similar way as compared to the freeze drying process. Rapid transformation of FeS to FeS, could significantly slow down TCE degradation in both natural and engineered systems. (C) 2010 Elsevier Ltd. All rights reserved. [10.1016/j.gca.2010.01.013](https://doi.org/10.1016/j.gca.2010.01.013)

Influence of quartz particles on wear in vertical roller mills. Part I: Quartz concentration

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Minerals Engineering, APR, 2010, Vol .23(5), pp. 390-398

The standard closed circuit comminution process commonly employed in industrial vertical roller mills has been analyzed to determine the influence of typical abrasive minerals on wear rates. With the main focus on raw mixes used in cement plants, synthetic mixtures imitating were prepared. Using statistical planning, a total of 10 tests were carried out with two different limestones and one type of quartz sand. The size distributions were kept constant and only the mixing ratios were varied. It appears from the investigation that mixtures consisting of minerals with different grindabilities result in an increased concentration of abrasive particles in the grinding bed ($R(2) > 0.99$). The present study shows that the quartz concentration in the grinding bed is determining the wear rate. (C) 2009 Elsevier Ltd. All rights reserved. [10.1016/j.mineng.2009.11.014](https://doi.org/10.1016/j.mineng.2009.11.014)

Study on the structure and pyrolysis characteristics of Chinese western coals

Junhong Wang, Juan Du, Liping Chang, Kechang Xie

Fuel Processing Technology, Volume 91, Issue 4, April 2010, Pages 430-433, ISSN 0378-3820, <http://dx.doi.org/10.1016/j.fuproc.2009.04.020>.

The structure and pyrolysis characteristics of three inertinite-rich Chinese western coals were researched and compared with one relative vitrinite-rich Chinese middle coal by means of XRD, TG-DTG and fixed-bed reactor. The results show that the atomic ratio O/C, aromaticity factor, even ring condensation number and ring condensation index increase and atomic ratio H/C decreases with increasing inertinite content in coal; inertinite contains more aromatic ring structure than that of vitrinite; the crystallite structure order of coal char increases slightly with increasing heat treatment temperature. The higher inertinite content in coal is, the lower pyrolysis reactivity of coal is at lower temperature, and yet they have obvious second pyrolysis reactivity in higher temperature. The pyrolysis reaction in primarily devolatilisation phase that comes mainly from the decomposition of containing hydrogen function groups and the secondary devolatilisation at high temperature is mainly the decomposition of stable containing oxygen function groups in coal matrix with higher inertinite.

Environmental impacts of coal combustion: A risk approach to assessment of emissions

Peter F. Nelson, Pushan Shah, Vlad Strezov, Brendan Halliburton, John N. Carras
Fuel, Volume 89, Issue 4, April 2010, Pages 810-816, ISSN 0016-2361,
<http://dx.doi.org/10.1016/j.fuel.2009.03.002>.

This paper summarises some of the work performed in the Cooperative Research Centre for Coal in Sustainable Development (CCSD) on emissions from current power generation. A comprehensive approach was taken in the CCSD program to assessing environmental issues of concern for the power, and by implication the coal, industries. Here results of sampling on full scale operating plants are described, and detailed data on emission fluxes, particle size distributions, trace element concentrations as a function of particle size, and speciation of the trace elements are illustrated. The results show that particle capture in electrostatic precipitators (ESPs) is significantly less efficient than in fabric filters (FFs), particularly for submicron material, and that significant enrichment is observed in the finer particle sizes emitted from both ESPs and FFs. Results for the speciation of chromium, arsenic and selenium in coals, bottom ash and fly ash are also presented. The majority of chromium in fly ash is present in the less toxic Cr³⁺ form. Speciation of arsenic in feed coals is variable but the dominant form of As in fly ash is the less toxic As⁵⁺.

Process optimization and modelling of sphalerite flotation from a low-grade Zn-Pb ore using response surface methodology

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Separation and Purification Technology, Volume 72, Issue 3, 11 May 2010, Pages 242-249, ISSN 1383-5866, <http://dx.doi.org/10.1016/j.seppur.2010.02.005>.

In this research sphalerite flotation from a low-grade lead-zinc ore containing 3% Zn and 1% Pb was studied. Three control parameters including activator (CuSO₄) dosage, collector (potassium amyl xanthate (PAX)) dosage and pH, each in five levels, were investigated. Response surface methodology (RSM) was implemented for statistical design and analysis of experiments and process modelling. Four quadratic mathematical models were derived for prediction of Zn grade, Zn recovery, Zn separation efficiency and Pb recovery. Analysis of variance showed that collector dosage was the most significant factor affecting Zn recovery and separation efficiency. In process optimization, maximum values of Zn recovery and separation efficiency were achieved as 79.12% and 64.59%, respectively. Using CuSO₄ concentration of 150 g/t, PAX dosage of 120 g/t, and pH of 10.4, Zn recovery of 61.5% and separation efficiency of 51.49% were obtained. However, in optimization studies, a case proposed by the model in which using the same consumption of reagents, Zn recovery and separation efficiency were improved about 9% and 5%, respectively. This study showed that RSM could effectively be applied for the modelling of flotation process and for finding an economical

optimum condition to achieve maximum separation efficiency under minimum consumption of flotation reagents.

Integration of Traditional Discipline Advantage and Construction of an Emerging Discipline Characteristic - Taking the Mineral Processing Engineering Major as an Example

Bai, LM; Dai, SJ

Proceedings Of The Third International Conference On Education Management Science And Engineering, MAY 21-22, 2010, YanAn City, PEOPLES R CHINA, M D FORUM ALLAWAH NSW, 2010, pp. 351-355

The current situation and development history of mineral processing discipline in China were analyzed while putting the development of this discipline into view of the industrialization process. The development dilemma and problem of this discipline which is mainly representative of college in the industrialization process of China were discussed. The informationization, efficiency and ecologization which are the development orientation of industrialization process of China were merged into mineral processing discipline and the development trends and way of thinking of this discipline were presented showing the development prospect and vitality of this discipline.

On the complex conductivity signatures of calcite precipitation

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Journal Of Geophysical Research-Biogeosciences, May, 2010, pp. 115

Calcite is a mineral phase that frequently precipitates during subsurface remediation or geotechnical engineering processes. This precipitation can lead to changes in the overall behavior of the system, such as flow alternation and soil strengthening. Because induced calcite precipitation is typically quite variable in space and time, monitoring its distribution in the subsurface is a challenge. In this research, we conducted a laboratory column experiment to investigate the potential of complex conductivity as a mean to remotely monitor calcite precipitation. Calcite precipitation was induced in a glass bead (3 mm) packed column through abiotic mixing of CaCl_2 and Na_2CO_3 solutions. The experiment continued for 12 days with a constant precipitation rate of similar to 0.6 milimole/d. Visual observations and scanning electron microscopy imaging revealed two distinct phases of precipitation: an earlier phase dominated by well distributed, discrete precipitates and a later phase characterized by localized precipitate aggregation and associated pore clogging. Complex conductivity measurements exhibited polarization signals that were characteristic of both phases of calcite precipitation, with the precipitation volume and crystal size controlling the overall polarization magnitude and relaxation time constant. We attribute the observed responses to polarization at the electrical double layer surrounding calcite crystals. Our experiment illustrates the potential of

electrical methods for characterizing the distribution and aggregation state of nonconductive minerals like calcite. Advancing our ability to quantify geochemical transformations using such noninvasive methods is expected to facilitate our understanding of complex processes associated with natural subsurface systems as well as processes induced through engineered treatments (such as environmental remediation and carbon sequestration). [10.1029/2009JG001129](https://doi.org/10.1029/2009JG001129)

The effect of breakage mechanism on the mineral liberation properties of sulphide ores

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Minerals Engineering, APR, 2010, Vol. 23(5), pp. 374-382

The effect of particle-bed breakage mechanisms on the liberation properties of ores remains unclear. Surprisingly few studies have been published in this area and limitations in liberation measurement techniques previously used have prevented definitive conclusions from being reached regarding whether particle-bed breakage enhances the liberation properties of mineral ores relative to conventional grinding mechanisms. In this study, two sulphide ores of differing textures were comminuted to various size distributions using impact and particle-bed breakage mechanisms in a hammer mill and a piston-die compression unit respectively. The liberation properties of the various discharge samples were then characterised using a mineral liberation analyser - a mineralogical characterisation system based on automated scanning electron microscopy. It was found that the size-by-size liberation properties of both valuable and gangue mineral phases were independent of both the method used to comminute the samples, as well as the particle size distribution of the final products. These effects are discussed in terms of how they may be exploited in liberation modelling and characterising comminution circuit performance. (C) 2009 Elsevier Ltd. All rights reserved.

[10.1016/j.mineng.2009.11.012](https://doi.org/10.1016/j.mineng.2009.11.012)

The effect of feed-coal particle size on the separating characteristics of a gas-solid fluidized bed

Zhao, YM; Luo, ZF; Chen, ZQ; Tang, LG; Wang, HF; Xing, HB

Journal Of The South African Institute Of Mining And Metallurgy, MAY, 2010, Vol. 110(5), pp. 219-224

The separating performance of a pilot dry beneficiation system using a gas-solid fluidized bed was investigated with coal from South Africa. The coal used for the study has a low inherent moisture content, a moderate ash content, a moderate volatile content, a low sulphur content and a high calorific value. Its washability is moderate. Experimental results show that the separating quality of the fluidized bed drops gradually as the feed-coal particle size decreases. The probable error, E,

values for 50-25 mm, 25-13 mm and 13-6 mm coals were 0.04 g/cm³, 0.06 g/cm³ and 0.09 g/cm³, respectively. The cause of the differences in separating characteristics was analysed by particle dynamics and numerical modelling. Furthermore, the pilot fluidized bed was employed to separate 50-6mm coal. In this experiment the coal ash content was reduced from 23.74% to 11.79%, with a probable error, E, value of 0.07 g/cm³ and a recovery efficiency of 98.26%. This indicates that the fluidized bed is applicable to the separation of coal from South Africa and has good separating performance and wide applicability.

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

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International Journal Of Coal Preparation And Utilization, 2010, Vol. 30(6), 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](https://doi.org/10.1080/19392691003776814)

The fungal and chemolithotrophic leaching of nickel laterites - Challenges and opportunities

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Hydrometallurgy, JUN, 2010, Vol. 103, pp. 150-157

Nickel is an important metal in human life and in the industry. In recent years, the world nickel demand has been driven by soaring steel production, particularly in China. With the rapid growing demand for nickel coupled with the depletion of high grade sulphide reserves, low-grade nickel ores, which cannot be economically processed by conventional metallurgical processes, become increasingly important sources of nickel. Laterite ore, which is often considered as a low-grade nickel ore, contains several kinds of metal elements including nickel, cobalt, iron, silicon, aluminium, and chromium: and thus, constitutes an alternative source of nickel. The nickel present in nickel laterites is not usually present as discrete minerals, but as cations substituted within manganese oxides, goethite, and/or clays. Because of this, it is difficult to upgrade the ore by beneficiation. As a result, nickel laterites are traditionally processed using pyrometallurgical and hydrometallurgical methods. In recent years, microbiological leaching has been found to be a promising novel

technology for recovering valuable minerals from traditionally difficult-to-process ores. Microbial leaching of low-grade ores offers many advantages over other conventional methods due to its relative simplicity, requiring mild operating conditions, low capital costs, low energy input, relatively unskilled labour requirements, and being environmentally friendly. Because of the importance of microbial leaching, recent advances in microbial assisted leaching of nickel laterites are discussed in this paper with emphasis on fungal (chemoorganotrophic) and chemolithotrophic microorganisms. (C) 2010 Elsevier B.V. All rights reserved.

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An experimental investigation of the effects of operating parameters on the wear of lifters in tumbling mills

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Minerals Engineering, JUN, 2010, Vol. 23(7), pp. 558-562.

Lifters are usually used with mill liners to extend their life and to enhance the grinding and crushing efficiency. Although the lifters are durable wear parts but they will gradually worn and consequently their dimensions change during the course of operation. These changes in dimensions have a significant influence on the overall economic performance of the mills. Therefore, it is useful to know the relationship between the mill operation and the lifter profile, and the influence of lifter wear on the change in lifter profile. In this work, a laboratory mill which is capable of producing the required impact and abrasion grinding was operated both wet and dry. Many factors were varied such as: velocity, charge, ore size and different material for the lifters. Also the wear rate on the top and face of lifters are compared in the different conditions. It is found that the mill charge and the mill speed significantly affect the wear rate. Also, the results showed how size distribution affects the wear rate. The results can be interpreted in terms of the wear process in industrial scale mills over different operating conditions. The experimental results provide the possibility of including the lifter wear in optimising mill performance. [10.1016/j.mineng.2009.12.010](https://doi.org/10.1016/j.mineng.2009.12.010)

Characteristic Improvement of Metal-Contaminated Sludge Using Mineralization Technology

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Environmental Progress & Sustainable Energy, JOHN WILEY & SONS INC, HOBOKEN APR, 2010, Vol. 29(1), pp. 68-77.

This study focuses on improving crystalline characteristics of metal-contaminated sludge. The mineralization behavior of Cu/Al or Cu/Fe coexisting in solution is surveyed, and the characteristics of residue and suspension settling are discussed in

the context of water content of residue and settling/specific filtration resistance of suspensions. Experimental data show that the hydrate of $\text{Cu}_4\text{SO}_4(\text{OH})_6$ forms during mineralization of copper sulfate solution when hydroxide ion concentration, reaction time, and temperature are not controlled appropriately. Mineral characteristics of the residue are usually poor when the $\text{Cu}_4\text{SO}_4(\text{OH})_6$ forms in Cu/Al or Cu/Fe solution. However, $\text{Cu}_4\text{SO}_4(\text{OH})_6$ can be further transformed into CuO with wet oxidation. or ferrite method, respectively (i.e., mineralization treatment). Water reduction of the residue is from 96.8% to 72.8% in the Cu/Al case or 95.6% to 66.6% in The Cu/Fe case, and the mineralized residue volume is only 1/10 of the hydrate sediment. This is particularly beneficial for sludge disposal. (C) 2009 American Institute of Chemical Engineers Environ Prog, 29: 68-77, 2010
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Recovery of precious metals through biosorption - A review

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Recovery of precious metals like gold, silver, palladium platinum etc. is interesting due to its high market prices along with various industrial applications. Conventional technologies viz, ion exchange, chemical binding, surface precipitation etc. which been have been developed for the recovery of such metals are not economically attractive. Biosorption represents a biotechnological innovation as well as a cost effective excellent tool for recovery of precious metals from aqueous solutions. A variety of biomaterials are known to bind the precious metals including algae, fungi, bacteria actinomycetes, yeast etc. along with some biopolymers and biowaste materials. The metal binding mechanism, as well as the parameters influencing the uptake of precious metals and isotherm modeling are presented. This article provides an overview of past achievements and present scenario of biosorption studies carried out on the use of some promising biosorbents which could serve as an economical means for recovering precious metals. The present review also highlights the use of biosorbents in real situations and hopes to provide insights into this research frontier. (C) 2010 Elsevier B.V. All rights reserved.

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Optimisation of mass transfer in column elution of rare earths from low grade weathered crust elution-deposited rare earth ore

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[Hydrometallurgy](#), JUN, 2010, Vol. 103, pp. 211-214

An investigation was carried out to optimize the leaching and mass transfer of rare earth metals with ammonium sulfate solution during the column elution of a low

grade weathered crust elution-deposited rare earth ore. The effects of flow rate, concentration of leach reagent and ore grade on the leaching performance were examined. The experimental data was analyzed using chromatographic non-equilibrium plate theory in order to elucidate the mass transfer phenomena. It was found that the relationship between the height equivalent to a theoretical plate (HETP) and the leaching flow rate can be described by the Van Deemter equation and there is an optimum flow rate in the leaching process. Compared with similar higher grade ores which have a sharp peak followed by a short tail, the leach curve of low grade ores has a long tail following a broader peak. (C) 2010 Elsevier B.V. All rights reserved. [10.1016/j.hydromet.2010.04.003](http://dx.doi.org/10.1016/j.hydromet.2010.04.003)

Numerical simulation of coalbed methane generation, dissipation and retention in SE edge of Ordos Basin, China

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This paper presents a numerical study on the formation history of coalbed methane (CBM) reservoir in the southeast edge of Ordos Basin, China. The coal seams studied belong to the Late Palaeozoic coal-bearing series. These coal seams have a burial history and experienced the process of subsidence, rapid subsidence alternated with uplift and then uplift, sequentially, and underwent the geothermal actions at normal, extremely high, and then normal temperatures, respectively. Coal organic matter of the coal seams matured in the Triassic Period and in the Late Jurassic to Early Cretaceous Period. The results from numerical simulation reveal that CBM reservoir evolution history can be classified into five stages, namely primary, initial, stagnant, active and dissipative stages. In the first (primary) stage, coal rank was very low and there was little methane generated and stored in the coal seams. In the second (initial) stage, the coal was converted to middle-high volatile bituminous coal. As a result, a certain amount of methane was generated and began to accumulate in coal seams except part of it escaped from coal seams by diffusion and cap outburst. In the third (stagnant) stage, generation of methane was almost stagnant due to the temperature of the coal seam that dropped slightly and the maturation of coal organic matter stopped. Meanwhile CBM would keep dissipating through diffusion. In the fourth (active) stage, coal rank varied from high volatile bituminous coal A to semianthracite which accelerated pyrolysis gas formation and resulted in a large amount of methane generated at a high speed. During this period, CBM was increasingly accumulated in coal seams although there would be considerable amounts of gas dissipated from the coal seams. In the last (dissipative) stage, due to coal seams uplifted at various rates and no more methane generated, CBM was continuously dissipated by diffusion throughout the whole coal seams and by permeation at some local areas. The simulation provides insights for further interpretation of how many factors that control or affect the CBM reservoir formation history and CBM accumulation. These factors include features of coal-bearing series,

characteristics of coal seams, physical properties of coal reservoir, tectonic evolution history, burial history and geothermal conditions, etc. In particular, tectonic evolution history and gas generation are critical. Under given conditions, CBM reservoirs in the study area were developed in different ways and the CBM was accumulated in the reservoirs at different levels. For example, the west part of study area is favourable for CBM accumulation. As a result, the gas content of the main coal seams in this region has a maximum of about 28 m³/t at depths of 900–1100 m, and generally increases with the increasing of burial depth from the east to the west. The coal reservoir is under-saturated in the east part where the burial depth is shallower than about 500 m while the west part is saturated. There is a close correlation of the lateral distribution of both gas content and saturation to the gas generation in the geological history.

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

Abhilash, and Mehta, K D and Kumar, Vinay and Pandey, B D and Tamrakar, P K (2010) *Column Bioleaching of a Low-Grade Silicate Ore of Uranium*. [Mineral Processing and Extractive Metallurgy Review](#), 31 (4). pp. 224-235.

The bioleaching of a low-grade Indian uraninite ore (triuranium octoxide, U₃O₈: 0.024%), containing ferro-silicate and magnetite as the major phases, and hematite and pyrite in minor amounts, has been reported. Experiments were carried out in laboratory scale column reactors inoculated with enriched culture of *Acidithiobacillus ferrooxidans* isolated from the source mine water. The pH effect on uranium recovery was examined with the same amounts of ores in different columns. With the presence of 10.64% Fe in the ore as ferro-silicate, the higher uranium biorecovery of 58.9% was observed with increase in cell count from 6.4 10⁷ to 9.7 10⁸ cells/mL at pH 1.7 in 40 days as compared to the uranium recovery of 56.8% at pH 1.9 with a corresponding value of 9.4 10⁸ cells/mL for 2.5-kg ore in the column. The dissolution of uranium under chemical leaching conditions, however, recorded a lower value of 47.9% in 40 days at room temperature. Recoveries were similar with 6-kg ore when column leaching was carried out at pH 1.7. The bioleaching of uranium from the low-grade ore of Turamdih may be correlated with the iron(II) and iron(III) concentrations, and redox potential values.

<http://eprints.nmlindia.org/1872/>

Abhilash, and Venkat Ramam, R and Mehta, K D and Pandey, B D (2010) *Native Marine Isolates from Indian Ocean Nodules*. [Microbiology Focus](#), 2.3 . p. 7.

The marine isolates from sea nodules can be worthy catalysts to explore the possibilities of faster bioleaching of low index ocean nodules mined from Indian

Ocean. The native microbes were isolated from Indian Ocean Nodules in Artificial Sea water Nutrient Broth (ASWNB) at pH 7.0. <http://eprints.nmlindia.org/1979/>

Bhagat, R P (2010) *Effect of Bed Height on Strength of Sinter and other Sintering Indices*. *Steel India*, 33 (2). pp. 184-191.

Pot sintering experiments were conducted to describe the effect of bed height on tumbler strength of sinter, reduction properties (RDI and RI) and other sintering indices. The basicity ratio, (CaO/ SiO₂) and MgO of sinter were kept at 1.6 % and 2.3% level, respectively in the present pot sintering study - the values which correspond to the condition of the sintering plant. The stabilization of sinter in plant condition was simulated with the pot sintering studies through the evaluation of return fines balance. Mineralogical analysis of the sinter samples reveals the presence of a higher percentage of ferrites in sinter samples from 550 mm bed height compared to 400 mm bed height when p- and s- hematite were predominant. A higher proportion of secondary hematite at this bed height could be attributed to higher oxygen potential due to higher permeability of the bed height. The yield of + 10 mm sinter and its tumbler strength (TI) improved quite significantly with the increase in bed height while speed of sintering decreased with the net result of marginal improvement in strand productivity. The reduction degradation index (RDI) decreases whereas reducibility index (RI) improved with the increase in bed height. Sinter produced in the lesser bed height pot had low FeO compared to that in taller bed height. And a correlation between FeO content of sinter and its RDI was established. However, these variables are inter-influenced by another variable since a lower RDI a value was achieved even at lower FeO of sinter when the flux size was narrowed down. FeO content of sinter around 8% has resulted in the best result as regards RD/. Return fines (RF) was not balanced when the sintering was conducted at lower bed height: return fines generation was about 40% higher than the return fines input; whereas, it was balanced at 550 mm bed height. <http://eprints.nmlindia.org/3826/>

Bhaskar Raju, G and Latha Priya, D and Latha, Swarna and Parvathy, S and Prabhakar, S (2010) *Removal of organics from the waste waters of dyebath by electrooxidation*. *Asian Journal of Water, Environment and Pollution*, 7 (4). pp. 19-23.

Residual dye in hydrolyzed form is the major organic constituent present in dyebath effluent resulting in the scarcity of water resources. The objective of this study is to remove organic pollutants by electrooxidation using graphite and RuO₂/IrO₂/TaO₂ coated titanium (MMO) as electrodes. Among the two electrode materials used, graphite was found to be better in terms of COD removal, current efficiency and energy consumption. Nearly 85% of COD was removed using graphite where as only 40 % COD removal was achieved using MMO material as electrode. The influence of chloride ion and current density on the degradation of organics was studied. The results indicate that the electro oxidation is an effective technique for the treatment of dyebath effluent. <http://eprints.nmlindia.org/3962/>

Bhattacharya, Sumantra and Dey, Shobhana (2010) *An operator friendly performance index for frother selection and optimization in coal flotation*. In: [XVI International Coal Preparation Congress, 2010](#), Lexington, UK.

The demand-supply gap for indigenous met coal of acceptable quality in India has reached such a level that coal blends in integrated steel plants usually have a ratio of 70 to 30 between the imported and domestic. Met coal constitutes nearly 30% of steel production cost in India. Met coal wash plants in India are hard pressed to reduce the washing cost. Fines circuit capacity generally had been 10-25% of the plant throughput. Reagents appear to constitute a minimum 45% of the coal flotation and associated dewatering cost in India. Contribution of frother alone to total reagent cost is around 30%. Selection of collector in coal flotation is usually between diesel oil and kerosene. Plant operators however face difficulty in quick selection of a frother from among those supplied by different manufacturers. There can possibly be no universal frother which would perform best irrespective of fluctuation in feed characteristics, typical for met coal wash plants in India. Therefore, an index has been proposed which takes into account all major performance parameters such as yield, misplacement, ash, selectivity, flotation rate and reagent cost. This index, convenient for plant operators, evaluates frother performance through the performance evaluation of the flotation process itself. (13 refs.) <http://eprints.nmlindia.org/1717/>

Das, Avimanyu and Bhattacharyya, K K (2010) *An improved process for the beneficiation of fine coking coal from Munidih area*. [Steel Tech](#), 4 (July). pp. 29-33.

Processing of -0.5 mm fine coking coal with a feed ash value of 30.38% was investigated. Mechanical cell flotation performance was observed to be close to but lower than the theoretical maximum performance. The inability of the mechanical cell to effectively beneficiate the ultra fines was attributed to the unsatisfactory performance in flotation. <http://eprints.nmlindia.org/5606/>

Das, Avimanyu and Sarkar, B and Vidyadhar, A and Roy, Subrata (2010) *Efficient Recovery of Combustibles From Coking Coal Fines*. [Mineral Processing and Extractive Metallurgy Review](#), 31 (4). pp. 236-249.

The processing of three Indian coking coal fines with feed ash values of 25.12% (S1), 22.97% (S2), and 30.38% (S3) was studied. Substantial improvement in the overall recovery of combustible could be obtained by splitting sample S1, exhibiting good washability but poor release behavior, into a coarser and a finer fraction and treating them by gravity and Jameson cell flotation, respectively. Sample S2 had over 70% of the material below 100 μ m and had excellent release characteristics. The Jameson cell flotation indeed resulted in very high recovery of combustibles at the desired target ash values and split processing was not required for this sample. The floatability and washability characteristics of sample S3 indicated that gravity-based methods might improve combustible recovery in terms of theoretical yield at the desired product ash values. A combination of spiral concentration of the coarser

fraction and froth flotation of the finer fraction using a Jameson cell showed some improvement in the combustible recovery of this sample. It was established in this study that if the floatability is poor or moderate, then split processing improves coal cleaning performance. Flotation alone may be recommended only when samples exhibit excellent floatability. <http://eprints.nmlindia.org/3098/>

Das, Suchandan K and Das, Rashmita (2010) *A Mathematical Model To Characterize Erosion Behaviour Of Boiler Grade Steels Impacted By Fly Ash In Coal Fired Power Plants*. In: [MS'10 Prague Proceedings of the International Conference on Modelling and Simulation 2010](#), 22 – 25 June 2010, Prague, Czech Republic.

A first principle based theoretical model has been developed on the erosion behaviour to predict erosion rates on the boiler components at room and elevated temperature. This model embodies mechanisms of erosion involving cutting wear, plastic deformation wear and effect of temperature on the erosion behaviour. Various grades of steels used in the fabrication of boiler components in conjunction with published data pertaining boiler fly ash has been used for modelling the process. The erosion sensitivity of silica content of fly ash, impact velocity, angle of impingement and variation of steel surface temperature have been studied to characterize the erosion behaviour. The model has been implemented in a computer code to predict the erosion rates at room and elevated temperature for various grades of steel used in boiler components. The model predictions have been found to be in good agreement with the published data, which depicted that minor increase in silica level in the ash can considerably enhances the erosion rate. <http://eprints.nmlindia.org/3548/>

Haxhiaj, A and Haxhiaj, E (2010) *The optimization of the quantity of coke and agglomerate in lead production in 'Water-jacket' furnace*. [Journal of Metallurgy and Materials Science](#), 52 (3). pp. 257-265.

The dependence of technical lead production on the composition of the agglomerate has been analyzed through observation of a Port-Piri furnace in Trepça. Additionally, the theoretical and real rapport of coke consumption per ton of technical lead was studied. The results reported include theoretical and experimental studies of the fore mentioned quantities of interest. The dependence of regional thermal balance on the composition of the load is reported graphically and analytically. The goal of this study was to optimize the parameters of the process with respect to the amount of technical lead produced, the amounts of lead in the agglomerate and the air in the furnace. Special attention was also placed on minimization of energy consumption and environmental pollution. <http://eprints.nmlindia.org/2572/>

Tiwary, S N and Tripathi, P S M (2010) *Effect of variation of moisture content of Hariajam coal on its electrical resistivity*. [Journal of Metallurgy and Materials Science](#), 52 (3). pp. 239-245.

In the absence of any alternative, efficient, less polluting and commercially exploitable source of energy, coal will irrefutably continue to play a major and dominant role in the energy scenario of India, particularly for thermal power generation. However, the quality of Indian coals -save for the limited reserves of low-ash-content coking coals, in general, is rather poor, being of low, non-coking grade, high mineral matter content, for which reason such coals need to be necessarily beneficiated to improve their quality to make them suitable not only for use in thermal power plants for power generation and steel industry but also for other non-fuel uses. From this point of view, the physicochemical properties of coal are required to be peremptorily understood thoroughly. Of the different physical properties of coal, its electrical characteristics-particularly the electrical resistivity, are very important in deciding its various end uses. The electrical resistivity of coal is of special importance for the production of carbon artifacts, e.g. graphites and carbon electrodes. Notwithstanding the importance of this aspect of coal characteristics, it has not received much attention of the coal scientists/technologists in India. Since the moisture content of coal affects its electrical resistivity, it, in turn, is prone to affect its quality also and accordingly its non-fuel end uses. This prompted us to study this aspect of coal characteristics in some detail. As a sequel to our previous communication on the effect of gamma-irradiation on the electrical resistivity of coal, the present paper reports the results of investigations on the variation of moisture- content of high-volatile; non-coking coal (from two seams, namely Gopinathpur and Singhpur middle, of Hariajam colliery) of Raniganj-coalfields (W.B.). The results evince that the electrical resistivity()of the coal is greatly affected by the variation in its moisture- content, especially up to 1% moisture in general. However, beyond 1% of the moisture-content of the coal-samples, the effect on the electricalresistivity of different samples from the above mentioned seams of this coal is comparatively less. The observed variation in the electrical resistivity of different coal samples of varying moisture content from these two seams has been explained as being possibly due to different amount of conducting impurities present in the coal at different depths of the seams, difference in porosity of coals and also in their slight structural differences. <http://eprints.nmlindia.org/2569/>

Vaish, A K and Singh, S D and Minj, R K and Chishi, H K and Gupta, R C (2010) *Prospects of Nickel—Chromium—Cobalt Bearing Magnetite Ore Deposit of Nagaland. IIM Metal News*, 13 (4). pp. 17-22.

Magnetite is one of the two major ore minerals of iron. It is a heavy black mineral with its characteristic metallic lusture and widely accepted as a viable and high quality feedstack for the production of premium quality, low impurity steel. The trend of Indian iron ore reserves(1) from 1980 onwards is shown in Fig. 1. The hematite ore reserves are 14630 million tonnes and that of magnetite ore 10619 million tonnes. <http://eprints.nmlindia.org/4599/>

Vijaya Kumar, T V and Rao, D S and Subba Rao, S and Prabhakar, S and Bhaskar Raju, G (2010) *Reverse flotation studies on an Indian low-grade iron ore slimes*. [International Journal of Engineering Science and Technology](#), 2 (4). pp. 637-648.

The present investigation deals with the recovery of iron values from the screw classifier overflow slimes from an iron ore washing plant by means of reverse cationic flotation as an alternate to direct anionic flotation. Selectivity index, an indicator of separation efficiency, was chosen as the response parameter for optimizing the quantity and evaluating a series of generically same but chemically different cationic collectors used in reverse flotation and for further optimization of other flotation process parameters. In the optimization, the main variables investigated were percent solids, collector and depressant dosage. An increase in the iron content of the concentrates is obtained with concomitant reduction in SiO₂ and Al₂O₃ levels. <http://eprints.nmlindia.org/4021/>