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Modeling of Fine Coal Processing in a Teeter Bed Separator.

Das, Avimanyu and Vidyadhar, A and Dey, S K (2009)
adas@nmlindia.org
In: International Seminar on Mineral Processing Technology (MPT-2009), October 28-30, 2009, IMMT, Bhubaneshwar.

Beneficiation of fine coal using Floatex density Separator (FDS) is investigated through experimental and computational approaches. Performance of the FDS is determined through detailed experimentation. The separation in the FDS is also described theoretically using a slip velocity correlation and steady state mass balance equations. The performance of the FDS is estimated by solving the resulting set of mathematical equations. The computed data are found to be in reasonable agreement with the experimental observations albeit with certain deviations. It is shown that at a low bed pressure the FDS acts as a size classifier. At an elevated bed pressure density based concentration is the dominant mode of separation. Low teeter water flow rate is inadequate for hydraulic transport of particles while too high a value leads to misplacement. It is shown that a velocity model based on modified Richarson and Zaki equation in which the dissipative pressure gradient is considered to be the primary driving force for separation predicts the performance more accurately than the other models. http://eprints.nmlindia.org/3789/

The Optimisation of Semi-Autogenous and Ball Mill Based Circuits for Mineral Processing by Means of Versatile and Efficient High Pressure Grinding Roll Technology

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Tenth Mill Operators Conference 2009, Proceedings, 10th Mill Operators Conference, OCT 12-14, 2009, Vol. 11, pp. 81-87.

Mineral resources all over the world are often heterogeneous and have variable ore properties and ore grade. As a result the ore processed in concentrating plants varies over the life of mines. Consequently the circuits often suffer from bottlenecks typically at the stages of crushing, semi-autogeneous (SAG) and ball milling. Bottlenecks may be remedied with equipment retrofits, however, design engineers should consider a phased approach to the circuit design that delays initial capital expenditure over the life of mine. This paper deals with the debottlenecking of existing mineral processing plants by means of high pressure grinding roll (HPGR) applications. It also deals with the use of innovative flow sheet designs using HPGRs for the design of Greenfield plants by engineering or mining companies. In the case of Greenfield plant design an analysis with respect to energy efficiency and operating cost (OPEX) is presented. The analysis compares the performance of SAG based circuits against HPGR circuits that may be influenced by variable ore properties. Globally about 600 HPGRs are installed in various applications in the cement and minerals industries. In excess of 100 of these HPGRs are used since the mid 1980s for crushing and grinding of various ore types including 'hard rock' applications. HPGR technology is mature enough to be considered as an ideal debottlenecking device. HPGR's are versatile, they have a low installation footprint and they are flexible in its machine settings (pressure, roll speed), which can be adjusted to react to ore variations whilst maintaining a high throughput. Examples for the benefits of using HPGR in terms of energy efficiency and operating costs are presented by this paper. 'Eco-efficient' flow sheets and sustainable development initiatives arc linked to energy savings as an 'energy cost' and benefit to the environment. Enemy savings' can also be analysed in terms of the 'dollar cost' (OPEX) savings. This paper demonstrates that HPGR is more energy efficient and may reduce the overall grinding energy requirements in the order of 16 per cent depending on the target grind size and ore properties. The HPGR is more cost efficient and may reduce overall grinding costs by as much as 19.3 per cent depending on the cost of energy, grinding media and the rate of grinding media wear in the comminution circuit.

The effect of flocculant solution transport and addition conditions on feedwell performance in gravity thickeners

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International Journal Of Mineral Processing, Oct-01, 2009, Vol. 93(2), pp. 115-127.

Solid-liquid separation of tailings slurries in gravity thickeners relies on the efficient mixing of slurry and dilute polymer flocculant solutions within the feedwell. Computational fluid dynamics (CFD) can provide predictions of solids distribution, liquor velocity and shear rate within a feedwell. and with the incorporation of an adsorption model, can also assess the effectiveness of flocculant mixing. This study presents the first use of feedwell CFD to examine the effect of the flocculant inlet direction and velocity on the subsequent distribution and adsorption of flocculant. When flocculant is injected inside the feed stream, a high inlet nozzle velocity will maximise adsorption, with injection preferably vertically upward or towards the feedwell walls. For injection inside the dilution stream (vertical upflow of liquor within the feedwell), the flocculant should be directed either upwards or inwards away from the strong downward flow of the feed stream, with the velocity not critical. At flocculant inlet velocities predicted by CFD to enhance mixing and adsorption, the shear rate experienced within the injection pipe exceeds that in the feedwell, and the duration under higher shear may be greater. Pipe flow studies for several flocculants have confirmed reductions in activity at a solution concentration of 0.025 wt.%; this effect diminishes with greater dilution. Much of this lost activity is recovered on standing, indicating that the applied shear leads to a mixture of chain scission (irreversible) and entanglement (reversible). Minimising the duration of such shear effects on flocculant solution transport to the feedwell is essential, as the potential for increased flocculant demand and reduced flocculation efficiency can easily exceed any benefit from improved feedwell mixing.
10.1016/j.minpro.2009.07.001

Solvent extraction and separation of zinc and cobalt from ammoniacal solution.

Sahu, S K and Kumar, Vivek and Pandey, B D and Kumar, Vinay (2009)
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In: International Seminar on Mineral Processing Technology (MPT-2009), October 28-30, 2009, IMMT, Bhubaneshwar.

A process was developed to recover Zn and Co by solvent extraction from the raffinate generated during processing of sea nodules. From a model ammoniacal solution containing 0.2 g/L Zn or 0.2 g/L Co, extraction of Zn and Co by Versatic acid was studied. A maximum of 87% Zn was extracted with 1M Versatic acid in single stage, whereas extraction of Co was negligible due to its higher oxidation state. When Co(III) was reduced to Co(II) by the addition of cobalt powder, 1M Versatic acid extracted 76% Co in a single

stage. From the McCabe Thiele diagram number of counter current extraction stages required for complete recovery of Zn and Co from ammoniacal solution was determined. Simulation of counter current extraction of Zn and Co was also carried out. Thus, this process can be used to recover Zn, leaving Co in the raffinate. Then Co can be recovered by solvent extraction with Versatic acid after reducing Co(III) to Co(II) state. http://eprints.nmlindia.org/5701/

Process development studies on recovery of clean coal from ultra fine hardcoal tailings using enhanced gravity separator

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Canadian Journal Of Chemical Engineering, OCT, 2009, Vol. 87(5), pp. 715-725.

In this study, we report the experimental results with respect to the beneficiation of fine hardcoal from the Catalagzi Coal Preparation site tailings containing about 90% (by weight) of -600 mu m size particles. These tailings contain 28.41% ash. The coal sample was subjected to a two-stage concentration process. The underflow product of hydrocyclone under optimized conditions was further processed in Mozley Multi-Gravity Separator to reduce the ash content of the coal. The results showed that a coal product containing 6.98% ash was obtainable with recovery of 61.73% by this two-stage concentration process. 10.1002/cjce.20206

Optimization of Process Parameters for Flowing Film Concentration of Ground Printed Circuit Boards.

Vidyadhar, A and Vaishanau, V S and Das, Avimanyu (2009)
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In: International Seminar on Mineral Processing Technology (MPT-2009), Oct 28-30, 2009, IMMT, Bhubaneshwar.

Printed circuit boards, incorporated in most electrical and electronic equipment, contain valuable metals such as Cu, Ni, Au, Ag, Pd, Fe, Sn and Pb, etc. The circuit boards are rich in metal content and the need for processing these wastes to extract the metals values and remove the non-metallic constituents has been felt all over the world. It was evident from size-wise chemical analysis of the ground PCBs that the particulate system is quite rich in metal value with about 23% of the total powder being metallic. It contained 12.8% Cu, 2.4% Pb, 1.2% Sn, 2.5% Al and 0.5% Ni. This paper summarizes the effect of operating variables of crushed PCB waste using Wilfley Table.

Detailed experimentation has been performed with crushed printed circuit boards according to a Box-Behnken design of experiments to establish the influence operating variables on the separation performance. The optimized conditions for maximizing the yield of the metal values with respect to the specified grade of the concentrate were discussed in the light of the experimental results. http://eprints.nmlindia.org/3790/

Prediction of Coke CSR from Ash Chemistry of Coal Blend

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International Journal Of Coal Preparation And Utilization, Vol. 29(5), 2009, pp. 243-250

Coke reactivity index (CRI) and coke strength after reaction (CSR) are the most important parameters used to assess the blast-furnace coke quality. The present work describes the possibility of estimating CSR for coke from ash chemistry of coal blends. For development and validation of the regression model, data obtained from the Tata Steel's coke oven battery numbers 8 and 9 were utilized. It was found that CSR is greatly influenced by coal ash chemistry. 10.1080/19392690903218117

Briquetting of Coal Fines and Sawdust - Effect of Particle-Size Distribution

Patil, D. P.; Taulbee, D.; Parekh, B. K.; Honaker, R.

International Journal Of Coal Preparation And Utilization, Vol. 29(5), 2009, pp. 251-264

The coal industry usually discards fine-size (-150microns) coal because of its high-moisture content and handling problems. One avenue for utilization is to either pelletize or briquette this material. However, industry has not adopted this route due in large part to significant drying and binder costs. In an effort to reduce these costs, compacting and briquetting studies were conducted to determine the effect of combining a coarse (1.18x0.15mm) spiral separator product with a fine coal flotation product (-150microns), with and without adding sawdust. Maximizing the packing density of the coal and wood waste mixture could potentially reduce the binder requirement by minimizing the void space as well as reducing shipping costs. Accordingly, work reported here focused on evaluating the impact of the particle-size distribution of different blends of fine and coarse coal, with and without sawdust and/or binder. The modified Proctor density of compacted blends along with the porosity and compressive strengths of briquettes made from each blend were

determined. For the coal-only blends, the packing density was maximized by a relatively high (70% to 80%) coarse coal content. However, the packing density did not correlate with the compressive strength of the briquette that instead maximized with 100% fine flotation coal and continuously decreased as higher proportions of coarse coal were added. Similar compaction and compressive-strength results were obtained with mixtures of sawdust and varying proportions of coarse and fine coal. With the addition of a binder, the highest strengths were no longer obtained with 100% fine coal but instead maximized between 20% and 50% coarse coal addition depending on how long the briquettes were cured. 10.1080/19392690903294423

The Effect of Fine Coal Particles on the Performance of Gas-Solid Fluidized Beds

Tang, L. G.; Zhao, Y. M.; Luo, Z. F.; Liang, C. C.; Chen, Z. Q.; Xing, H. B.
International Journal Of Coal Preparation And Utilization, Vol. 29(5), 2009, pp. 265-278

The distribution of 3x1mm fine coal particles across the fluidized bed was analyzed during beneficiation of coal in a gas-solid fluidized-bed separator. The effect of accumulation of the fine coal on the bed performance was also studied. The experimental results show that as 3x1mm size fine coal content increases in the solid medium the mean density of bed decreases linearly. A mathematical model was developed that can predict the standard deviation of the bed density. The bed density increases sharply as the coal-fines content exceeds 4.5 weight%, at which point the bed becomes unstable and poor fluidization performance takes place. Furthermore, the separation performance of a bed was measured by 50x6mm size tracker balls. The separation performance decreased gradually as the fine coal particles accumulated. When the content of the bed reached 4.5 weight%, the probable error, E, rose from 0.05-0.08g/cm3. Therefore, to maintain good fluidization and separation performance the 3x1mm fine coal content of the medium should be controlled to less than 4.5% during dry beneficiation processing of coal. 10.1080/19392690903411977

Single particle impact breakage characteristics of clinkers related to mineral composition and grindability

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Minerals Engineering, OCT, 2009, Vol. 22(13), pp. 1160-1165.

Single particle impact breakage characteristics of clinkers from different plants were determined by the drop-weight technique. impact breakage distribution parameter (t(10)) defined by Narayanan INarayanan, S.S., Whiten, W.J., 1983. Breakage characteristics for ores for ball mill modelling. In: Proceeding of the Australasian Institute of Mining and Metallurgy, vol. 286, pp. 31-39.] was used to characterise the breakage distributions of different clinkers based on the specific comminution energy. The single particle impact breakage resistance parameter as represented by A.b [Man, Y.T., 2000. A model based scale-up procedure for wet, overflow ball mills. Ph.D. Thesis, Department of Mining, Minerals and Materials Engineering, The University of Queensland) based on the model parameters of the well known E(cs)-t(10) relationship given by Leung [Leung, K., 1987. An energy-based ore specific model for autogeneous and semi-autogeneous grinding. Ph.D. Thesis, The University of Queensland, JKMRC] was correlated with the standard bond index number, belite and alite mineral amounts. (C) 2009 Published by Elsevier Ltd. 10.1016/j.mineng.2009.06.001

An investigation into the effect of combinations of various reagents and pH regimes on the flotation of pyrrhotite.

Dey, Shobhana and Allison, S and Franzidis, J.-P and Yorath, G and Harris, P J and O'Connor, C T (2009)
sd@nmlindia.org
In: Flotation '09, 2009, Cape Town, South Africa.
http://eprints.nmlindia.org/5695/

New approach for quantification of sulphydryl collector- mixture on sulphide mineral surface.

Dey, Shobhana and Franzidis, J.-P and Harris, P J (2009)
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In: International Seminar on Mineral Processing Technology (MPT-2009) , October 28-30, 2009, IMMT, Bhubaneshwar.
http://eprints.nmlindia.org/5696/

Numerical studies of the effects of medium properties in dense medium cyclone operations

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Minerals Engineering, OCT, 2009, Vol. 22(11), pp. 931-943.

A mathematical approach is proposed to describe the multiphase flow in a 1000 mm industrial dense medium cyclone. A mixture multiphase model is employed to describe the flow of the dense medium (comprising finely ground magnetite contaminated with non-magnetic material in water) and the air core, where the turbulence is described by the well established Reynolds stress model. The stochastic Lagrangian particle tracking method is used to simulate the flow of coal particles. The proposed approach was qualitatively validated using literature and industrial data and then used to study the effects of medium properties including medium density, magnetite type and non-magnetic content. It is found that as the medium density increases, the pressure drop increases, resulting in a high pressure gradient force on coal particles and reduced separating efficiencies. The segregation of magnetite particles becomes serious as magnetite particle size increases, which leads to a high density differential and a high off-set. The viscosity of medium decreases and the segregation of magnetite particles become significant with the decrease of non-magnetic content, resulting in a high density differential and off-set.
10.1016/j.mineng.2009.03.019

A new practical method to determine the microwave energy absorption ability of materials

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Minerals Engineering, PERGAMON-ELSEVIER SCIENCE LTD, OXFORD, OCT, 2009, Vol. 22(13), pp. 1154-1159

To quantitatively measure and compare the ability of different materials in absorbing microwave energy, a new practical method, only using a home microwave oven with microwave radiation out of the bottom of the cavity as the major apparatus, was developed. During the measuring process, each target material and water, separately contained with two microwave transparent containers, respectively, were simultaneously placed in the oven cavity for microwave irradiation. The water container was above the tested materials container, and the water acted as the medium to absorb-the microwave energy surplus to that absorbed by tested materials. By determining the water temperature and then calculating its absorbed microwave energy, the microwave energy absorbed by the target materials could be obtained. According to this method, seven bulk solid materials of reagent grade were tested and the results agree well with previous research reports. In addition, the principle and control of the measuring conditions of

the novel method were discussed in this paper. (C) 2009 Published by Elsevier. 10.1016/j.mineng.2009.05.003

A Mintek perspective of the past 25 years in minerals bioleaching
Gericke, M; Neale, JW; van Staden, PJ
Journal of the South African Institute of Mining and Metallurgy, OCT, 2009, Vol. 109(10), pp. 567-585

The microbial leaching of metal sulfides is now an established biotechnological technology. Over the past 25 years, refinements in the engineering design of bioleaching processes have paralleled advances in our understanding of the diversity and role of the micro-organisms driving the process and the mechanisms by which micro-organisms enhance metal sulfide oxidation. Commercial success started with the treatment of refractory gold concentrates using mesophilic micro-organisms, followed by the development of tank bioleaching processes for the treatment of base metal concentrates. This was, initially, a mesophilic process with limited potential for recovery of copper from chalcopyrite concentrates due to slow rates and low copper extractions. The exploitation of thermophiles represents a major breakthrough in the development of bioleaching technology for the treatment of chalcopyrite-containing ores and concentrates. This development also opened the route to heap bioleaching of chalcopyrite ores, which is now a major focus of research programmes and piloting campaigns. This paper reviews the historical development of minerals bioleaching processes and gives an update on the current status of commercial tank and heap bioleach operations around the world.

Design of a Dry Cover Pilot Test for Acid Mine Drainage Abatement in Southern Brazil. I: Materials Characterization and Numerical Modeling
Soares, AB; Ubaldo, MD; de Souza, VP; Soares, PSM; Barbosa, MC; Mendonca, RMG
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Mine Water and the Environment, SPRINGER HEIDELBERG, HEIDELBERG, OCT, 2009, Vol. 28(3), pp. 219-231.

Pyritic coal wastes produced by a coal beneficiation plant in the State of Santa Catarina in southern Brazil are acid generating. In this paper, we report the results from the first phase of a study evaluating the performance of dry covers for minimizing generation of acid mine drainage and its release to the environment. The first phase includes our investigation of locally available

materials for dry covers. Numerical modeling led to four configurations being selected for testing: a dry cover using a double capillary barrier with bottom ash, a dry cover with a single layer of clay, a dry cover with mixed waste, and waste with no cover. Modeling also showed that the best position for the lysimeter was at the bottom of the excavation, where it would not interfere with the water flux in the waste. A subsequent paper will describe the construction of the experimental unit and the results of the geotechnical and geochemical studies. 10.1007/s10230-009-0077-5

A novel approach to the geometallurgical modelling of the Collahuasi grinding circuit

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Minerals Engineering, PERGAMON-ELSEVIER SCIENCE LTD, OXFORD, OCT, 2009, Vol. 22(12), pp. 1060-1067.

Compania Minera Doila Ines de Collahuasi SCM initiated the development of a new geometallurgical model to characterize its Rosario deposit in terms of its comminution circuit capacity and flotation performance. The comminution component of the model is now complete and is described in detail in this article. The model uses a combination Of Simulation and power-based approaches to relate ore hardness and flotation feed size to grinding circuit throughput. Ore hardness values are provided by Collahuasi's block model which has been populated with ore characterisation data derived from Bond ball work index tests, JK drop-weight tests and SMC Tests (R) on diamond drill cores. The influences of planned and unplanned maintenance downtime are taken into account both in terms of frequency and duration. The accuracy of the model is demonstrated using weekly production data taken from the period January-December 2008, showing an average relative error of 5.2% and an R(2) value of 0.95. The model is now in successful routine use at the mine for planning purposes and is currently in the process of being further developed to incorporate the response of the flotation circuit. 10.1016/j.mineng.2009.03.017

Separation performance of double deck banana screens - Part 1: Flow and separation for different accelerations

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Minerals Engineering, NOV, 2009, Vol. 22(14), pp. 1218-1229.

Banana screens are often used for high capacity separation of iron ore, coal and aggregates into different size fractions. They consist of one or more curved decks that are fitted with screen panels with arrays of square or rectangular holes. The screen structure is vibrated at high frequency to generate peak accelerations of around 4-6g which separates particles flowing over each screen according to their size. Screens are often used to close comminution circuits and return specific size fractions of rock to different destinations such as pebble mills, crushers and back into the mills. All multi-deck screens are difficult to sample for intermediate products which makes measurement and optimization very difficult. Banana screens are even more difficult because the screen cut size varies with the varying slope of the decks. In this paper, the discrete element method (DEM) is used to simulate a full industrial scale double deck banana screen for a range of accelerations. The nature of the particle flow through this complex machine is explored for a range of peak accelerations. Critical aspects of the flow are linked to the separation performance. 10.1016/j.mineng.2009.07.002

Application of acidithiobacillus ferrooxidans in coal flotation

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International Journal of Coal Preparation And Utilization, Vol. 29(6), 2009, pp. 279-288

Bioflotation is a potential method for removing pyritic sulphur from coal. Sodium cyanide is a well-known depressant for pyrite in flotation of sulphide minerals; however, for coal this reagent is unacceptable from the environmental point of view. This study investigates an alternate to sodium cyanide; Acidithiobacillus Ferrooxidans, a nonharmful bacterial reagent as a pyrite depressant. The flotation behavior of pyrite and other gangue particles using the sodium cyanide and the Ferrooxidans is compared by applying the general first-order flotation model. The kinetic parameters extracted from the model demonstrated that the modified flotation rate of pyrite was reduced, and the selectivity between coal and gangue was improved using the bacteria. These results indicate that Acidithiobacillus Ferrooxidans has potential in removing pyritic sulfur from coal. 10.1080/19392690903558314

Considerations on the kinetics of froth flotation of ultrafine coal contained in tailings

Chaves, A. P.; Ruiz, A. S.

International Journal Of Coal Preparation And Utilization, Vol. 29(6), 2009, pp. 289-297

This article presents a kinetic evaluation of froth flotation of ultrafine coal contained in the tailings from a Colombian coal preparation plant. The plant utilizes a dense-medium cyclones and spirals circuit. The tailings contained material that was 63% finer than 14 mu m. Flotation tests were performed with and without coal "promoters" (diesel oil or kerosene) to evaluate the kinetics of flotation of coal. It was found that flotation rates were higher when no promoter was added. Different kinetic models were evaluated for the flotation of the coal from the tailings, and it was found that the best fitted model was the classical first-order model. 10.1080/19392690903558371

An overview study of chlorination reactions applied to the primary extraction and recycling of metals and to the synthesis of new reagents

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Thermochimica Acta, ELSEVIER SCIENCE BV, AMSTERDAM, Nov-10, 2009, Vol. 495, pp. 42-50.

Energy intensive classical metallurgical processes, the depletion of high-grade ores and primary sources push the scientific and technical communities to treat lean and complex ores as well as secondary metal resources for the recovery of valuable metals. Chlorination technique could be a suitable technology for this purpose. This paper Summarizes laboratory experimentation of chlorination processes developed for the extraction of tantalum and niobium from their bearing materials, the upgrading of chromite, the treatment of sulfide concentrates, and the decontamination of jarosite, as well as for the synthesis of potassium ferrate. Each investigation started by a thermodynamic study of different systems (M-O-Cl, M-S-Cl, M = metal) including the calculations of the standard free energy of chlorination reactions and phase stability diagrams of these systems. The kinetics of these chlorination reactions was studied by thermogravimetric analysis. The effects of total gas flow rate, temperature, individual reactant partial pressures, etc., on the chlorination reaction rate were investigated. Besides, experiments were also conducted in tubular furnaces. Several different qualitative and quantitative analyses methods were used to evaluate the selectivity and performance of the chlorination processes. The results reported in this paper show the advantages of the chlorination technology in terms of energy saving. selectivity of the processes,and recovery rate of valuable metals. They also demonstrate the possibility to treat lean raw materials, to improve the decontamination of wastes, to generate environmentally safer residues, to engineer new compounds, etc. 10.1016/j.tca.2009.05.013

Silica sand resources in the Netherlands

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Netherlands Journal Of Geosciences-Geologie En Mijnbouw, NOV, 2009, Vol. 88(3), pp. 147-160.

Silica sand, (almost) pure quartz sand, is a valuable and scarce mineral resource within the shallow Dutch subsurface. High-grade deposits are exploited in the southeasternmost part of the country, as raw material for the glass, ceramic, chemical and other process industries. Dutch land-use policy requires that scarce mineral resources (including silica sand) are taken into consideration in spatial planning and when preparing for large-scale engineering or construction works. For this purpose, and in order to review the long-term possibilities for home production of silica sand, we determined resource potential nationally. Our approach was (1) to establish the relevant conditions and processes associated with the deposition of the currently exploited sands, (2) identify lithostratigraphic units that are genetically similar or are otherwise known to contain quartz-rich sands, and (3) query the Dutch geological survey's borehole database for potential silica sand occurrences within those units. As we have to rely on non-dedicated data, the latter step was undertaken using a largely qualitative set of lithological search parameters. Finally, a limited number of available chemical analyses was used for preliminary verification purposes.

Using this approach, we identified three prospective areas: one in the north of the province of Limburg and east of the province of Noord-Brabant (similar to 750 km(2)), one in the central south of Noord-Brabant (similar to 45 km(2)), and one in the east of the Gelderland and Overijssel provinces (similar to 1,200 km(2)). For each area, first-order characteristics of possible silica sand resources are presented (type of deposit, depth, approximate thickness). In the terms of current reporting conventions, we resolved silica sand occurrence to the level of 'reconnaissance mineral resource' or 'exploration result', and our results do not constitute a formal resource declaration. Available chemical data suggest that the resources in the first two areas could be or become economic, although the grades are lower than those of the currently exploited resources. The third area is less promising in that respect, but available data is too limited to reject the area in this stage. Even so, we tentatively conclude that home production of silica sand can probably be maintained after the reserves in Limburg are depleted.

Mineral Processing.

Das, A (2009)
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In: A Continuing Education Course for Metallurgy for Engineers, December 14-16, 2009, NML, Jamshedpur.

The minerals and the metals are integrally associated with the development of human culture and growth of the society. Minerals are essential component of Nation's material and economic base. They contribute to indust-rialization and form an important infrastructure for the development of the country. However, conservation of these non-renewable assets is absolutely essential in view of the rapid industrialization and consumption of minerals. Attempts should be aimed to use the resour-ces wisely and efficiently for complete utilization of the components with no waste. Ignoring the awareness in respect of mineral resources, environmental issues have come into prominence and the aspect of conservation and safe guarding the environment can be managed by making proper use of the mined materials, wasting the least, reclamation, restoration, afforestation and creation of better environment for better habitat.
http://eprints.nmlindia.org/5929/

Modeling Competitive Adsorption of Copper(II), Lead(II), and Cadmium(II) by Kaolinite-Based Clay Mineral/Humic Acid System

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Environmental Progress & Sustainable Energy, DEC, 2009, Vol. 28(4), pp. 493-506.

The aim of this work is to investigate and model the simultaneous adsorption of Cu(II), Cd(II), and Pb(II) in the presence and absence of humic acid on kaolinite-based clays. The preliminary capacity estimation of clays for metal was made with the use of a modified Langmuir approach, and adsorption data collected at various pH were processed using the FITEQL 3.2 computer program to establish the model. The three types of surface sites responsible for adsorption were considered to be the permanent charge sites X(2)(2-), and variable charge sites comprised of S(1)OH silanol groups and S(2)OH aluminol groups of kaolinite-based clays. Heavy metal cations were assumed to bind to the surface in the form of outer sphere and inner sphere monodentate complexes. When humic acid was added, divalent metal ion adsorption was modeled using a multisite binding model by the aid of FITEQL 3.2. since the stability of the ternary surface complexes in the presence of humic acid was higher than that of the corresponding binary heavy metal

cation complexes, the adsorption versus pH curves were sleeper (and distinctly S-shaped) compared with the tailed curves observed in binary clay metal ion systems, probably due to the fact that humic acid-coated kaolinite essentially constituted the active surface for metal sorption. Although competitive metal adsorption from (metal ions mixture+humate) solutions was generally lower than those from individual metal ion solutions, Cd(2+), being the metal ion with the highest affinity toward permanent charge sites, was the least affected ion at relatively low pH from competitive adsorption. (C) 2008 American Institute of Chemical Engineers Environ Prog, 28: 493-506, 2009
10.1002/ep.10331

Mineralogical characteristics of soil dust from source regions in northern China

Shen, ZX; Caquineau, S; Cao, JJ; Zhang, XY; Han, YM; Gaudichet, A; Gomes, L
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Particuology, DEC, 2009, Vol. 7(6), pp. 507-512.

Mineral compositions of aerosol particles were investigated at four sites (Aksu, Dunhuang, Zhenbeitai, and Tongliao) in desert regions of northern China from March to May in 2001 and 2002 during the intensive field campaign period of ACE-Asia (Aerosol Characterization Experiments-Asia). The X-ray diffraction (XRD) results show the main minerals for Asian dust are illite, chlorite, kaolinite, quartz, feldspar, calcite, and dolomite. Gypsum, homblende, and halite are also detected in several samples. Semi-quantitative mineralogical data of aerosol samples show that carbonate content decreases from western to eastern source areas; that is, soil dust collected at western source area sites of Dunhuang and Aksu are enriched with carbonate, while northeastern source area site of Tongliao is associated with low carbonate content. But the spatial distribution of feldspar exhibits a different pattern as compared to carbonate, increasing from the western to the eastern sources. The total clay content is significantly higher (73% in average) at the deposition site of Changwu than those at source areas. Air-mass back trajectory studies for the three dust storm events observed at Changwu, showed that soil dust transport pathways were as expected from carbonate content for the source identification, further demonstrating that carbonate was a useful tracer for eolian dust on regional scale in northern China.
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Cemented products containing waste from mineral processing and bioleaching

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The characteristics of cemented products ranging in initial consistency from 'paste-like' to 'flowable', relevant to paste backfill and backfill with controlled low strength materials (CLSM), respectively, were compared for mixes incorporating waste from pilot scale bioleaching of European refractory gold, copper and copper/nickel sulphide flotation concentrates. Compositional and structural properties were linked to mechanical strength, hydraulic conductivity and hydrolytic stability (leachability) in fabricated laboratory specimens containing sand, pulverised fuel ash, waste and Portland cement in the proportions 70, 15, 10 and 5, respectively, together with variable quantities of water. In some experiments, sand was replaced by flotation tailings. The results showed that mixtures containing 10% of waste with 15.0-37.5% water by mass gave cemented materials with unconfined compressive strength (UCS) in the range 0.4-3.0 MPa after 28 days of hardening, this range encompassing typical paste-fill and CLSM formulations. They also indicated formulations giving maximum UCS and retention of strength at higher water content in the presence of the (finer sized) waste. Hydraulic conductivity (10(-7)-10(-1) m/s) was comparable to commercial CLSM. Chemical analysis indicated low levels of most toxic elements and correspondingly low diffusion leaching, thus reducing requirements for special lining or encapsulation procedures to avoid groundwater contamination. However, chromium leaching, for example, remained an issue, thus indicating a need for further development before regulatory acceptance and deployment in field applications can become feasible. The formulated materials are consistent in principle with a scheme of integrated waste management based on designed combinations of paste (for mine backfill), CLSM (for engineering foundation construction) and mineral bulk (for site landscape/soil restoration). In particular, they facilitate production of different materials for paste backfill and CLSM applications by judicious adjustment of water content. 10.1016/j.mineng.2009.08.004

Moisture-induced swelling of coal

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The gas-induced swelling behavior of coal is important when considering CO(2) sequestration into coal seams or enhanced coalbed methane applications, but coals may also swell in the presence of moisture, or shrink on drying. In this paper we examine the moisture-swelling properties of coals from Australia and elsewhere. Results on the moisture uptake and corresponding swelling measurements are presented for 15 coals of various ranks (sub-bituminous and bituminous) at 22 degrees C and atmospheric pressure. Measurements were made by exposing sample blocks of coal (nominally 30 x 10 x 10mm) to relative humidities ranging from 0% to 97%. A selection of coals was also fully saturated in water. Moisture uptake at 97% relative humidity (RH) ranged from about 2.5% to more than 16% db. Maximum linear strain associated with the moisture sorption (measured at 97% RH) varied from about 0.2% to 1.3%, with lower rank coals showing the most swelling. In all cases, swelling was greater in the direction perpendicular to the bedding plane. These results correspond to volumetric swelling of about 0.5% to around 5%. Although exhibiting significant expansion, all of the samples returned to their original dimensions upon drying.Volumetric moisture sorption and the amount of swelling induced were found to be strongly correlated by a single linear expression that held for all of the coals examined. It was further found that the volume of the water adsorbed was linearly related tothe pore space within the coal, however, at 97% relative humidity, only about 60% of the available pore space is occupied by water. Exposure to liquid water allowed the pores to completely fill; although for the lowest rank coals, the volume of water absorbed appeared to be slightly more than the corresponding pore volume. Despite the additional water uptake, immersion in water did not produce further swelling beyond that induced at 97% relative humidity.
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A novel fluidized bed drying and density segregation process for upgrading low-rank coals

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Lignite and sub-bituminous coals are attractive due to their low cost, low emissions, and high reactivity. However, these coals contain large amounts of moisture, which reduces calorific value and lowers plant efficiency. A novel fluidized bed drying process was developed that uses low-grade waste heat to reduce fuel moisture content of low-rank high-moisture coals and

concurrently lowers sulfur and mercury content of dried coal through density segregation. This paper discusses quality improvement of low-rank coals by low-temperature thermal drying, describes changes in microstructure of coal particles and describes the reduction in sulfur and mercury via density segregation during thermal drying of lignite in a specially designed fluidized bed. 10.1080/19392691003666387

Adsorption behavior of rare earth elements using polyethyleneglycol (phosphomolybdate and tungstate) heteropolyacid sorbents in nitric solution

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A new type of crystalline sorbent was prepared by the reaction of polyethyleneglycol (PEG) with phosphomolybdic (PMo) and phosphotungstic (PW) heteropolyacids. The morphology of the obtained sorbents was studied by X-ray diffraction (XRD) and scanning electron microscopy (SEM). It has been shown that a complexing reaction occurs between PEG and the heteropolyacids. By using these sorbents, the adsorption behaviors of rare earth elements in nitric solution were studied. The effects of temperature, contact time, nitric acid and initial metal ion concentration on the adsorption were investigated. In 0.1-5.0 mol L(-1) HNO(3), the adsorption percentage decreases with the increase of acid concentration. H,PEG400,PW and H,PEG400,PMo exhibited a different selectivity for rare earth metals with H,PEG400,PW adsorbing in the order of La(3+)>Y(3+)>Pr(3+)>Gd(3+)>Sm(3+), and H,PEG400,PMo in the order of Y(3+)>La(3+)>Pr(3+)>Gd(3+)>Sm(3+). The experimental maximum adsorption capacities of the sorbents are in the range of 90-225 mg g(-1) for Y(3+), La(3+), Pr(3+), Sm(3+) and Gd(3+). In all cases, the maximum adsorption capacities of H,PEG400,PW are near to those of H,PEG400,PMo. The equilibrium data were evaluated according to the Freundlich and Langmuir isotherms and the Langmuir equation gave a better fit and modeled the adsorption well.
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Solvent extraction study of rare earth elements from chloride medium by mixtures of sec-nonylphenoxy acetic acid with Cyanex301 or Cyanex302

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The extraction of rare earth elements from chloride medium by mixtures of sec-nonylphenoxy acetic acid (CA100) with bis(2,4,4-trimethylpentyl) dithiophosphinic acid (Cyanex301) or bis(2,4,4-trimethylpentyl) monothiophosphinic acid (Cyanex302) in n-heptane has been studied. The synergistic enhancement of the extraction of lanthanum (III) by mixtures of CA100 with Cyanex301 has been investigated using the methods of slope analysis and constant mole. The extracted complex of lanthanum (III) is determined. The logarithm of the equilibrium constant is calculated as - 1.41. The formation constants and the thermodynamic functions, Delta H, Delta G, and Delta S have also been determined. Moreover, the different extraction effects of rare earth elements in the mixing systems of CA100 with Cyanex301 or Cyanex302 have been employed to consider the possibility of separating rare earth elements according to their separation factors. 10.1016/j.hydromet.2009.09.006

Recovery of Ni, Co and rare earths from spent Ni-metal hydride batteries and preparation of spherical Ni(OH)(2)

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A hydrometallurgical procedure has been developed for the separation and recovery of nickel, cobalt and rare earths (RE) from spent Ni-MH batteries. In the process of separation and recovery, the positive and negative electrode materials were merged and leached with 3 M H2SO4 at 95 degrees C. In this stage, about 94.8% of rare earths were separated from other metals due to the low solubility of RESO4 at relatively high temperature. Then iron, zinc and manganese (together with the remaining 5.2% rare earths) were almost completely separated from nickel and cobalt by solvent extraction with 20% P204. Rare earths in the organic phase were recovered by stripping with 2 M HCl after scrubbing Zn and Mn. Most rare earth sulphates remaining in the leach residue were transformed to RE(OH)(3) by treatment with NaOH and then redissolved from the filter cake as RECl3 by using the rare earth strip liquor and additional HCl. Cobalt was easily separated from nickel by solvent extraction with 20% Cyanex 272 and pure cobalt and nickel sulphates were recovered from evaporation of the strip liquor and raffinate respectively. Finally, spherical nickel hydroxide powder was synthesized from the pure nickel sulphate, which is an important starting material for Ni-MH batteries. The overall recovery efficiency for rare earths, cobalt and nickel exceeded 98%.
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