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Directions of hard coal processing technological changes in Poland

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GOSPODARKA SUROWCAMI MINERALNYMI-MINERAL RESOURCES MANAGEMENT, [WYDAWNICTWO IGSMIE PAN, KRAKOW], 2008, Vol. 24(1), pp. 245-258.

The purpose of the union program Scenarios of hard coal extractive industry technological development" was to determine the directions of changes and development till 2020. Oil the basis of so-called technological cards, 4 types of coal processing plants in Poland were selected [2, 3, 4, 5, 12]: energetic coal beneficiation of granulation above 20 (10) mm, energetic coal beneficiation of granulation above 0, 1 (1) mm, energetic coal beneficiation of full range of granulation, coking coal beneficiation of full range of granulation. Because of the coal quality, many different beneficiation techniques are required, which cause creation of separate technological systems. As the result of analyses (by AHP method) the development technologies of full beneficiation of energetic and coking coals were accepted, which technological schemes and data were presented on Fig. I and in Table 1, 2. According to the Fig. 1, three methods of coal wastes application were shown, i.e. de-stoning at the bottom of the mine (Fig. 2), de-stoning of thick output in processing plant, including mineral aggregates production, replacing beneficiation in heavy liquids (Fig. 3) and traditional raw coal beneficiation with modern mineral aggregates production installation (Fig. 4). With the world achievements and technologies being applied as the background, the present state and recommended changes for polish hard coal mining were shown, including: gravitational beneficiation of thick and medium fractions (chapter 3), gravitational beneficiation of fine fractions (chapter 4), flotation (chapter 5). For gravitational bcneficiation of thick and medium fractions, mainly the devices of DISA type (both 2 and 3 product) with their discussion of potential development and application. For gravitational beneficiation of fine fractions, the culm, medium grained, grained and raw coal de-stoning jigs were presented. Furthermore, the types of devices being applied in the whole world, as hydrocyclones with heavy liquids (ie. Larcodems), spiral concentrators, teeter-bed separators were discussed. Concerning the flotation, the froth flotation and selective flotation were presented with discussion of applied devices of this type in the modern mines in the whole world. The researching works in the context of coal gravitational beneficiation should lead to elaborate methods of

ultrafine coal beneficiation, coal desulfurization, removing undesirable components from ashes, applying modern hydrocyclones with heavy liquids, searching for agents allowing reducing costs and dewatering products of fine coal beneficiation.

Estimating effect of chrome ore granulometry on sintered pellet properties

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IRONMAKING & STEELMAKING, [MANEY PUBLISHING, LEEDS], JAN, 2008, Vol. 35(1), pp. 27-32.

Chromite ore pellets are used for ferrochrome production by the smelting reduction process. The strength and porosity of the sintered pellets play a significant role in smelting reduction. Granulometry of the chromite fines used for pellet production is an imperative enabler which controls the pellet strength and porosity by packing of particles and formation of bonds due to melting of gangues at high temperature sintering. The effect of chromite ore granulometry and sintering process parameters was evaluated to improve the metallurgical performance of pellets in a submerged arc furnace. The drop test, compressive strength and porosity of sintered pellet samples from plant and laboratory tests were evaluated. Mathematical correlations of the pellet properties (strength and porosity), ore granulometry and sintering parameters were determined using Statistica (ver7), statistical software package. It was found that ore granulometry, i. e. particle size, plays a vital role in the pelletisation process by controlling the number of contact points for bond formation and due to different liberation and smelting reduction characteristics of gangue minerals. It was concluded that for Sukinda chromite ores, required pellet properties can be achieved by maximising the 74-37 mu m fraction of chromite fines in the charge and sintering at 1000 degrees C.
DOI: 10.1179/174328107X203976

In depth analysis of alumina removal from iron ore fines using teetered bed gravity separator.

Sarkar, B and Das, Avimanyu and Roy, Subrata and Rai, S K (2008)
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Mineral Processing and Extractive Metallurgy (Trans. IMM C), 117 (1). pp. 48-55.

The performance of floatex density separator (FDS) for alumina removal from iron ore fines of size <1˙0 mm has been studied. Screw classifier feed containing 4˙28% alumina has been used as the raw feed material. Desliming in hydrocyclone helps to reduce the alumina content down to 3˙39% by removing high alumina bearing ultrafine particles. Experimental campaign was undertaken considering a factorial design of experiments with three factors, namely teeter water rate, bed pressure and feed pulp density, to quantify the influence of various parameters. It was found that in single stage processing in FDS, 72% of the feed alumina could be removed. A concentrate

containing 1˙66% alumina could be achieved at a yield of ~57% in FDS. Higher teeter water was found to improve alumina removal albeit with a small decrease in iron recovery. It was observed that higher bed pressure and lower pulp density are favourable for alumina rejection. The present study established that underflow moisture is a good indicator of FDS performance. The misplacement of ultrafines in FDS underflow product increases linearly with underflow moisture content. It has been suggested that a feed with a narrow size distribution would be better suited for processing in the FDS. Splitting the feed into a coarse and a fine size fraction and treating them separately would be beneficial in obtaining still better alumina removal.

http://eprints.nmlindia.org/3175/

Hard coal mechanical beneficiation in the perspective of the year 2020

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Work performed by Research Consortium (partners: Central Mining Institute - coordinator, AGH University of Science and Technology, KOMAG Mining Mechanization Centre, Silesian University of Technology, EMAG Centre) in the task 4.4 "Scenarios of Technological Development of mechanical coal beneficiation" of the foresight project is presented in the paper. Results analysis of innovative technology of steam and coking coal is described. For the purpose of analysis innovation level of technology was established for each of the foresight tasks. Particular criteria were attributed to following weights describing its importance: Criterion of current technological (technical) level referred to other advanced technical domains (materials, automation, information technology, management, etc.) - weight: 0.25. Criterion of technology efficiency referred to external conditions - weight: 0. 15. Criterion of technology versatility referred to technology and application conditions - weight 0. 10. Criterion of negative environmental impact minimization - weight: 0.25. Criterion of occupational safety and health - weight: 0.25. Each of the beneficiation technologies had a preferential grade scale in the range of 0 to 3. Particular grades were attributed to the following technological advance: 0 - useless technology, 1 - technology with limited usability, 2 - useful technology, 3 - very useful technology. In accordance with guidelines assumed for completion of task 3 three levels of technology were determined: decaying technology, widespread technology and developing technology. For the propagating technology and widespread technology three levels of innovation intensity were assumed: a - low, b - medium, c - high. Forecast of coal beneficiation technologies and change of working condition till year 2020 are presented. Factors conditioning this development were identified i.e.: financial investments and location, The paper also describes direction of research on coal beneficiation technologies and results of a survey made among responders.

An anorganic bioceramic matrix for use as scaffold in bone regeneration: pharmaceutical development and preliminary biological evaluation

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JOURNAL OF DRUG DELIVERY SCIENCE AND TECHNOLOGY, EDITIONS SANTE, PARIS, JAN-FEB, 2008, Vol. 18(1), pp. 73-78.

Regenerative medicine is an interdisciplinary field involving biology, medicine and engineering. It is focused on the repair, regeneration or replacement of cells, tissues or organs in order to restore their biological functionality to improve patients' quality of life. The purpose of this work was to develop an anorganic bioceramic matrix obtained from natural and traceable bovine bones capable of acting as a scaffold and as a mineral reservoir for guided bone heating. The manufacturing process used went through several stages in order to assure the removal of all organic components. The products obtained were analyzed and a biological evaluation performed. An anorganic matrix derived from bovine bones with morphology similar to human cancellous bone was obtained. The biological evaluation has shown that the material was well integrated to the tissue with no signs of inflammation and the beginning of new bone formation. This biomaterial appears to be a promising candidate for future applications in tissue engineering and drug delivery as a scaffold with a porous structure.

Controlled release of insulin-like growth factor-1 and bone marrow stromal cell function of bone-like mineral layer-coated poly(lactic-co-glycolic acid) scaffolds

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JOURNAL OF TISSUE ENGINEERING AND REGENERATIVE MEDICINE, [JOHN WILEY & SONS LTD., CHICHESTER], JAN, 2008, Vol. 2(1), pp. 43-49.

Controlled release of growth factors or drugs provides great therapeutic advantages for bone defects which do not heal with normal therapeutic treatments. We have accelerated the deposition of bone-like mineral (BLM) on the surface of three-dimensional (3D) poly(lactic-co-glycolic acid) (PLGA) porous scaffolds to 36-48 h by modifying the biomimetic process parameters and applying surface treatments onto PLGA scaffolds. We used simulated body fluid containing insulin-like growth factor-1 (IGF-1; 1 mu g/ml) to mineralize the PLGA scaffolds for 48 h. IGF-1 was co-precipitated with mineral on the surface of the PLGA scaffolds. IGF-1-incorporated mineralized scaffolds demonstrated slow controlled release over a 30 day period when they were incubated in phosphate-buffered saline (PBS) at 37 degrees C. Bone marrow stromal cell (BMSC) function on three different types of scaffolds, such as control (non-mineralized) scaffolds, mineralized scaffolds, and IGF-1-incorporated mineralized scaffolds was also investigated. BMSC attachment and proliferation was enhanced for IGF-1-incorporated mineralized scaffolds compared with controls during the culture period. BMSC differentiation was not changed during the culture period among the three

groups of scaffolds, as assessed by alkaline phosphatase activity and osteocalcin assay. According to findings from this study, BLM has great potential to be used as a carrier for biological molecules for localized release applications as well as bone tissue-engineering applications. Copyright (c) 2008 John Wiley & Sons, Ltd.
DOI: 10.1002/term.65

A comparative mineralogical and geochemical characterisation of iron ores from two Indian Precambrian deposits and Krivoy rog deposit, Ukraine: implications for the upgrading of lean grade ore.

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Applied Earth Science : IMM Transactions section B, 117 (3). pp. 125-147.

Iron ores from two important Precambrian belts in India are studied in detail. The first of these is the Jilling-Langalota deposit, hosted by banded iron formations along with generations of shales, tuffs belonging to Iron Ore Group of Eastern India and is hosted in the Singhbhum-North Orissa Craton. The second group of ores is from the Chitradurga basin in Eastern Dharwar Craton, Southern India. These form part of the Archaean greenstone belts and show a typical oxide–carbonate–sulphide association. The Jilling-Langalota deposit contains considerable amounts of blue dust that is absent in the Chitradurga deposit. Comparisons are made between the Indian iron ores and those of the Krivoy Rog province of the Central Ukrainian Shield. The Indian iron ores are relatively richer in Fe and contain higher amounts of alumina and phosphorous compared with those of the Krivoy Rog deposit. The Indian iron ore samples contain porous and friable oxides and hydroxides of iron with kaolinite, gibbsite and quartz. In contrast, the ores from Krivoy Rog are massive with negligible clay and a higher quartz content leading to very low alumina and very high silica contents in the ores and slime. The Indian ores and slimes are manganiferous in nature with high alumina, which is deleterious to processing and is due to the presence of intercalated tuffaceous shales and clay. The Eastern Indian iron ore deposits could have been formed due to enrichment of the primary ore by gradual removal of silica. It is believed that the massive ores result from direct precipitation while powdery blue dust is formed owing to circulating fluids, which leach away the silica from the protore. The host rock is exhalatic banded iron formation and the ubiquitous presence of intercalated tuffaceous shales point towards a genesis that could have involved Fe leaching from sea floor volcanogenic rocks. The nature of these ores along with the parting shale is responsible for production of large amounts of alumina rich slime during mining and handling. The detailed mineralogical characterisation studies aided by X-ray diffraction, scanning electron microscopy—energy dispersive spectroscopy, physical parameters and chemical characteristics have indicated the presence of various mineral phases and established the nature of iron-bearing and gangue assemblages of the bulk ores and slime samples from the three iron ore deposits. These in turn are useful in understanding the amenability of the ores and slimes for beneficiation and waste utilisation.

Physical and thermal treatment of phosphate ores - An overview

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INTERNATIONAL JOURNAL OF MINERAL PROCESSING, [ELSEVIER SCIENCE BV, AMSTERDAM], Jan, 2008, Vol. 85(4), pp. 59-84.

The annual consumption of phosphate rock approached 150 million tons. The marketable phosphate is usually 30% P2O5 Or higher. The run-of-mine material is mostly of lower grade which needs processing or upgrading. The processing techniques of phosphate ores depend mostly on the type of associated gangue minerals present in the mined rock. In some cases, simple, inexpensive techniques are enough to produce the required grade. For example, crushing and screening is used to get rid of the coarse hard siliceous material, and attrition scrubbing and desliming is used to remove the clayey fine fraction. If silica is the main gangue material, single-stage or double-stage flotation is the conventional mineral processing technique used in this case. If the ore is igneous carbonatitic alkaline or ultra basic phosphate deposit, crushing, grinding, scrubbing, and flotation associated with other steps such as magnetic and/or gravity separation is proved to be successful in upgrading this type of ore. The sedimentary phosphate ores having carbonate-apatite as the main phosphate minerals and containing carbonates (calcite and/or dolomite) represent a challenge in the field of phosphate concentration due to similarity in the physico-chemical properties of surfaces of the ore constituents. Also, if considerable amount of organic matter constitutes the main gangue material, upgrading of the ore becomes difficult. New flotation systems (techniques and reagents) are being developed to treat these challenging phosphate ores. Furthermore, calcination is another solution for upgrading these difficult-to-treat types of ores. However, calcination is indicted with some controversial drawbacks. This overview discusses and summarizes the State-of-the-Art and the existing efforts to overcome these problems and to produce a high-grade phosphate product suitable for fertilizers and other phosphate compounds.
DOI: 10.1016/j.minpro.2007.09.001

Process flowsheet development for beneficiation of nickel ore

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Nickel sulphide ore subjected to this investigation was taken from the Marmara district of Turkey, where widespread chromite mineralization can be observed. Some amounts of magnetite and chromite exist in the ore together with sulphide and oxide type nickel minerals. The ore sample contains 1.32% Ni, 10.79% SiO2, 78.39% Fe2O3, 1.3 g/t Ag,

and 1.0 g/t Au. The ore sample is constituted of about 70% magnetite, 15% sulphide minerals, and 5% chromite and iron oxides, as well as 10% gangue minerals. Nickel mineralization in the ore such as pentlandite, violarite, millerite awaruite, and asbolane was determined. Due to the complex structure of mineralization, a combination of gravity-separation and flotation methods was applied for the concentration of nickel sulphide and oxide ores. A nickel concentrate containing 12.32% Ni was produced with 89.7% recovery and final tailings with 0.088% Ni can be disposed with 4.9% of metal loss. A process flowsheet was developed according to the optimum test results. The importance of this research is that it is the first example of developing a flowsheet for the beneficiation of sulphide and oxide type nickel mineralization observed together in chromite ore deposits.
DOI: 10.1080/08827500701257936

Preferential orientation of biological apatite crystallite in original, regenerated and diseased cortical bones

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JOURNAL OF THE CERAMIC SOCIETY OF JAPAN, [CERAMIC SOC JAPAN-NIPPON SERAMIKKUSU, KYOKAI, TOKYO], FEB, 2008, Vol. 116, pp. 313-315.

The bone mechanical function depends on both bone quantity and quality corresponding dominantly to bone mineral density (BMD: density of biological apatite) and other factors, respectively. BMD is correlated with bone strength but accounts for only 60-70% of the variance in the ultimate strength of bone tissue. Thus, new parameters representing bone quality have been investigated so far. Bone has a well-organized microstructure on the nano-scale level and is composed of mineral biological apatite (BAp) and collagen (Col) fibril, providing reinforcement and pliability, respectively. Because BAp crystallizes in an anisotropic hexagonal lattice, mechanical properties of a BAp crystallite should depend on the crystal orientation. Thus, preferential orientation of the BAp c-axis along the extended collagen fibrils in hard tissues must be closely related to the mechanical function of bone and is also utilized as a possible index for evaluating bone quality. In this study, BAp orientation was analyzed as a parameter of bone quality in hard tissues under various conditions such as original, regenerated and diseased bones. Finally, we can conclude that the degree of BAp orientation is a useful parameter to evaluate in vivo stress distribution, nano-scale microstructure and the related mechanical function, the regenerative process of the regenerated bone and to diagnose bone diseases such as osteoarthritis, etc.
DOI: 10.2109/jcersj2.116.313

The materials science of bone: Lessons from nature for biomimetic materials synthesis

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MRS BULLETIN, [MATERIALS RESEARCH SOC, WARRENDALE], JAN, 2008, Vol. 33(1), pp. 49-55.

There has been considerable recent interest in natural bone as a material, due in part to its interesting combination of mechanical properties: bone is stiff and tough but lightweight. This unusual combination of properties results from a nanocomposite structure of approximately equal volumes of mineral and hydrated organic matter. Much recent effort has been focused on the structure, properties, and performance at different length scales relative to the hierarchical organization of bone. Historically, such bone research has emphasized clinical and medical aspects, including engineering materials for bone augmentation or replacement, bone-biomaterial interactions and interfaces, and more recently, scaffolds for bone tissue engineering. However, within the fast-growing biomimetics field, the bone extracellular matrix is taken as a model for materials development. Efforts have been made both to mimic the bony material itself as well as to mimic the process by which bone forms.
DOI: 10.1557/mrs2008.14

New chemical weathering indices for estimating the mechanical properties of rocks: A case study from the Kurtun granodiorite, NE turkey

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TURKISH JOURNAL OF EARTH SCIENCES, [SCIENTIFIC TECHNICAL RESEARCH COUNCIL TURKEY-TUBITAK, ANKARA], JAN-MAR, 2008, Vol. 17(1), pp. 187-207.

The chemical weathering of rock proceeds by water-rock interaction. During weathering geochemically mobile elements, alkali and alkali-earth elements are easily leached from rocks, leaving the residual elements to combine with components from the atmosphere to form new minerals. No single weathering index given in the literature fits the model of the process involved in chemical weathering outlined above. This study deals with the derivation of three new chemical weathering indices by taking both chemical processes such as leaching and new mineral formation into account. The new indices are chemical leaching index (CLI), chemical weathering product index (CWPI) and total chemical weathering index (TCWI). These indices are applied to selected weathering profiles in the Kurtun granodiorite, NE Turkey, in order to estimate the effects of chemical weathering on the physico-mechanical properties of rock materials. The relative variation of the mechanical properties and TCWI display a statistically significant correlation. Besides, it is shown that TCWI and weatherability index, originally defined by Hodder (1984) can be used together to evaluate the effect of chemical weathering on the mechanical behaviour of rocks.

Monetization of nigeria coal by conversion to hydrocarbon fuels through Fischer-Tropsch process

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ENERGY SOURCES PART B-ECONOMICS PLANNING AND POLICY, [TAYLOR & FRANCIS INC, PHILADELPHIA], 2008, Vol. 3(2), pp. 155-165.

Given the instability of crude oil prices and the disruptions in crude oil supply chains, this article offers a complementing investment proposal through diversification of Nigeria's energy source and dependence. Therefore, the following issues were examined and reported: A comparative survey of coal and hydrocarbon reserve bases in Nigeria was undertaken and presented. An excursion into the economic, environmental, and technological justifications for the proposed diversification and roll-back to coal-based resource was also undertaken and presented. The technology available for coal beneficiation for environmental pollution control was reviewed and reported. The Fischer-Tropsch synthesis bothering on the process chemistry and its advances into Sasol's slurry phase distillate process (sspdp) was reviewed. Specifically, the adoption of Sasol's advanced synthol process (sasp) and the slurry phase distillate process were recommended as ways of processing the products of coal gasification. The article concludes by discussing all the above-mentioned issues with regard to value addition as a means of wealth creation and investment.
DOI: 10.1080/15567240600815109

Physical and hydraulic properties of engineered soil media for bioretention basins

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TRANSACTIONS OF THE ASABE, [AMER SOC AGRICULTURAL & BIOLOGICAL ENGINEERS, ST JOSEPH], MAR-APR, 2008, Vol. 51(2), pp. 499-514.

The composition of engineered soil media largely determines the stormwater treatment efficiency of urban bioretention basins. Laboratory flow-through experiments were conducted to quantify infiltration, bulk density, and moisture holding capacity as a function of different composite mixtures of sand, soil, and compost, and to assess the effect of compaction on bulk density, moisture holding capacity, and saturated hydraulic conductivity. Eleven mixtures were evaluated that varied in volumetric proportions of sand (30% to 70%), sandy or silt loam soil (0% or 2001o), and organic compost (20% to 70%). Steady-state infiltration rates were high for all mixtures, ranging from 87 to 178 cm h(-1), and followed the order of mixtures containing sand and compost only > mixtures containing sand, compost, and sandy soil > mixtures containing sand, compost, and silt loam soil. Infiltration rates for mixtures containing sand and compost only and mixtures containing sand, compost, and sandy soil exhibited a significant linear relationship with the ratio of sand to compost. Bulk density of the mixtures was inversely related to the proportion of compost and followed the order of mixtures containing sand, compost, and silt loam soil > mixtures containing sand, compost, and sandy soil > mixtures containing sand and compost only. Conversely, moisture holding capacity

increased with the proportion of compost and followed the order of mixtures containing sand and compost only > mixtures containing sand, compost, and sandy soil > mixtures containing sand, compost, and silt loam soil. Compaction as a result of an initial wetting process and the infiltration tests led to increases in bulk density and decreases in moisture holding capacity, with mixtures containing a silt loam component showing the greatest resistance to these effects. Bulk density, moisture holding capacity, and compaction were all linearly related to the ratio of sand/compost in the mixture. Air permeability measurements were used to estimate saturated hydraulic conductivity of four of the mixtures. Reductions of compost and additions of soil decreased saturated hydraulic conductivity. For the same proportions of sand, soil, and compost, the mixture containing silt loam soil was less compactable and incurred greater changes in saturated hydraulic conductivity compared to the mixture containing sandy soil. Although, at least initially, compost controlled the physical density of these mixtures, the textural class of the mineral component appears to help stabilize infiltration and dampen the effect of changing the ratio of sand to compost on the physical and functional characteristics of these mixtures.

Impact of electronic blasting detonators on downstream operations of a quarry

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MINERALS & METALLURGICAL PROCESSING, [SOC MINING METALLURGY EXPLORATION INC
LITTLETON], FEB, 2008, Vol. 25(1), pp. 32-40.

In 2005, CANMET-MMSL used its pool of expertise in ground control, open pit and underground mine engineering, mineral processing, information technology and applied mineralogy to launch a mine-to-mill research project. The objective of the project was to optimize the distribution of rock breakage energy among blasting, crushing and grinding activities, thereby maximizing the efficiency of energy utilization within comminution processes. Tests were designed to demonstrate that this approach could reduce energy consumption, thus contributing to the reduction of green house gas (GHG) production in the Canadian mining industry. The project was accomplished in collaboration with DynoConsult and Dyno Nobel Canada Inc., a world leader in commercial explosives. Data analysis from 12 blasts (six with electronic and six with pyrotechnic detonators) in three different geological formations of a quarry (soft, medium and hard rock) shows that electronic blasting technology increases rock fragmentation by 15% (in hard rock) to 20% (in soft rock). A more uniform rock fragment size distribution is also obtained. The impact of the improved quality blast product on downstream processes of the quarry is a productivity increase of 5% in rock excavation and transportation, an energy reduction of 10% at the primary crusher and an increase of 15% of the primary crusher throughput. Extended to the Canadian mining industry, such results would represent a GHG emission reduction of about 0.05 Mt/y. A soft-sensor prototype, based on primary crusher data (i.e., energy consumption, throughput, feed and product size distribution) and a simplified computerized process model, was developed for on-line measurement of the rock operating work index. Additionally, 385 rock samples and specimens were collected and prepared to determine the tensile and compressive strength of the rock

material, to evaluate the aggregate crushing work index and to examine the development of micro- and macro-fractures by means of binocular and SEM microscopy. Blast-induced rock damage was evaluated at the end of the laboratory-testing program. Even though a reduction of rock hardness of around 30% was observed after blasting, the impact of the blasting method (i.e., use of electronic or pyrotechnic detonators) on the induced rock damage could not be observed. It is either absent or not perceptible with the accuracy of the measuring techniques and the number of samples analyzed.

The evolution of a mineral liberation model by the repetition of a simple random breakage pattern

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MINERALS ENGINEERING, [PERGAMON-ELSEVIER SCIENCE LTD, OXFORD], FEB, 2008, Vol. 21(3), pp. 213-223.

Mineral liberation models of multi-mineral particulate materials are described by functions of continuous or discrete random variables such as the size and the grade of their particles. In the present work that describes a binary system both size and grade are treated as discrete variables and particles are classified into size and grade classes accordingly. Initially the present work develops a model to predict the distribution of particles of the same size class into the different grade classes. This distribution gives the liberation status of each size class and if combined with the size distribution of the particulate material it produces the total liberation spectrum. Initially the process defines an equivalent size, below which liberation begins, called "critical liberation size". It then describes a sequential size reduction pattern used only in order to relate the size class of the child particles to the probability of falling into any available grade class. This process defines the liberation model. The size reduction pattern accepted dictates by itself the size ratio of the equivalent size classes used. However this pattern is not used for the prediction of the volume-size (or mass-size) distribution of the final particulate material. It is believed that any size reduction model using selection and breakage functions independent of the particle grade in combination with the proposed liberation spectrum of the final product.
DOI: 10.1016/j.mineng.2007.09.008

Quantifying rate enhancements for acid catalysis in CO_2-enriched high-temperature water

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AICHE JOURNAL, [JOHN WILEY & SONS INC, HOBOKEN], FEB, 2008, Vol. 54(2), pp. 516-528.

Thermodynamic calculations revealed that 10 to 100-fold increases in reaction rate are obtainable with added CO2 (0.1-1 MPa) for an acid-catalyzed reaction in high-temperature liquid water (HTW) that is first order in H+ concentration. These calculations suggest that CO2 is most effective as a rate-enhancing additive in HTW at lower temperatures (150-200 degrees C). When compared with increased temperature as a competitive option for accelerating acid-catalyzed reactions in HTW, CO2 addition generally carries a lower pressure penalty (and no temperature penalty) for the model acid-catalyzed reaction with activation energies of up to 35 kcal/mol. An experimental survey revealed that CO2 addition is effective for achieving increased reaction rates for dibenzyl ether hydrolysis in HTW, but that bisphenol A cleavage, methyl benzoate hydrolysis, and o-phthalic acid decarboxylation were not significantly impacted by added CO2. This behavior is consistent with previous results for these reactions wherein mineral acid, rather than CO2, was added to lower the pH. A summary of experimental results reported for reactions in CO2-enriched HTW revealed that product yields of some reactions can be increased by a factor of 23 with added CO2. Taken collectively, these results suggest that Co-2 addition may be a practical technique for making HTW more attractive as a reaction medium for acid-catalyzed organic synthesis. (c) 2007 American Institute of Chemical Engineers.
DOI: 10.1002/aic.11392

Study of a laboratory-scale froth flotation process using artificial neural networks

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MINERAL PROCESSING AND EXTRACTIVE METALLURGY REVIEW, [TAYLOR & FRANCIS INC, PHILADELPHIA], 2008, Vol. 29(2), pp. 130-142.

A three-layer feed-forward artificial neural network (ANN) model, trained using the error back propagation algorithm, has been established to simulate the froth flotation process for the beneficiation of coal fines. The network model validates the experimentally observed qualitative and quantitative trends. The optimal model parameters in terms of network weights have been estimated and can be used to compute the parameters of the coal flotation process over wide-ranging experimental conditions.
DOI: 10.1080/08827500701421912

Effective reaction parameters for mixing controlled reactions in heterogeneous media

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WATER RESOURCES RESEARCH, [AMER GEOPHYSICAL UNION, WASHINGTON], Feb, 2008, Vol. 44(2).

Sound understanding of mixing-controlled reactions in heterogeneous media is needed for the realistic modeling of contaminant transport in aquifers and is a precondition for the evaluation of natural attenuation processes, the design of nuclear waste disposal, and the engineered remediation of contaminated sites. In this work, we study the bimolecular dissolution-precipitation equilibrium reaction, adapted after De Simoni et al. (2005). Because of advective and dispersive transport of the reacting species, the system is globally in nonequilibrium because the effective reaction rate is limited by the finite rate of transport and thus is affected by the heterogeneity of the formation. We study the macroscopic formulation of such a reactive transport system in terms of mixing-controlled reaction parameters which integrate the impact of spatial heterogeneity. The apparent chemical saturation is found to be a function of the concentration variance and is generally greater than its local-scale equivalent. This explains why water samples taken from pumping wells are normally nonequilibrium with respect to minerals existing in the aquifer, even when local equilibrium is to be expected. The reaction rate is given by the product of a reaction factor, associated with the local equilibrium constant and concentration variance, and a mixing factor, which is the product of the microdispersion coefficient and the square gradient of the mean and perturbation concentration fields. The mixing factor dominates the description of the reaction rate in the upscaled macroscopic models. The reaction rate predicted by macroscopic models is controlled by two competing effects: The large heterogeneity-induced macrodispersion coefficient leads to an increase of reaction rate, while a more smoothed concentration gradient may lead to a decrease of the reaction rate. Macroscopic models may only give a good approximation at large time and away from the plume center of mass because of the balanced variance budget but significantly underestimate reaction rate near the plume center because of the smoothed concentration gradient field. In fact, in an application example, reaction rate is maximum around the plume center, where a homogeneous equivalent medium would predict zero rates.
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A method for predicting the specific energy requirement of comminution circuits and assessing their energy utilisation efficiency

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MINERALS ENGINEERING, [PERGAMON-ELSEVIER SCIENCE LTD, OXFORD], FEB, 2008, Vol. 21(3), pp. 224-233.

This paper presents a new approach for determining the specific energy requirement of tumbling mill (grinding) circuits. It is used to demonstrate that there is no significant difference between the energy utilisation efficiency of any of the grinding circuits of the plants studied. Laboratory test results are also presented which indicate that classifier efficiency and recycle load in closed ball mill circuits can have a significant influence on the apparent energy utilisation efficiency. The experimental data indicate that this is

achieved through changes to the gradient of the size distribution of the final product. (c) 2007 Elsevier Ltd. All rights reserved.
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Carbon sequestration

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PHILOSOPHICAL TRANSACTIONS OF THE ROYAL SOCIETY B-BIOLOGICAL SCIENCES, [ROYAL SOC, LONDON], Feb-27, 2008, Vol. 363, pp. 815-830.

Developing technologies to reduce the rate of increase of atmospheric concentration of carbon dioxide (CO(2)) from annual emissions of 8.6 Pg C yr(-1) from energy, process industry, land-use conversion and soil cultivation is an important issue of the twenty-first century. Of the three options of reducing the global energy use, developing low or no-carbon fuel and sequestering emissions, this manuscript describes processes for carbon (CO(2)) sequestration and discusses abiotic and biotic technologies. Carbon sequestration implies transfer of atmospheric CO(2) into other long-lived global pools including oceanic, pedologic, biotic and geological strata to reduce the net rate of increase in atmospheric CO(2). Engineering techniques of CO(2) injection in deep ocean, geological strata, old coal mines and oil wells, and saline aquifers along with mineral carbonation of CO(2) constitute abiotic techniques. These techniques have a large potential of thousands of Pg, are expensive, have leakage risks and may be available for routine use by 2025 and beyond. In comparison, biotic techniques are natural and cost-effective processes, have numerous ancillary benefits, are immediately applicable but have finite sink capacity. Biotic and abiotic C sequestration options have specific nitches, are complementary, and have potential to mitigate the climate change risks.
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Coal beneficiation of Candiota mine by dry jigging

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The objective of this work is to test dry jigging, operated with air, to eliminate pyrite nodules and liberated clays from Candiota coal. Candiota mine is the biggest Brazilian Coal deposit, which is beneficiated for fueling a thermoelectric plant. This coal presents a high degree of liberated pyrite in a wide range of densities. Hence, gravity separation of pyrite appears apparently obvious. However, any wet treatment results difficult due to the high porosity of the material as a consequence of its low rank. For that reason, dry jigging was proved instead with encouraging results. Samples from the upper layer of

the seam, which had around 1.8% sulfur and about 51% ash, appeared after jigging with about 0.7% sulfur and near 47% ash. After these results, pilot jigs are planned to install at the plant.
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Coal-fine beneficiation studies of a bench-scale water-only cyclone using artificial neural network

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Coal fines generated in Indian coal preparation plants account for 25%-30% of run-of-mine (ROM) coal. Coal cleaning is receiving increasingly greater attention of process engineers in view of the increase in amounts to be handled as well as the difficult washability characteristics of high-ash-content Indian coals. Froth flotation is usually practiced in Indian coal washeries for washing the coals to bring down their ash content to acceptable limits. Because of the supply of feed coal from multiple sources, their different characteristics and composition, viz., varying mineralogy and ash content, presence of microfines, and their varying oxidation levels, the fine coal circuits, more often than not, fail to deliver consistent product quality and desired yields. Water-only cyclones have been used in most of the western countries for treating coal and mineral fines below 3 mm. However, the industrial use of these cyclones in India has not yet been put to practice in the coal-washing industry; the primary reason for this being that their design is unsuitable for high-ash content coals and therefore needs to be suitably modified according to the feed material characteristics. Highlighted in the present paper are the results of a case study of beneficiation of high-ash fine coal, using a water-only cyclone. The influence of two of the critical design variables, viz., cyclone length and solid concentration, on which the cyclone performance and the process yield (%) depend to a great extent, is described. Further, based on the experimental data of a water-only cyclone of varying lengths used for below a 3 mm coal beneficiation study, an attempt has also been made to develop a three-layer feed-forward artificial neural network (ANN) model, which is inherently trained using an error-back propagation algorithm. The results evince that the predictions from the ANN model are in good qualitative and quantitative agreement with the experimental observations, thereby validating the applicability and accuracy of the developed ANN model.
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Acceleration of biomimetic mineralization to apply in bone regeneration

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BIOMEDICAL MATERIALS, [IOP PUBLISHING LTD, BRISTOL], MAR, 2008, Vol 3(1).

The delivery of growth factors and therapeutic drugs into bone defects is a major clinical challenge. Biomimetically prepared bone-like mineral (BLM) containing a carbonated apatite layer can be used to deliver growth factors and drugs in a controlled manner. In the conventional biomimetic process, BLM can be deposited on the biodegradable polymer surfaces by soaking them in simulated body fluid (SBF) for 16 days or more. The aim of this study was to accelerate the biomimetic process of depositing BML in the polymer surfaces. We accelerated the deposition of mineral on 3D poly(lactic-co-glycolic acid) (PLGA) porous scaffolds to 36-48 h by modifying the biomimetic process parameters and applying surface treatments to PLGA scaffolds. The BLM was coated on scaffolds after surface treatments followed by incubation at 37 degrees C in 15 ml of 5 x SBF. We characterized the BLM created using the accelerated biomineralization process with wide angle x-ray diffraction (XRD), Fourier transform infrared (FTIR) microscopy, and scanning electron microscopy (SEM). The FTIR and XRD analyses of mineralized scaffolds show similarities between biomimetically prepared BLM, and bone bioapatite and carbonated apatite. We also found that the BLM layer on the surface of scaffolds was stable even after 21 days immersed in Tris buffered saline and cell culture media. This study suggests that BLM was stable for at least 3 weeks in both media, and therefore, BLM has a potential for use as a carrier for biological molecules for localized release applications as well as bone tissue engineering applications.
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Development of ion-beam nano-structuring techniques in KIGAM

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The Ion Beam Application Group at Korea Institute of Geoscience and Mineral Resources (KIGAM) has been engaged in a broad range of research activities from fundamental studies of nuclear spectroscopy and the development and application of ion beam analysis techniques, including accelerator mass spectrometry (AMS), to materials science studies and micro-engineering employing versatile ion irradiation. The laboratory is equipped with 1.7-MV Tandem Van de Graaff accelerator and an AMS system (1-MV Tandetron), and a state-of-the-art 500-kV high current ion implanter will be installed by the end of 2007. In recent years, we have been devoted to the development of nano-fabrication techniques based on ion beam engineering such as single and compound semiconductor nanocrystals syntheses, the fabrication of Si compatible nano-photonic devices, and ion-cut processes for SOI (Si-on-insulator) and GOI (GaAs-on-insulator) wafer fabrications and GaN layer transfer. This presentation covers the context of the development of ion-beam nano-structuring techniques in KIGAM, and the future direction of nano-technology based on ion implantation is also

briefly discussed, taking nano-scale proton beam direct writing, maskless ion projection lithography and single ion implantation as practical examples.

Electroleaching and electrodeposition of zinc in a single-cell process for the treatment of solid waste

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This work deals with zinc beneficiation of industrial solid waste by an electrochemical technique combining electroleaching and electrodeposition in a single-cell process. This technique is based on leaching of the solid waste by the protons generated at the anode and migration of the resulting ions toward the cathode where deposition takes place. A laboratory cell was built for testing the method. It consisted of three compartments, two electrode compartments and a solid waste chamber placed between these. Catholyte and anolyte were sulphuric/sulphate solutions at optimised concentrations. Experiments were first carried out using a zinc solution and an inert matrix in the central compartment, then using a synthetic waste prepared by dispersing zinc oxide in silicon dioxide. Best performance was obtained with treatment duration of 6 h, at 4.5 A dm(-2) and with catholyte circulation. In this case, a 97% of zinc oxide lixiviation and 75% of zinc-plated were achieved. (C) 2007 Elsevier B.V. All rights reserved.
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Evaluation of large eddy simulation and Euler-Euler CFD models for solids flow dynamics in a stirred tank reactor

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AICHE JOURNAL, [JOHN WILEY & SONS INC, HOBOKEN], MAR, 2008, Vol. 54(3), pp. 766-778.

Mechanically agitated reactors find wide range of applications for solid suspension and mixing in the chemical, biochemical, and mineral processing industries. Understanding the solids dynamics in these reactors is necessary to improve the design and operation of such reactors. Computational fluid dynamic (CFD) models are often useful in this regard, as it can provide significant insights into the flow and mixing of the phases involved. However, the model predictions need extensive evaluation with experimental results before they can be confidently used for the scale-up and optimization of large scale reactors. Recently, Guha et al. carried out a systematic experimental investigation of the solids hydrodynamics in dense solid-liquid suspensions (2.5-19% solids loading w/w) in a stirred tank using the Computer Automated Radioactive Particle Tracking (CARPT) technique, which provided extensive information to efficiently assess the ability of the existing CFD models in predicting the solids dynamics in slurry reactors.

This work presents such an evaluation by comparing the averaged solids velocities, turbulent kinetic energy, and solids sojourn time distributions predicted by CFD models with those obtained from the CARPT experiment for overall solids holdup of 1% (v/v) (2.5% w/w) at Reynolds number of 74,000. The Large Eddy Simulation (LES) and the Euler-Euler model are the models chosen for evaluation in the current study. (c) 2008 American Institute of Chemical Engineers.
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Lean management implementation in mining industries

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DYNA-COLOMBIA, UNIV NAC COLOMBIA, [FAC NAC MINAS, MEDELLIN], MAR, 2008, Vol. 75, pp. 81-89.

Among the alternatives to assure its survival, a particularly relevant one for Organizations is innovation. Innovation has several dimensions among which it is possible to include: i) raw material; ii) product; iii) process; iv) market; v) the way how administration is made. This paper has the objective to show the possibility to implement a new management way in the industries of mineral extraction through the integrated use of the concepts developed in the construction of the Toyota of Production System (TPS)/Lean Production System, and the concepts and traditional techniques originating from the Mining Engineering and the Industrial Engineering. The paper shows this integration in two sceneries of the mining (fluospar and amethyst). The results indicate the reduction of the production costs and increase of the productivity and the improvement of the Workers Life Quality.

Synthesis of multifunctional polyvinylsaccharide containing controllable amounts of biospecific ligands

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BIOCONJUGATE CHEMISTRY, [AMER CHEMICAL SOC, WASHINGTON], MAR, 2008, Vol. 19(3), pp. 617-625.

In the present study, the attempt to synthesize a multibiofunctional polymeric vector to be used for construction of composite scaffolds for bone tissue engineering has been undertaken. The polymers based on 2-deoxy-2-methacrylamido-D-glucose were functionalized by a growth factor (BMP-2), GRGDSP peptide, and poly(L-lysine) using aldehyde chemistry. The covalent modification process was quantitatively studied, and a polymer conjugate containing all these ligands was formed. In addition, the impacts of coupled ligands toward the adsorption of polymers on the commercial mineral macroporous matrix Sponceram used in cell culture applications were studied.
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The effect of cyclone geometry and operating conditions on spigot capacity of dense medium cyclones

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Dense medium cyclones separate particles primarily according to their differences in density, and are used in the beneficiation of coal, iron ore, and diamonds, amongst others. The cyclone can, however, be constrained by the ore carrying capacity of the spigot, especially for ores in which a significantly large proportion of the feed particles need exit through the sinks stream. Currently, the spigot capacities used in the sizing and selection process for dense medium cyclones are based mainly on those capacities provided by the original developers of the dense medium cyclone, Dutch State Mines (DSM). Further, it is not clear which parameters, other than the spigot diameter, have an influence on the spigot capacity of dense medium cyclones. The influence of the cyclone geometry and operating conditions on the spigot capacity of dense medium cyclones was investigated, and parameters of importance in this regard were identified. An empirical model that quantifies the effect of the various parameters on the spigot capacity is presented in this paper. Furthermore, the spigot capacities determined experimentally in this study are compared with those given by DSM.
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Utilization of hazardous wastes and by-products as a green concrete material through S/S process: A review

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REVIEWS ON ADVANCED MATERIALS SCIENCE, [INST PROBLEMS MECHANICAL ENGINEERING-RUSSIAN ACAD SCIENCES, ST PTERSBURG], MAR, 2008, Vol. 17, pp. 42-61.

The disposal and treatment of hazardous industrial waste is very costly affairs for the industries, it has been a dormant issue. The new millennium brings challenges for the civil and environmental engineers and opportunities for research on the utilization of the solid waste and by-products and basic properties of concrete and its materials. The recycling of waste and by-products attracts an increasing interest worldwide due to the high environmental impact of the cement and concrete industries. Normal concrete is manufactured using sand and stones, but lightweight concrete can be made by using industrial by-products and hazardous solid wastes such as expanded fly ash, slag, sludge, etc. The Best Demonstrated Available Technology (BDAT) stabilization/solidification (S/S) can be used for treatment of concrete contaminated

solid hazardous wastes and by-products. The performance of concrete is measured in terms of physical, engineering, and chemical properties. The review describes how chemical and mineral admixtures help in the improvement of the lightweight concrete properties. Cement is replaced by the 15-35% fly ash in the concrete mix. Fly ash increases concrete strength, improves sulfate resistance, decreases permeability, reduces the water ratio required, and improves the workability of the concrete. Partial substitution solid hazardous waste does not strongly affect the strength of concrete and other properties. This mixed lightweight concrete is safe enough to be used in sustainable environmental applications, like road-beds, filling materials, etc.

Study of separation features in floatex density separator for cleaning fine coal

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INTERNATIONAL JOURNAL OF MINERAL PROCESSING, [ELSEVIER SCIENCE BV, AMSTERDAM], Mar, 2008, Vol. 86, pp. 40-49.

The separation performance of a Floatex Density Separator (FDS) for Indian coals has been studied. Experimental results reveal that both density as well as size have substantial influence on separation performance. It is seen that at a lower bed pressure the unit acts more like a classifier rather than a concentrator. With increasing bed pressure, the classification effect is, however, reduced and the concentration effect becomes more dominant due to proper development of suspension density. The separation performance of the FDS is described with density as well as size partitions. It is found that the size or density alone is not able to describe the separation fully. The terminal settling velocity, which includes both the size and density of a particle, can be a useful descriptor of separation in FDS. U-t50 may be defined as the terminal settling velocity of those particles that have equal tendency to report to the overflow or to the underflow stream. As a result, a higher teeter water flow rate helps in carrying larger-lighter particles to the overflow (higher settling velocity) by increasing the cut off terminal settling velocity as it increases the net upward force. (C) 2007 Elsevier B.V. All rights reserved.
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