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Scaling behavior in constant pressure batch dewatering of fine particle suspensions

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International Journal of Mineral Processing, Volume 83(1–2), 4 July 2007, Pages 28-35

The constant pressure batch dewatering process of fine suspension systems in which dewatering occurs in two stages, viz. cake formation and cake consolidation is considered. Scaling transformations for the dewatering time and extent of dewatering are proposed. Using experimental data obtained by varying the applied pressure and feed solids concentration, we show that the distinct temporal dewatering profiles in the *cake consolidation stage* collapse on to a unique master curve as a result of scaling. For fixed suspension chemistry, the master curve can be generated using data from a single dewatering test. Application of the existence of the master curve for prediction of key dewatering process parameters is illustrated. In addition, it is shown that the scaling behavior can persist even when the chemistry of the suspension is varied.

Selection of solvent extraction reagent for the separation of europium (III) and gadolinium(III)

Author(s): Carlos A. Morais, Virgínia S.T. Ciminelli

Minerals Engineering, Volume 20, Issue 8, July 2007, Pages 747-752

This work has been aimed at identifying suitable conditions for the separation of europium/gadolinium mixture, with a high Gd content and without previous europium reduction, into a phase of high-purity Gd and a Eu-enriched mixture. Acid and basic extractants have been evaluated in a number of experimental conditions. Two acid extractants were investigated, DEHPA and (HEH(EHP)), the latter in its natural and saponified forms. Also, a series of basic extractants, Primene JM-T®, Primene 81R®, Alamine 336® and Aliquat 336® was evaluated. The Aliquat 336® was employed in chloride and nitrate forms. The experiments with acid extractants were carried out in hydrochloric medium, while the basic extractants were investigated in nitric and sulfuric medium. The selectivity achieved with Aliquat 336® (separation factor of 2.0) was superior to those obtained with the acid extractants (separation factors of 1.48 for

DEHPA and 1.59 for HEH(EHP)).

Coal and potash flotation enhancement using a clay binder

Author(s): Tao, D.; Chen, G. L.; Zhou, X. H.; et al.

Conference: 6th UBC-McGill-UA Biennial International Symposium on Fundamentals of Mineral Processing Location: Montreal, CANADA Date: OCT, 2006; Sponsor(s): UBC-McGill-UA ; Source: CANADIAN METALLURGICAL QUARTERLY Volume: 46 Issue: 3 Pages: 243-250 Published: JUL 2007

The adverse effects of clay particles on coal and mineral processing operations such as gravity separation, flotation, filtration and thickening are well known in the mining industry. In particular, the presence of ultra-fine clay particles deteriorates froth flotation performance, which has been attributed to slime coatings that inhibit bubble attachment and to adsorption of the frother and/or collector by the clay particles. The present study was conducted to evaluate the performance of a clay binding agent developed by Georgia-Pacific Resins, Inc. in enhancing coal and mineral flotation performance. Mechanical flotation tests were carried out using coal and potash samples. Process parameters investigated included slurry solids percentage, impeller rotation speed, binder dosage, etc. Flotation results show that the use of GP reagents significantly enhanced flotation efficiency under different conditions. The required binder dosage and conditioning time were about 0.45 kg/t and 0.5 to 1 minute, respectively. More significant improvements in process performance were observed at higher solids percentage and higher impeller rotation speed.

Influence of fineness of fly ash on the aggregate pelletization process

Author(s): R. Manikandan, K. Ramamurthy

Cement and Concrete Composites, *Volume 29, Issue 6*, *July 2007*, *Pages 456-464*

One of the main issues associated with fly ash is the variation in the fineness of fly ash produced within a plant and between thermal power plants, due to the variation in the quality of coal used and the production technique adopted in which pelletization of fly ash becomes complex. In this paper, the influence of fineness of fly ash is studied by collecting typical samples of fly ash from two thermal power plants. Significance of the factors influencing the pelletization of fly ash was statistically determined by adopting 2^4 with eight run and 2^5 with sixteen run fractional factorial design for fly ash with fineness of 414 m^2/kg and 257 m^2/kg, respectively. Finer fly ash exhibits higher pelletization efficiency as compared to coarser fly ash. Addition of clay binders like bentonite and kaolinite enhanced the pelletization efficiency of coarser fly ash. Amount of binder content and moisture content varies with type of binder used (with fly ash having a fineness of 257 m^2/kg), which is attributed to the difference in plasticity index. Addition of clay binder changes the relative influence of pelletization factors.

Binderless briquetting of some selected South African prime coking, blend coking and weathered bituminouscoals and the effect of coal properties on binderless briquetting

Author(s): S.J. Mangena, V.M. du Cann

International Journal of Coal Geology, Volume 71(2–3), 2 July 2007, Pages 303-312

The binderless briquetting of some selected South African prime coking and blend coking coals, as well as the effects of weathering on the binderless briquetting of some inertinite-rich bituminous coals, were investigated in the laboratory. Selected properties of these coals were determined and the coals were briquetted at various moisture contents and pressures. Based on the results obtained in this study, binderless briquetting was found to be most successful in the cases of the fresh, vitrinite-rich coking and blend coking coals and satisfactory in the fresh inertinite-rich Witbank coals. However, the bonding process seemed to be adversely affected by weathering. The negative impact on bonding could be ameliorated to some extent by the presence of a significant kaolinite content when the percentage ash reports in the order of more than 15% (air-dry basis). It should, however, be noted that kaolinite may reduce the water resistance of the briquettes.

On empiricism in minerals processing research

Author(s): Stevenson, Paul; Galvin, Kevin P.

Source: MINERALS ENGINEERING Volume: 20 Issue: 8 Pages: 776-781 DOI: 10.1016/j.mineng.2007.02.005 Published: JUL 2007

Because the physics that underpin many minerals processing operations is often complex, many researchers find it convenient to give empirical descriptions of their experimental observations. However, such empirical correlations are often given in a dimensionally inconsistent form which means that their utility is limited. In this article, the steps that must be taken to develop a correlation that has the required number of degrees of freedom that are necessary and sufficient to adequately characterise a system and retain dimensional consistency are presented. This methodology is supported by four examples of the rigorous development of empirical correlations that may be of interest to minerals processing engineers. (c) 2007 Published by Elsevier Ltd.

Effect of MgO and ZrO_2 additions on the properties of magnesite-chrome composite refractory

Author(s): A. Ghosh, M.K. Haldar, S.K. Das
Ceramics International, *Volume 33(5)*, *July 2007*, *Pages 821-825*

Magnesite-chrome aggregates have been prepared from friable chrome ore and magnesia of different reactivity in the presence of an additive, ZrO_2. Two types of batch

compositions using sintered magnesia, caustic magnesia and chrome ore have been selected for preparing mag-chrome composites. The batch consisting of sintered magnesia and friable chrome ore (SMC) was vibromilled for 8 h, whereas caustic magnesia compositions were added directly to a vibromilled chrome ore (CMC) and mixed in a fluidized bed mixer. Additions of 1–5 wt.% ZrO_2 were made to the batches. Firings were carried out between 1700 and 1750 °C with 2 h soaking. Aggregates were characterized by evaluating densification, hot modulus of rupture and microstructure. The reactivity of magnesia was found to play an important role in the final properties of samples. Introducing less reactive sintered magnesia improved all the properties of the aggregates. ZrO_2 was found to be a good sintering aid in the magnesite-chrome composites.

Design of a flotation cell equipped with ultrasound transducers to enhance coal flotation

Author(s): Şafak G. Özkan, Halit Z. Kuyumcu

Ultrasonics Sonochemistry, *Volume 14, Issue 5*, *July 2007*,*Pages 639-645*

Ultrasonic treatment is widely used for surface cleaning during physical, chemical and physico-chemical processes in mineral processing. Several research papers and a few industrial applications about the subject suggest that the mechanism behind the positive effect of ultrasound for mineral processing and especially flotation is due to formation of cavitation by ultrasonic energy. Within this study, coal floatability is investigated by use of a specially designed flotation cell equipped with ultrasound transducers with different power, frequency and geometry. The results indicate that ultrasonic treatment during coal flotation positively affects the quality and quantity of the properties of floated coals while using of lesser amounts of reagent than a conventional flotation system.

Utilization of pyrite ash wastes by pelletization process

Author(s): Nurcan Tugrul, Emek Moroydor Derun, Mehmet Piskin

Powder Technology, *Volume 176, Issues 2–3*, *20 July 2007*, *Pages 72-76*

In Turkey, pyrite, copper melting gases and sulfur are used as a raw material in sulfuric acid production. Pyrite ashes are obtained as a result of the sulfuric acid production process during the roasting of pyrite ores. These wastes are generally landfilled or dumped into the sea. Pyrite ash wastes can be utilized as a raw material in the production of iron ore, and thus environmental pollution can be avoided; however, these wastes need to achieve certain physical and chemical properties before they are used. Pyrite ashes are agglomerated into pellets to allow them acquire the required properties for use as iron ore in a blast furnace. The essential parameters affecting the pelletization of pyrite ashes are studied using bentonite as a binder. The metallurgical

properties of pyrite ash, bentonite, a mixture of pyrite ash and bentonite, and sintered pellets are studied using X-ray analyses. Wet-drop, wet-crush, dry-crush and sintered-crush tests are carried out to investigate the strength of the pyrite ash wastes pellets prepared from feeds with different sieve size and bentonite content. The results of this analysis demonstrate that pyrite ashes can be agglomerated into pellets and used as feed for the blast furnace in the iron production industry.

A new approach for the classification of coal fly ashes based on their origin, composition, properties, and behaviour

Author(s): Stanislav V. Vassilev, Christina G. Vassileva

Fuel, *Volume 86, Issues 10–11*, *July–August 2007*, *Pages 1490-1512*

The present work introduces and evaluates a new approach for the classification system of coal fly ashes (FAs) based on their origin, phase-mineral and chemical composition, properties, and behaviour. The detailed data for 41 FAs produced from various feed coals at 37 coal-fired thermo-electric power stations (TPSs) in Spain, Bulgaria, The Netherlands, Italy, Turkey, and Greece were used for that purpose. The chemical FA classification system was organized according to the contents, common geochemical associations, and significant positive or negative correlations of ash-forming elements in FAs using three end members, namely (1) sum of Si, Al, K, Ti and P oxides; (2) sum of Ca, Mg, S, Na and Mn oxides; and (3) Fe oxide. This approach divided four chemical FA types (Sialic, Calsialic, Ferrisialic, and Ferricalsialic) with three dominant tendencies (high acid, medium acid, and low acid). The most important phase-mineral FA classification system was organized according to the contents, associations, correlations, properties, and behaviours of species in FAs using also three end members, namely: (1) glass; (2) quartz + mullite; and (3) other minerals. This approach divided four phase-mineral FA types (Pozzolanic, Inert, Active, and Mixed) with three dominant tendencies (high pozzolanic, medium pozzolanic, and low pozzolanic). The specified chemical and phase-mineral FA types and subtypes were characterized and the relationships and distinctions between them were also described. It was found that characteristics such as (1) feed coal and combustion technology used in TPS; (2) water–soluble, magnetic and heavy fractions, pH, fluid ash-fusion temperature, detrital/authigenic index, and BET specific surface area of FAs; and especially (3) content, modes of occurrence, and distribution of glass, quartz, mullite, lime-portlandite, periclase-brucite, Ca sulphates, Ca and Ca–Mg silicates, magnetite-hematite, and char types in FAs; give the most valuable information for the determination of the potential utilization directions and environmental concerns of FAs.

Experimental prediction of the agglomeration capability of waste vegetable oils (WVO) in relation to the recovery of coal from coal fines cleaning wastes (CFCW)

Author(s): Adolfo F. Valdés, M. Dolores González-Azpiroz, Carlos G. Blanco, Ana B. Garcı´a

Fuel, *Volume 86, Issues 10–11*, *July–August 2007*, *Pages 1345-1350*

Coal fines cleaning wastes (CFCW) were agglomerated with samples of a vegetable oil heated at 150 °C for 1–15 days. An agglomeration efficiency index (AEI) which variation depends on the oil agglomeration capability was calculated. Good linear correlations were attained between the AEI values and the viscosity, and the unsaturation degree of the oil monitored by FT–IR and ^{1}H NMR. Based on the results achieved, the prediction of the agglomeration capability of the waste vegetable oils (WVO) from these properties in relation to the recovery of coal from coal fines cleaning wastes appears feasible.

Low CO_2 emission technologies for iron and steelmaking as well as titania slag production

Author(s): Andreas Orth, Nikola Anastasijevic, Heinz Eichberger

Minerals Engineering, *Volume 20, Issue 9*, *August 2007*, *Pages 854-861*

The world wide discussion on climate change caused by CO_2 and other greenhouse gases (GHGs) attributable to human activities has put the focus on the energy intensive production technologies for iron and steelmaking. Taking into account the enormous production increase for these versatile materials in the last years, modern technologies with lower CO_2 and GHGs emissions are imperative to keep at least today's status, though a decrease is challenged. Outokumpu Technology has developed direct reduction technologies that allow in combination with smelting reduction processes or electric arc furnaces a substantial lowering of CO_2 emissions. In the presented contribution to MMME 06 three examples will be given:

The Circofer® process, already demonstrated in pilot plant scale, uses coal as reductant in a two stage CFB (circulating fluidized bed)/FB (fluidized bed) reactor configuration to obtain a highly metallized product suitable for charging into smelting processes. One possible application of Circofer is, in a single stage configuration, as prereduction unit in combination with HIsmelt®, a smelting reduction technology to produce hot metal using iron ore and coal fines. Using Circofer as prereduction step, the capacity of a given HIsmelt installation can be increased by the factor three to four compared to cold feed and CO_2 emission can be lowered to values about 20% below the standard of a modern blast furnace, as this combination of technologies requires no agglomeration plant or coke ovens. A second application of Circofer is the combination with an electric arc furnace (EAF) to produce steel directly from direct reduced iron (DRI).

The direct charging of metallic fines into an EAF was successfully tested, observing no increased dust emission from the furnace. Charging hot DRI into an EAF decreases drastically electric power consumption and thus further lowers CO_2 emission. Applying Circosmelt, the combination of a single stage Circofer system with an electric reduction furnace for ilmenite processing, only half of the electric power consumption required today for titania slag production using cold, unreduced feed material is required. A common additional advantage of all Circofer based routes is that a 99% pure CO_2

stream is removed for process reasons from the process gas and can be used for enhanced crude oil production or sequestration methods. The paper will report on the status of the different developments and its market introduction. Outokumpu Technology GmbH (formerly Lurgi Metallurgie) has been involved in the development, design and supply of plants for processing iron bearing ores in fluidized bed reactor systems for more than 30 years.

Examination of ultrasonic treatment of iron ore fines using automatic iron ore texture classification

Author(s): Donskoi, E.; Campbell, J. J.; Young, J. M.; et al.
Book Group Author(s): Australasian Inst Mining & Metallurgy
Conference: Iron Ore Conference 2007 Location: Perth, AUSTRALIA Date: AUG 20-22, 2007, Sponsor(s): CSIRO; Australasian Inst Mining & Metallurgy; Australian Iron Ore Ind, Source: IRON ORE CONFERENCE 2007, PROCEEDINGS Pages: 251-257 Published: 2007

In order to correctly predict the performance of beneficiation processes, such as hydrocycloning or ultrasonic treatment of iron ore fines, it is important to understand possible changes in size distribution, mineral composition and textural peculiarities. During beneficiation processes, iron ore can be subjected to various physical actions which may result in changes in size distribution. In the case of soft or friable ores, attritioning and/or deagglomeration may have a significant effect on both separation performance and product stream specifications. Optical image analysis tools, which give statistical information on a particle by particle basis, can help in better understanding the response of the ores to these processes. An experimental study has been conducted to investigate the response of a haematitic-goethitic iron ore to a combination of stirring and ultrasonic treatment. The effect of stirring and ultrasonic treatment on the size and mineral distribution has been quantified using image analysis and automatic ore texture classification. This approach has been applied to several size coarse fractions of the initial feed and product. The results show that, following treatment, the mass proportion of ore texture classes which contained higher amounts of ochreous goethite and kaolinite had significantly decreased compared with that in the feed, while the proportion of texture classes where haematite was the major mineral had increased. Liberation analysis also showed a significant increase in the proportion of particles with more than 95 per cent haematite and vitreous goethite.

Advances of iron ore beneficiation in China

Author(s): Zou, J.; Book Group Author(s): Australasian Inst Mining & Metallurgy
Conference: Iron Ore Conference 2007 Location: Perth, AUSTRALIA Date: AUG 20-22, 2007 ; Sponsor(s): CSIRO; Australasian Inst Mining & Metallurgy; Australian Iron Ore.
Source: IRON ORE CONFERENCE 2007, PROCEEDINGS Pages: 31-33 Published: 2007

China has large amounts of iron ore reserves, but iron ore in China, with low-grade, small disseminated particles and many other associated minerals, is difficult to dress. In recent years, with the fast development of China's steel industry, the demand for iron ore has increased markedly. The new technologies in iron ore dressing in China are very effective in processing haematite and other difficult to dress iron ores. The iron ore grade and recovery rate has been improved. This result alleviates the difficulty in iron ore supply in China.

Balancing the reagent suite to optimise grade and recovery

Author(s): Valenta, Michael M.

Conference: Reagents 2006 Conference Location: Cape Town, SOUTH AFRICA Date: NOV 01, 2006; Source: MINERALS ENGINEERING Volume: 20 Issue: 10 Pages: 979-985 DOI: 10.1016/j.mineng.2007.02.011 Published: AUG 2007

The recovery of Platinum Group Metals and Gold (PGM + Au) from the UG-2 reef of the Bushveld Complex is an interesting challenge when the selection and optimisation of the reagent suite is considered. The UG-2 reef is characterised by two predominant gangue phases i.e. chromite and silicate, that have significantly different physical and chemical properties. A strategy needs to be devised to address concentrate grade that will reduce the recovery of gangue without significantly affecting the recovery of the valuable species. Recovery of the valuable species is complicated by the fact that PGM + Au occurs as a variety of different minerals having varying chemical and physical properties. The operating strategy has to consider the characteristics of the valuable mineral species and maximise recovery while meeting stringent grade specifications. Laboratory tests are conducted to illustrate the effect of the various flotation parameters. Applications of the findings on existing concentrators are discussed illustrating the need for a better understanding of the contribution of the various mechanisms occurring in the flotation cell. The paper demonstrates the significance of entrainment in the recovery of both valuable species and gangue species, and the need for a greater understanding of this non-selective sub-process on overall circuit performance. This paper forms part of a postgraduate study through the University of Cape Town into the development of a mechanistic model for the entrainment process. Although much work has been done in this study of the effect of various other parameters on the flotation of UG-2 ore, this paper focuses on the effect of frother, depressant and water on the flotation results.

Exergy as a tool for evaluation of the resource efficiency of recycling systems

Author(s): O. Ignatenko, A. van Schaik, M.A. Reuter

Minerals Engineering, *Volume 20, Issue 9*, *August 2007*, *Pages 862-874*

Recycling contributes significantly to the natural resources preservation. However since recycling technology at the same time requires primary materials and energy input, both contributing to the natural resources depletion, it is important to evaluate the resource efficiency of the whole recycling chain to determine the actual benefit of recycling. For

such an evaluation exergy analysis can be used by calculation of the exergy efficiency as an indicator for the resource efficiency of the recycling chain.

In this paper exergy analysis is added as a metric to the fundamental recycling system optimisation model developed previously by the authors. This addition allows evaluation and optimisation of the recycling system environmental performance on a fundamental basis, capturing exergy efficiency in the system as a function of physical, metallurgical and thermal processing and the quality of recyclates. Several car recycling scenarios have been evaluated using the fundamental recycling system optimisation model. The results reveal the influence of legislatively required recycling/recovery quotas and recycling system architecture on the environmental benefits of recycling. The results suggest that legislation does not represent the best exergy and resource efficiency of the system supporting the view that the present stringent legislation for end-of-life vehicle recycling is violating fundamental thermodynamics.

Development of a process flow sheet for beneficiation of Indian banded haematite quartz (BHQ) iron ore

Author(s): Raj, B.; Rao, B. S. S.; Chandra, S.; Book Group Author(s): Australasian Inst Mining & Metallurgy; Conference: Iron Ore Conference 2007 Location: Perth, AUSTRALIA Date: AUG 20-22, 2007; Sponsor(s): CSIRO; Australasian Inst Mining & Metallurgy; Australian Iron Ore Ind ; Source: IRON ORE CONFERENCE 2007, PROCEEDINGS Pages: 375-380 Published: 2007

India's iron ore mining industry is growing rapidly in order to augment the capacity to meet the unprecedented demand for the iron ore. Traditionally, much of Indian iron ore production came from exploitation of high-grade haematite ores, with the exception of Kudremukh which beneficiates lean grade Banded Magnetite Quartz ore. Now with the changed scenario of demand and supply, keeping long term sustainability in mind, it is imperative to develop suitable processing technology for exploitation of banded haematite quartz (BHQ) ore available abundantly and not utilised so far. In this direction detailed characterisation and beneficiation studies were conducted with BHQ iron ore from the Bellary-Hospet region of India, assaying 36.5 per cent Fe. The mineralogical studies with the image analyser system revealed the presence of maghemite and haematite as iron-bearing minerals. The gangue mineral associations were siliceous, ferro-magnesian and carbonate minerals. Higher degrees of liberation were observed in the size range of 75 - 212 microns. Liberation grind tests were performed by grinding the ore to different top sizes in a closed circuit laboratory ball mill with the ground samples subjected to Davis tube tests. The yield, grade and recovery were used as parameters to plan a two-stage wet drum magnetic separation based on grinding the primary magnetic concentrate.

After subjecting the final magnetic concentrate to flotation to remove residual silica a concentrate assaying more than 68 per cent was obtained. The non-magnetic product from the primary magnetic separation was deslimed, ground, blended with secondary magnetic tails and was subjected to a two pass wet high intensity magnetic separation

(WHIMS). The WHIMS concentrate was further subjected to two-stage flotation to remove residual silica to obtain concentrates assaying 64 - 66 per cent Fe. The final combined concentrate front wet drum magnet and WHIMS after flotation could yield a blast furnace (BF) grade pellet feed concentrate assaying more than 65 per cent Fe with a yield about 39 per cent and iron recovery about 70 per cent. A direct reduction (DR) grade pellet feed concentrate assaying 67 per cent Fe with a yield of about 28 31 per cent and iron recovery about 53 - 57 per cent could also be produced. Based on the test work, a process flow sheet was developed to beneficiate the BHQ ore for production of BF/DR grade pellet feed concentrate. In this paper methodology adopted for selection of individual process, various diagnostic tests performed to rule out other beneficiation processes and the final process flow sheet development is presented and discussed in detail.

Utilization of humic acid as a depressant for hematite in the reverse flotation of iron ore

Author(s): Iranildes Daniel dos Santos, José Farias Oliveira

Minerals Engineering, Volume 20, Issue 10, August 2007, Pages 1003-1007

In the present work the utilization of humic acid as a depressant for hematite in the iron ore flotation process was studied taking into consideration its physicochemical properties. Contact angle measurements of hematite and quartz were performed using a computer controlled Ramé-Hart goniometer. After conditioning with humic acid at pH 10.2, at low dodecylamine concentrations, hematite presented a much lower contact angle as compared to that of quartz under the same conditions. Microflotation tests were carried out using an EMDEE flotation apparatus. Initially, the two minerals were studied individually. The results showed that, depending of the humic acid and dodecylamine concentrations, the floatability of quartz was higher than 90% and 61% of the hematite was depressed. The flotation of the mixture of the two minerals (25% quartz and 75% hematite) was subsequently studied. The hematite recovery was higher than 90% in the depressed concentrate which assayed 86.0% Fe_2O_3. The results suggest that humic acid could be used as an alternative for starch in the iron ore flotation process.

Development of a new methodology to integrate ELV treatment limits into requirements for metal automotive part design

Author(s): D. Froelich, N. Haoues, Y. Leroy, H. Renard

Minerals Engineering, Volume 20, Issue 9, August 2007, Pages 891-901

Although aluminium and steel have been well recycled for many years, the development of new materials and new automotive designs resulting in unfavourable material associations raises the question of metal scrap quality. A new approach is required in order to integrate the limits of the shredding and dismantling processes regarding metal

scrap quality into design. The purpose of this paper is to propose a new methodology to guide material choices during design. This methodology defines the minimum data and the interactions between design and end-of-life (EOL) material constants. The results such as the metal association matrix and the identification of process limits help to avoid recycling problems, which are taken into account in design requirements in order to improve metal scrap quality. This paper is based on a study concerning metal scrap quality and shredding and dismantling performances during end-of-life vehicle (ELV) treatment.

Image analysis of size and shape of mineral particles

Author(s): Wang, Weixing, Book Editor(s): Lei, JS; Yu, J; Zhou, SG
Conference: 4th International Conference on Fuzzy Systems and Knowledge Discovery Location: Haikou, PEOPLES R CHINA Date: AUG 24-27, 2007 Sponsor(s): Hainan Univ; IEEE Reliabil Soc; Asia Pacific Neural Network Assembly, Source: FOURTH INTERNATIONAL CONFERENCE ON FUZZY SYSTEMS AND KNOWLEDGE DISCOVERY, VOL 4, PROCEEDINGS Pages: 41-44 DOI: 10.1109/FSKD.2007.353 Published: 2007

Mineral analysis is very important in engineering geology. It is often that a geologist analyzes minerals on an image under microscope, or by taking photos. It is difficult to recognize minerals automatically due to the complexity of mineral images. This paper presents the newly studied an image segmentation algorithm for mineral particles. The algorithm consists of image pre-processing, gray level image segmentation, background split, merge of small regions, and merge and split based on shape analysis. The developed algorithm has been tested in a laboratory and works satisfactory.

The effect of titanium on reduction degradation of iron ore agglomerates

Author(s): Paananen, T.; Kinnunen, K. ; Book Group Author(s): Australasian Inst Mining & Metallurgy; Conference: Iron Ore Conference 2007 Location: Perth, AUSTRALIA Date: AUG 20-22, 2007, Sponsor(s): CSIRO; Australasian Inst Mining & Metallurgy; Australian Iron Ore Ind, Source: IRON ORE CONFERENCE 2007, PROCEEDINGS Pages: 361-367 Published: 2007

A strong correlation between the reduction degradation index (RDI) of production sinter and the titanium content of the sinter mix was identified at the Ruukki sintering plant between 2000 and 2004. The titanium distribution in different mineral phases was studied using samples from Pot sintering tests. Titanium additions were made using two different materials: rutile and crushed titanium-bearing haematite pellets. While both titanium additions clearly increased the RDI, titanium seemed to favour secondary haematite. The study focused on the effect of titanium in haematite, because haematite is reduced to magnetite in the RDI test. During the haematite-magnetite reduction, reduction degradation was observed. To increase accuracy, the phenomenon was investigated first by sintering and then reducing synthetic minerals under controlled laboratory conditions at the University of Oulu. The effect of titanium oxide in solid

solution in magnetite on the magnetite to haematite transformation rate was studied first in order to simulate the final stage of the sintering process. In other experiments, haematite samples doped with 0.5, 2.0 and 5.0 wt per cent titanium oxide were studied using thermogravimetry under a controlled gas atmosphere (CO/CO2/H-2/N-2). Sintered samples were reduced using the same gas composition as in the RDI test. Polished sections for optical microscopy and SEM-EDS analysis were prepared from both reduced and oxidised samples and unreduced sintered samples. The titanium oxide content of haematite had a clear effect on reduction degradation of the samples. Furthermore, increasing titanium oxide content in solid solution in magnetite radically accelerated the oxidation rate. Similar observations regarding the effects of titanium have been reported earlier, but this was the first time the effect of very small additions of titanium were shown to deteriorate blast furnace burden quality and a reason suggested behind the process.

Mechanism of separating pyrite and dolomite by flotation

Author(s): Anping Liu, Wen Ni, Wei Wu

Journal of University of Science and Technology Beijing, Mineral, Metallurgy, Material, *Volume 14, Issue 4*, *August 2007*, *Pages 291-296*

To study the mechanism of separating pyrite and dolomite by flotation, the acting mechanisms of WHL depressor and both the minerals were studied by means of thermogravimetric and differential thermal analysis (TG-DTA), Fourier transform infrareddiffuse reflection spectroscopy (FTIR-DRS), and X-ray photoelectron spectroscopy (XPS). The results indicated that WHL formed metal salts with metal ions dissolved in water from dolomite and pyrite, which then deposited on their surfaces. Both of the minerals could be depressed by WHL. In the process of flotation, sulfur was created besides the WHL being absorbed on the surface of the sulfur concentrate, and its recovery rate was slightly affected.

Chelating reagents for flotation

Author(s): A.M. Marabini, M. Ciriachi, P. Plescia, M. Barbaro

Minerals Engineering, *Volume 20, Issue 10*, *August 2007*, *Pages 1014-1025*

The paper provides a review of the studies performed, starting from the 1970 up to today by Italian National Council's Mineral Processing Institute, to develop application for the use of chelating reagents in the flotation of metallic minerals. A summary is given of the various phases through which the studies progressed, starting by employing commercial reagents and then moving on to the synthesis of new long-chain chelate collectors for the flotation of sulphide and oxidized Pb, Zn, and Cu minerals. In particular a description is presented of the thermodynamic and structural criteria to be followed in designing and synthesizing chelate-type collectors with optimal structure for a given

metallic mineral. A theoretical method has been developed for choosing chelating groups that exert selective action on one metallic mineral rather than others. The theoretical approach is based on thermodynamic data of the chemical equilibria in solution. Moreover, the flotation results obtained in the flotation of oxidized and mixed Zn–Pb ores, by using chelating reagents with a mixed aliphatic–aromatic structure, provided interesting pointers for designing the non-polar portion. The structural criteria identified via these studies were interpreted on the basis of chemical and steric considerations. Recently, the thermodynamic approach was adopted to identify selective reagents for the removal of minor elements and for the separation of copper from zinc in the xanthate flotation of complex sulphide ores.

Low Density Dry Coal Beneficiation Using an Air Dense Medium Fluidized Bed

Author(s): Zhen-fu LUO, Jian-feng ZHU, Mao-ming FAN, Yue-min ZHAO, Xiu-xiang TAO

Journal of China University of Mining and Technology,*Volume 17, Issue 3*, *September 2007*, *Pages 306-309*

For the production of low ash content clean coal, separation at low density is required for some raw coals. Based on analyzing the fluidizing characteristics of magnetic pearls with a specific size distribution and formation mechanism of a microbubble fluidized bed, optimal technological and operating parameters suitable for low density coal separation were determined. The experimental results show that an air dense medium fluidized bed with low density can be formed using magnetic pearls as medium solids, which can efficiently beneficiate coal of 6–50 mm size with a probable error E_p value of 0.05 at a separating density of 1.44 g/cm^3.

Rate of water transfer to flotation froth in the flotation of low-rank coal that also requires the use of oily collector

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The entrainment of hydrophilic gangue particles in flotation is related to the amount of water reporting to the froth. It is well established that the amount of water reported to the froth is controlled by frother concentration. As it is shown in this paper, in the flotation systems in which emulsified oily collector is also used (e.g. coal flotation), solids recovery strongly depends on the collector dosages as also does the water recovery. While the tests carried out at low (1000 g/t) and high (8000 g/t) oil dosages show different effects of frother additions on water transfer rates to the froth, all the experimental points when water transfer rates are plotted versus solids transfer rates to the froth converge on one single curve. This suggests that the effect of both the frother and collector on water transfer rates is first of all determined by the transfer of solids to

the froth, and thus by the effect of these two agents on the solids transfer to froth.

Improvement of Egyptian talc quality for industrial uses by flotation process and leaching

Author(s): Mahmoud M. Ahmed, Galal A. Ibrahim, Mohamed M.A. Hassan

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Talc is an industrial mineral that is widely used. It is always associated with other minerals, which determine the quality of talc samples for industrial purposes. Various operating variables control the natural floatability of talc. For enhancement of talc flotation, sodium hexametphosphate is used as a depressant for associated gangue minerals. In addition, oleic acid (in an equal mixture with kerosene) is used as an anionic collector. The results presented in this paper provided useful and important information on how to improve the quality of Egyptian talc, obtained from different sites, for industrial uses. The optimum conditions were obtained at pH = 11, depressant dosage = 1.0 kg/t, collector dosage = 1.2 kg/t and pulp density = 200 g/L. At these conditions, SiO_2 assay increased from 54.10% to 54.94%, MgO assay increased from 29.90% to 31.76%, CaO decreased from 0.80% to 0.42%, Al_2O_3 decreased from 5.50% to 3.11%, Fe_2O_3 decreased from 8.20% to 7.24%, the whiteness increased from 75.4% to 83.7%, and the loss on ignition decreased from 6.64% to 5.21%. The mass recovery of final concentrate was 92.4%. The component recoveries of SiO_2 and MgO (the major constituents of talc) in the final concentrate were 93.8% and 98.2%, respectively. More improvement of talc quality was obtained by leaching the final concentrate of flotation with a 10% diluted hydrochloric acid. The mass recovery of final product was about 85% of initial feed. In this final product, Fe_2O_3 decreased to 3.12%, CaO decreased to 0.38%, and Al_2O_3 decreased to 3.01%. The assay of SiO_2 increased to 58.96%, MgO percent was nearly the same as in the final concentrate of flotation, the whiteness increased to 88.5%, and the loss on ignition decreased to 4.03%. The final product may be suitable for many industrial uses such as low-loss electronics (a type of ceramics), paints, rubber, plastics, roofing, textiles, refractories, insecticides and coating of welding rods.

An analysis of historic production trends in Australian base metal mining

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Ore Geology Reviews, *Volume 32, Issues 1–2*, *September 2007*, *Pages 227-261*

The base metal mining sector, including copper, lead–zinc–silver and nickel, has been a prominent and critical feature of the Australian minerals industry. The various mines and fields have been producers of world significance, including Broken Hill, Mt Isa, Mt Lyell,

Olympic Dam, Cobar and Kambalda. The long-term production trends in the base metal sector governing these historic fields remain relatively undocumented. This includes trends in ore grades, mining technique (open cut versus underground), solid wastes produced (tailings and waste rock), technology (e.g., milling) and known economic resources. This paper presents these results for the Australian base metals sector — arguably the first such systematic compilation undertaken. A historical overview is discussed for each major commodity to outline the principal developments and changes for that commodity, followed by the presentation of mining and milling trends. Overall, the key trends are declining ore grades versus increasing metal production and ore milled, and increased open cut mining and associated waste rock (though this latter aspect remains significantly under-reported). The extent of known economic resources has steadily increased for all commodities analysed, principally due to the inclusion of lower grade ores and/or difficult to treat ores (such as nickel laterites) or new deposit discoveries. Based on present mine plans and proposals, future metal production will increasingly shift towards lower ore grades and larger open cut mines to maintain production levels. There are sufficient known economic resources for about three decades or more, providing a basis to sustain the existing base metal industry but beyond this timeframe is difficult to predict. These trends point to the need to accurately report complete data on base metal mining and milling as key inputs into quantifying mineral resource trends as well as the environmental aspects of “sustainable mining”.

Bioleaching of iron from highly contaminated Kaolin clay by *Aspergillus niger*

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Applied Clay Science, *Volume 37, Issues 3–4*, *September 2007*, *Pages 251-257*

Kaolin is a clay mineral that has a wide application in the industry specially, in paper, ceramic, and porcelain manufacturing. One of the most important factors that affects the value of this raw material is its brightness. Unfortunately, with the iron oxides deposit on mineral particles during kaolin formation, much of this clay has become unusable for industries. So, several chemical methods have been applied in mineral processing plants to reduce these contaminants, but finding a more sustainable approach like biological methods have always attracted a great attention. In this work bioleaching of iron from a highly contaminated kaolin sample was carried out using two different strains of *Aspergillus niger*, and the effects of strain type, pulp density, and time of clay addition on the iron removal were investigated by employing a 2^3 full factorial design. Finally, it is concluded that strain type has the most significant effect on the response; also, the highest removal extent was 42.8% that was obtained by using the strain isolated from pistachio shell, and at the pulp density of 20 g/l when the clay was added at the beginning of the experiments.

On the drying rates of individual iron oxide pellets

Author(s): T. Tsukerman, C. Duchesne, D. Hodouin

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After agglomeration, iron oxide pellets are sintered in continuous furnaces to develop the mechanical properties required by iron making plants. In the first zones of the furnace, pellets are dried by the hot recycled gas. The objective of the study is to model their drying kinetics. For that purpose, individual pellets, instrumented for temperature measurement, are dried in a laboratory furnace equipped with a thermo-balance. The results show that there are four stages in the drying process: 1—an evaporation of the water film at the pellet surface; 2—an hybrid regime with surface film evaporation and apparition of dry spots with evaporation fronts moving within the pellet; 3—a shrinking wet core leaving behind the evaporation front a dry shell where there is water vapour diffusion; 4—a change of diffusion into bulk transportation of water through the dry shell, when the evaporation front is close to the boiling point. Mass and heat transfer equations are numerically solved, and the simulated values compared to the experimental results.

Eco-efficiency in the Australian minerals processing sector

Author(s): Rene van Berkel

Journal of Cleaner Production, *Volume 15, Issues 8–9*,*2007*, *Pages 772-781*

The resources sector has come to accept that the global quest for sustainable development is one of the key shapers of its future development and business success. While much uncertainty remains regarding the full ramifications of sustainable development, it is uncontested that preventive environmental and resource productivity strategies, or eco-efficiency (EE), are conditional for the minerals industry's ability to progress in sustainable development. A customised framework for EE in minerals processing is proposed. It connects five *prevention practices* (process design; input substitution; plant improvement; good housekeeping; and reuse, recycling and recovery) with five *resource productivity themes* (resource efficiency; energy use and greenhouse gas emissions; water use and impacts; control of minor elements and toxics; and by-product creation). These are illustrated with practical examples from gold, base metals, alumina, aluminium and pigment operations in Australia. This illustrates that EE is possible from technical and operational perspectives, with implementation ultimately depending on the ability of project teams to build a convincing business case. Moreover, from a technology perspective, EE can be fostered at three distinct and mutually reinforcing innovation platforms: operations; plant design; and process technology.

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