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Editors:

R. Singh

A. Das

N.G. Goswami

Compilation: A.K. Sahu

INDIAN INSTITUTE OF MINERAL ENGINEERS

C/o Mineral Processing Division

CSIR-NATIONAL METALLURGICAL LABORATORY

JAMSHEDPUR 831 007, JHARKHAND WEBSITE: www.iimeindia.com

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CSIR-National Metallurgical Laboratory

Jamshedpur 831 007, Jharkhand

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1. Effect of cuprous cyanide, dry and wet milling on the selective flotation of galena and sphalerite

M.D. Seke, P.C. Pistorius
Minerals Engineering, Volume 19, Issue 1, Pages 1-104 (January 2006)

Abstract: Batch flotation tests of a lead–zinc sulphide composite ore from the Rosh Pinah Mine have been carried out at pH 8.5 in the presence of copper cyanide complexes. These copper cyanide complexes are often found in the recycled water that is used in the milling and the lead flotation circuits. Flotation results have shown that cuprous cyanide complexes can activate sphalerite. In addition, the activation and subsequent flotation of sphalerite was greater when the composite was dry milled as compared to wet milling. Surface analysis of copper (I)-activated sphalerite samples was studied by X-ray photoelectron spectroscopy (XPS). XPS results showed the presence of copper species on the surface of sphalerite after activation with cuprous cyanide complexes. The copper species could be removed from the surface of sphalerite after treatment with sodium cyanide. This explains, amongst others reasons, the high cyanide requirement at Rosh Pinah Mine for the efficient depression of sphalerite in the lead flotation circuit.

2. Efficiency of different clay minerals modified with a cationic surfactant in the adsorption of pesticides: Influence of clay type and pesticide hydrophobicity

Sanchez-Martin, MJ; Rodriguez-Cruz, MS; Andrades, MS; Sanchez-Camazano, M
Applied Clay Science, Vol. 31, 2006, pp. 216-228. 10.1016/j.clay.2005.07.008

Abstract: In the present work we studied the efficiency of a series of clay minerals (montmorillonite, illite, muscovite, sepiolite and palygorskite) modified with the cationic surfactant octadecyltrimetylammonium bromide (ODTMA) in the adsorption of the pesticides penconazole, linuron, alachlor, atrazine and metalaxyl. A study was also carried out on the effect of the structure (expansible and non-expansible layered, and non-layered), the surface area and charge density of the clay minerals, and the hydrophobicity of the pesticides (K-ow) on the adsorption process. Adsorption-desorption isotherms of the pesticides by clay minerals were obtained and the constants of the Freundlich model (K-f and K-fd) (natural clays) and of the linear model (K and K-des) (ODTMA-clays) were determined. Correlation coefficient values (r(2)) found between K and K-desom and organic matter (OM) content of

ODTMA-clays indicate a more effective partitioning of the pesticides in the organic phase of ODTMA after desorption. Furthermore the positive significant correlation found between the K-desom values and the charge density of different ODTMA-clays indicates that a higher density of ODTMA in the clay gives rise to the formation of an organic phase more effective for the partition of the pesticides. This correlation explained that the highest K-desom value obtained was for kaolinite and the lowest K-desom value was for montmorillonite in the adsorption of all pesticides by the different organo clays. Simple correlations between adsorption constants and K-ow values, and multiple correlations between these constants and clay OM contents and K-ow values were also calculated. The results obtained indicate the interest of ODTMA-clays in the adsorption of hydrophobic pesticides. Non-expandible layered and fibrous clay minerals may also be of interest as adsorbents derived from their density charge, and these minerals, when modified with ODTMA, and used in appropriate amounts, higher than that of montmorillonite, or when present in soils with high clay contents, even in the absence of montmorillonite, may be good adsorbents for hydrophobic pesticides. According to the results of the study, ODTMA-clays and ODTMA-soils could be used as barriers to prevent the mobility of certain hydrophobic pesticides from a point source of pollution.

3. Removal of heavy metal ions by dithiocarbamate-anchored polymer/ organosmectite composites

Say, R; Birlik, E; Denizli, A; Ersoz, A
Applied Clay Science, Vol. 31, 2006, pp. 298-305. 10.1016/j.clay.2005.10.006

Abstract: In this study, the dithiocarbamate-anchored polymer/organosmectite composites were prepared for the removal of heavy metal ions (lead, cadmium and chromium) from aqueous media containing different amounts of these ions (50-750 ppm) and at different pH values (2.0-8.0). Initially, the modification of the natural smectite minerals was performed by treatment with quartamin styrene and chloromethylstyrene. Then, modified smectite nanocomposites were reacted with carbondisulfide, in order to incorporate dithiocarbamate functional groups into the nanolayer of organoclay. The dithiocarbamate-anchored nano-composites have been characterized by FTIR and used in the adsorption-desorption process. The maximum adsorptions of heavy metal ions onto the dithiocarbarnate-anchored polymer/organosmectite composites from their solution was 170.7 mg g(-1) for Pb(II); 82.2 mg g(-1) for Cd(II) and 71.1 mg g(-1) for Cr(III). Competition between heavy metal ions (in the case of adsorption from mixture) yielded adsorption capacities of 70.4 mg g(-1) for Pb(II); 31.8 mg g(-1) for Cd(II) and 20.3 mg g(-1) for Cr(III). Desorption of the heavy metal ions from composite was studied in 0.5 M NaCl and very high desorption rates, greater than 93%, were achieved in all cases. Adsorption-desorption cycles showed the feasibility of repeated uses of this nanocomposite.

4. Separation of small metallic nonferrous particles in low concentration from mineral wastes using dielectrophoresis

Lungu, M
INTERNATIONAL JOURNAL OF MINERAL PROCESSING, Vol. 78, 4, 2006, pp. 215-219. 10.1016/j.minpro.2005.10.007

Abstract: This paper presents a theoretical study and a method regarding the separation of small nonferrous particles (Au, Ag) in low concentration from mineral wastes, using the dielectrophoresis phenomenon. The main theoretical considerations referring to the dielectrophoresis and the appearance and action of the electric gradient forces, typical for nonuniform fields, are presented. The gradient and superficial electric forces, in competition with gravitational forces, act on the dielectric particles from the surface of the material subjected to the separation process. Under the combined actions of all these forces, the metallic particles are concentrated on the surface of the mixture, forming a Superficial conductive layer. Finally, the experimental results and conclusions regarding the concentrations in Au and Ag of the particles collected from the formed layer are presented, based oil chemical analysis.

5. **Pre-concentration and residual bitumen removal from Athabasca oilsands froth treatment tailings by a Falcon centrifugal concentrator**
Liu, Q; Cui, Z; Etsell, TH
INTERNATIONAL JOURNAL OF MINERAL PROCESSING, Vol. 78, 4, 2006, pp. 220-230. 10.1016/j.minpro.2005.10.010

Abstract: Both froth flotation and centrifugal concentration were used to pre-concentrate the oil sands froth treatment tailings prior to the recovery of heavy minerals (titanium and zirconium minerals). Over 90% of the heavy minerals were recovered into a bulk flotation concentrate that was about 50% of the feed mass at 85 degrees C without any reagents. The same recoveries were obtained at 50 degrees C with the addition of NaOH and/or sodium oleate. However, the flotation concentrate also recovered over 90% of the residual bitumen and much of the clays/slimes. Subsequent treatment of the flotation concentrate such as dewatering and bitumen removal would be difficult due to these residual bitumen and clays. On the other hand, a SB40 centrifugal concentrator recovered over 85% of the heavy minerals but less than 30% of the residual bitumen. With improved liberation the recovery of the residual bitumen into the concentrate could be further reduced. The particle sizes of the SB40 concentrates were also larger than the flotation concentrates, making subsequent processing much easier.

6. **Influence of shape characteristics of talc mineral on the column flotation behavior**
Kursun, H; Ulusoy, U
INTERNATIONAL JOURNAL OF MINERAL PROCESSING, Vol. 78, 4, 2006, pp. 262-268. 10.1016/j.minpro.2005.11.003

Abstract: Column flotation, which is a very effective process in mineral processing especially for easily floatable minerals, is one of the most important new developments to emerge in mineral processing technology in the last years. In this study, the flotation behavior of talc products having different particle shapes produced by different grinding mills (ball and rod mill) was determined by using column flotation process. Shape characteristics of the particles were investigated by the two dimensional measuring technique based on the particle projections obtained from the SEM microphotographs using a COREL Draw 10.0 program. The results showed that particles possessing higher elongation and flatness properties were recovered better during column flotation, whilst roundness and relative width had a negative effect on the flotation behavior of the talc mineral studied. Consequently, as the shape of the particles produced by the mill deviated from the ideal sphere, their floatability was increased. (c) 2005 Elsevier B.V. All rights reserved.

7. Modeling of copper(II) and lead(II) adsorption on kaolinite-based clay minerals individually and in the presence of humic acid

Hizal, J; Apak, R
JOURNAL OF COLLOID AND INTERFACE SCIENCE, Vol. 295, 1, 2006, pp. 1-13.
10.1016/j.jcis.2005.08.005

Abstract: The aim of this study is to explain how clay minerals adsorb heavy metals individually and in the presence of humic acid, and to model heavy metal adsorption specifically based on surface-metal binary and surface-metal-ligand ternary complexation. The adsorption of Cu(II) and Pb(II) on kaolinite-based clay minerals has been modeled by the aid of the FITEQL3.2 computer program using single- and double-site binding models of the Langmuir approach. Potentiometric titrations and adsorption capacity experiments were carried out in solutions containing different concentrations of the inert electrolyte NaClO(4); however, the modeling of binary and ternary surface complexation was deliberately done at high ionic strength (0.1 M electrolyte) for eliminating adsorption onto the permanent negatively charged sites of kaolinite. A "two-site, two pK(a)" model was adapted, and as for the two surface sites responsible for adsorption, it may be arbitrarily assigned that S(1)OH sites represent silanol and organic functional groups such as carboxyl having pK(a) values close to that of silanol, and S(2)OH sites represent aluminol and organic functional groups such as phenolics whose pKa values are close to that of aluminol, as all the studied clays contained organic carbon. Copper(II) showed a higher adsorption capacity and higher binding constants, while lead(II), being a softer cation (in respect to HSAB theory) preferred the softer basic sites with aluminol-phenol functional groups. Heavy metal cations are assumed to bind to the clay surface as the sole (unhydrolyzed) M(II) ion and form monodentate surface complexes. Cu(II) and Pb(II) adsorption in the presence of humic acid was modeled using a double-site binding model by the aid of FITEQL3.2, and then the whole system including binary surface-metal and surface-ligand and ternary surface-metal-ligand complexes was resolved with respect to species distributions and relevant stability constants. Electrostatic effects were accounted for using a diffuse layer model (DLM) requiring minimum number of adjustable parameters. Metal adsorption onto clay at low pH

increased in the presence of humic acid, and the metal adsorption vs pH curves of metal-kaolinite-humic acid suspensions were much steeper (and distinctly S shaped) compared to the wider pH-gradient curves observed in binary clay-metal systems. The clay mineral in the presence of humic acid probably behaved more like a chelating ion-exchanger sorbent for heavy metals rather than being a simple inorganic ion exchanger. (c) 2005 Elsevier Inc. All rights reserved.

8. Mineralogical characterisation of Secunda gasifier feedstock and coarse ash

Matjie, RH; van Alphen, C; Pistorius, PC
MINERALS ENGINEERING, Vol. 19, 3, 2006, pp. 256-261.
10.1016/j.mineng.2005.06.010

Abstract: The formation of clinkers in a Sasol-Lurgi fixed bed dry bottom (FBDB) gasifier is a complex process controlled by coal mineralogy and operating conditions. This paper explores the link between the coal mineralogy and the mineralogy of the corresponding clinkers/coarse ash. CCSEM and XRD results indicate that kaolinite (Al2Si2O5(OH)(4)) and to a lesser extent quartz (SiO2) are the major coal minerals. Minor minerals are calcite (CaCO3), dolomite (CaMg(CO3)(2)) and pyrite (FeS2). Kaolinite and quartz are associated with rock fragments ("stone") or as fine inclusions in organic rich coal particles. Calcite/dolomite and pyrite occur in coarse and fine cleats or fine inclusions in carbon-rich particles. The coarse ash and clinker samples contain the following phases: (1) Ca-and Fe-bearing aluminosilicate glass, (2) Crystallised phases in glass (anorthite and mullite), (3) Remnant rock fragments, (4) Large extraneous Fe-oxide/pyrrhotite/Fe-S-O particles (originally coarse pyrite cleat fragments), (5) Large extraneous Ca-oxide/Ca-Mg-oxide/carbonate particles (originally coarse carbonate cleat fragments) and (6) Uncombusted carbon-rich particles (char) with their associated minerals (kaolinite, quartz and carbonates). The equilibrium phases (as calculated with Factsage) for temperatures above 1220 degrees C correspond approximately to the phases which were identified in ash and clinker by CCSEM. (c) 2005 Elsevier Ltd. All rights reserved.

9. A dynamic-CFD hybrid model of a submerged arc furnace for phosphorus production

Scheepers, E; Yang, Y; Reuter, MA; Adema, AT
MINERALS ENGINEERING, Vol.19, 3, 2006, pp. 309-317.
10.1016/j.mineng.2005.07.018

Abstract: The paper presents the architecture of a submerged arc furnace process model. It utilises the robust and simplistic solving capabilities of a time dependent, dynamic modelling by employing flowrate and composition data. Next, it employs continuously updated electrical data in order to optimise the model's predictive ability, with zero-order hold elements enforced on flowrate and composition data until these variables are resampled. The addition of a set of fundamentally derived variables generated through the online use of a vectorised, look-up table, is also proposed. Such a look-up table is created offline by utilising computational fluid

dynamic (CFD) modelling techniques. Promising results indicate that this pragmatic methodology allows an intermediate version of this model to reasonably predict the metallurgy of the subsequent tap within the inherent accuracy of the data. The model is being tested on industrial data. (c) 2005 Elsevier Ltd. All rights reserved.

10. **Theoretical basis for optimal collector concentrations and pulp pH values during flotation of sulfide-free minerals**
Abramov, AA; Magazanik, DV
JOURNAL OF MINING SCIENCE, Vol. 42, 2, 2006, pp. 178-188.
10.1007/s10913-006-0045-4

Abstract: A hypothesis that associates optimal conditions of mineral flotation with a zero charge of their surface is put forward. This hypothesis serves as a basis for a methodology to obtain and verify quantitative physical-chemical models for a minimal necessary concentration of a collector during flotation of sulfide-free minerals. These models may be of use for upgrading engineering processes of flotation and as a job for the concentration plant automation systems.

11. **A comprehensive characterisation of fly ash from a thermal power plant in Eastern India**
Sarkar, A; Rano, R; Udaybhanu, G; Basu, AK
FUEL PROCESSING TECHNOLOGY, Vol. 87, 3, 2006, pp. 259-277.
10.1016/j.fuproc.2005.09.005

Abstract: A comprehensive characterisation of fly ash from Bokaro Thermal Power Plant, Jharkhand, India has been carried out for creating utilisation potential of the ash. As received fly ash, was size fractionated and the fractions were characterised. The non-magnetic and magnetic fractions of ash have been analysed in terms of their morphological, mineralogical features and physico-chemical properties. The results of such analysis reveal that there is a striking difference in the features and properties of the coarser and finer particles. The coarser fractions of the non-magnetic component seem to contain high percentage of char and semicoked/coked carbonaceous particles. The percentage of char albeit the carbon content decreases with decrease in size of the particles. The particles of the finer fractions have more spheroidal character than the coarser ones. The nonmagnetic components essentially contain quartz and mullite as the main mineral phases. The magnetic component differs from the non-magnetic ones in respect of shape, mineralogical composition and carbon content. These are much more spheroidal than the non-magnetic ones. The ferrospheres present in these components bear crystallites with different geometrical patterns clearly indicating a definite degree of variation in the crystallisation process. Such comprehensive characterisation leads to not only a definite direction about the uses of the various fractions of the ash, but also gives useful informations regarding the prevailing combustion process. (C) 2005 Elsevier B.V. All rights reserved.

12. **Interactive effects of the type of milling media and copper sulphate addition on the flotation performance of sulphide minerals from Merensky ore Part I: Pulp chemistry**

Bradshaw, DJ; Buswell, AM; Harris, PJ; Ekmekci, Z

INTERNATIONAL JOURNAL OF MINERAL PROCESSING, Vol. 78, 3, 2006, pp. 153-163. 10.1016/j.minpro.2005.10.004

Abstract: It is well known that the chemical environment determines the success of the flotation process, however its characterisation and control is difficult to achieve. This paper, as two parts, Part I and Part II, evaluates the use of various measurements and their interpretation to gain an understanding of the influence of varying parameters such as the type of milling media and copper sulphate addition on the flotation performance of sulphide minerals from a platinum group mineral (PGM) bearing Merensky ore. It shows the complexity of interpretation and the importance of analysing flotation performance holistically. Part I focuses on the pulp chemistry and mineral potential measurements have been used to show the differences in the response of the various mineral electrodes to different conditions. The final flotation recoveries of the sulphide minerals in the ore followed the same trend as the decrease in mineral potential due to collector addition viz. chalcopyrite > pentlandite > pyrrhotite. Type of milling media and copper sulphate addition slightly affected the mineral electrode potential and flotation recovery of chalcopyrite. Addition of copper sulphate increased the recovery of pentlandite and particularly pyrrhotite due to activation by copper (II) ions. The copper activation mechanism was likely to be in the form of initial adsorption of copper hydroxide followed by reduction to Cu+ at the surface. However, the changes in flotation performance of the different minerals in the ore could not be completely described by the electrochemical changes, demonstrating the limitations of these measurements. Part II addresses the effect of froth stability as demonstrated by the variations in the mass and water recovery data resulting from the different milling conditions and addition of copper sulphate which emphasised the importance of considering the froth phase in the evaluation of flotation data. (c) 2005 Elsevier B.V. All rights reserved.

13. **Platinum-group mineral assemblages in the Platreef at the Sandsloot Mine, northern Bushveld Complex, South Africa**

Holwell, DA; McDonald, I; Armitage, PEB

MINERALOGICAL MAGAZINE, Vol. 70, 1, 2006, pp. 83-101. 10.1180/0026461067010315

Abstract: Platinum group mineral (PGM) assemblages in the Platreef at Sandsloot, northern Bushveld Complex, in a variety of lithologies reveal a complex multi-stage mineralization history. During crystallization of the Platreef pyroxenites, platinum group elements (PGE) and base-metal sulphides (BMS) were distributed thoughout the interstitial liquid forming a telluride-dominant assemblage devoid of PGE sulphides. Redistribution of PGE into the metamorphic footwall by hydrothermal fluids has formed arsenide-, alloy- and antimonide-dominant assemblages, indicating a significant volatile influence during crystallization. Serpentinization of the

footwall has produced an antimonide-dominant PGM assemblage. Parts of the igneous reef were subjected to alteration by a late-stage, Fe-rich fluid, producing ultramafic zones where the telluride-dominant assemblage has been recrystallized to an alloy-dominant one, particularly rich in Pt-Fe and Pd-Pb alloys. A thin, small-volume zone of PGE-BMS mineralization along the base of the hangingwall contains a primary PGM assemblage that is locally altered to one dominated by Pt/Pd germanides. This is thought to have formed when the new pulse of Main Zone magma entered the chamber, and scavenged PGE from the underlying Platreef pyroxenites. That each major rock type at Sandsloot contains a distinctive PGM assemblage reflects the importance of syn- and post-emplacement fluid and magmatic processes on the development of Platreef mineralization.

14. Heavy metal removal mechanism of acid mine drainage in wetlands: A critical review

Sheoran, AS; Sheoran, V
MINERALS ENGINEERING, Vol. 19, 2, 2006, pp. 105-116.
10.1016/j.mineng.2005.08.006

Abstract: Acid mine drainage (AMD) is one of the most significant environmental challenges facing the mining industry worldwide. Water infiltrating through the metal sulphide minerals, effluents of mineral processing plants and seepage from tailing dams becomes acidic and this acidic nature of the solution allows the metals to be transported in their most soluble form. The conventional treatment technologies used in the treatment of acid mine drainage are expensive both in terms of operating and capital costs. One of the methods of achieving compliance using passive treatment systems at low cost, producing treated water pollution free, and fostering a community responsibility for acid mine water treatment involves the use of wetland treatment system. These wetlands absorb and bind heavy metals and make them slowly concentrated in the sedimentary deposits to become part of the geological cycle. In this paper a critical review of the heavy metal removal mechanism involving various physical, chemical and biological processes, which govern wetland performance, have been made. This information is important for the siting and use of wetlands for remediation of heavy metals. (c) 2005 Elsevier Ltd. All rights reserved.

15. An investigation into the feasibility of recovering valuable metals from solid oxide compounds by gas phase extraction in a fluidised bed

Potgieter, JH; Kabemba, MA; Teodorovic, A; Potgieter-Vermaak, SS; Augustyn, WG
MINERALS ENGINEERING, 19, 2, 2006, pp. 140-146.
10.1016/j.mineng.2005.08.002

Abstract: Recent years have seen the application of the concept of fluidisation extended to different kinds of industrial processes. This technology now plays a central role in the chemical and petrochemical industries, in power generation and in mineral processing and metallurgy. The current research is directed towards gas-phase extraction of metals because of the high yield of recovery that can potentially be achieved. This process achieves the extraction of metals by using a volatile

organic reagent, which passes through the feed material and reacts selectively with the metal to be extracted. The product is a volatile metal complex, which is removed from the residual gangue by a carrier gas. The results showed that the procedure could be successfully applied to recover aluminium, chromium, vanadium and iron with acetylacetone from their respective solid oxides in a fluidised bed. The percentage recovery ranged from 75.2% for iron to 48.2% for chromium. Kinetic investigations were performed to estimate the activation energy required for each reaction. The recovery of the metals depended on the temperature and reaction time.

16. Adsorption of polysaccharide onto talc

Liu, GS; Feng, QM; Ou, LM; Lu, YP; Zhang, GF
MINERALS ENGINEERING, Vol. 19, 2, 2006, pp. 147-153.
10.1016/j.mineng.2005.08.005

Abstract: The interaction of polysaccharide with talc has been investigated through adsorption, flotation, and electrokinetic measurements. The adsorption densities are independent of pH and the isotherms exhibit Langmuirian behavior. The order of adsorption density of several polysaccharides investigated in the paper onto talc is CMC > CMS > dextrin. Pretreatment of talc with EDTA (ethylenediaminetetraacetic acid), leaching and calcinations result in a decrease in the adsorption density, highlighting the importance of metallic magnesium sites for the adsorption process. An increase in the surface face-to-edge ratio leads to increase in adsorption density. The flotation recoveries are independent of pH. CMC exhibit best depressant ability, followed by CMS and then dextrin among the three depressants, complementing the adsorption results. However, polysaccharide depressant ability is reduced in the case of leached and calcined talc sample in comparison to that on talc. Electrokinetic measurements portray conformational rearrangements of macromolecules with the loading, resulting in the shift of the shear plane, further away from the interface. The adsorption process is governed by hydrogen bonding as well as chemical interaction between the polysaccharides and the surface metal hydroxide groups of talc. The best depressant activity of CMC may be attributed to its more favorable carboxyl groups as opposed to the hydroxyl groups of dextrin, apart from its higher molecular weight. (c) 2005 Elsevier Ltd. All rights reserved.

17. High-density-infrared (HDI) treatment of mineral processing equipment for enhanced wear resistance

Tao, D; Blue, C; Dahotre, NB; Honaker, R; Parekh, BK; Engleman, PG; Zhao, C; Han, H
MINERALS ENGINEERING, Vol. 19, 2, 2006, pp. 190-196.
10.1016/j.mineng.2005.09.038

Abstract: Equipment wear and corrosion have significant adverse impact on the operating cost and efficiency of mineral processing plants. In this study, advanced surface enhancement technologies were investigated to improve the wear resistance of metal surface of mineral processing equipment. Enhanced metal surfaces were

achieved through surface conversion, enrichment, and coating by use of advanced high-density-infrared (HDI) technology. Attempts were made to determine the effects of process parameters on surface properties and corresponding optimum conditions. The microstructure of the enhanced metal surfaces was characterized by SEM, EDS, and microindentation. Laboratory dry sliding wear testing was carried out to investigate the wear performance and the viable coating candidate was determined.

18. Copper(II) sulfide?

Goh, SW; Buckley, AN; Lamb, RN
MINERALS ENGINEERING, Vol. 19, 2, 2006, pp. 204-208.
10.1016/j.mineng.2005.09.003
Abstract: Reference to covellite as copper(II) sulfide has been challenged. To support the nominally Cu(I) formal oxidation state for covellite suggested by X-ray photoelectron spectroscopy, the Cu L-2,L-3 near-edge X-ray absorption fine structure spectrum for unoxidised covellite has been determined in fluorescence yield mode. Interpretation of the Cu L-3-edge spectrum has been effected with the assistance of ab initio calculations of the density of unfilled states and the simulation of spectra from both Cu sites in the covellite structure. An alternative explanation has been provided for a covellite Cu L-2,L-3-edge spectrum determined in electron yield mode that had been rationalised previously in terms of the presence of both Cu(I) and Cu(II) in the covellite structure. The relevance to mineral processing of the Cu(I) formal oxidation state in copper sulfides and other sulfide minerals has been discussed. (c) 2005 Elsevier Ltd. All rights reserved.

19. Recovery of copper from melting furnaces dust by microorganisms

Oliazadeh, M; Massinaie, M; Bagheri, AS; Shahverdi, AR
MINERALS ENGINEERING, Vol. 19, 2, 2006, pp. 209-210.
10.1016/j.mineng.2005.09.004

Abstract: Bacterial leaching of the copper dust emanating from smelting furnaces of Sarcheshmeh Copper Mine has been studied. The present procedure to treat the dust which consists of about 30% copper is included in its collection and sending back to the furnace. Regarding the considerable amount of copper oxide minerals in the dust, a sulphuric acid leaching process was performed prior to bacterial leaching. Shake flask experiments were run using a mixed culture of thiobacilli and the effects of some parameters such as culture medium and pulp density on copper extraction were studied. Copper recoveries in 5% pulp density of inoculated and control flasks after 22 days incubation were 87% and 38%, respectively. (c) 2005 Elsevier Ltd. All rights reserved.

20. Advanced surface-enhancement technology for decreasing wear and corrosion of equipment used for mineral processing

Tao, D; Honaker, R; Parekh, BK; Zhao, C; Han, H; Engleman, G; Dahotre, NB; Blue, C
MINERALS & METALLURGICAL PROCESSING, Vol. 23, 1, 2006, pp. 27-32.

Abstract: Equipment wear and corrosion have significant adverse impacts on the operating cost and efficiency of mineral processing plants. In this paper, advanced surface-enhancement technologies are investigated to decrease the wear and corrosion rates of metal surfaces. Enhanced metal surfaces are achieved through surface conversion, enrichment and coating by use of an advanced high-density infrared (HDI) plasma arc lamp. Studies were done to determine the effects of process parameters on surface properties and identify optimum conditions. The microstructure of the enhanced metal surfaces was characterized by SEM, EDS and microindentation. Laboratory wear testing was carried out to investigate the wear performance, and a viable coating candidate was determined.

21. Development of high-efficiency hydraulic separators

Luttrell, GH; Westerfield, TC; Kohmuench, JN; Mankosa, MJ; Mikkola, KA; Oswald, G
MINERALS & METALLURGICAL PROCESSING, Vol. 23, 1, 2006, pp. 33-39.

Abstract: Hydraulic separators are commonly used for particle size classification and gravity concentration of minerals and coal Unfortunately, the efficiency of these processes can be quite low due to poor equipment design and variations in feed consistency. To help alleviate these problems, an industry-driven R&D program was undertaken to develop a new generation of hydraulic separators that are more efficient and less costly to operate and maintain. Two of the most promising technologies, the CrossFlow and HydroFloat separators, have now been tested at industrial sites. The data obtained from these sites have been used to illustrate the potential performance improvements that can be realized through the application of these high-efficiency separators.

22. Effect of media type on regrinding with stirred mills

Orumwense, AO
MINERALS & METALLURGICAL PROCESSING, Vol. 23, 1, 2006, pp. 40-44.

Abstract: Ball mills are commonly used for regrinding operations in the mineral processing industry. However, efforts are now being made to use stirred mills for regrinding, particularly in instances where very fine grinding is required. Media type (steel shot, glass beads, alumina balls and crushed quartz), media size, mill speed and the number of passes required to obtained the target product size are studied. The product size and energy consumption are used in the evaluation of the test results. The grinding media size, shape, density, filling ratio, mill circumferential speed and grinding time play distinct roles in product size fineness.

23. Mechanisms of ethyl(hydroxyethyl) cellulose-solid interaction: Influence of hydrophobic modification

Wang, J; Somasundaran, P
JOURNAL OF COLLOID AND INTERFACE SCIENCE, Vol. 293, 2, 2006, pp. 322-332.

10.1016/j.jcis.2005.06.072

Abstract: Hydroxyethyl cellulose and its hydrophobically modified derivatives are widely used in many industrial areas such as pharmaceuticals, cosmetics, textiles, paint and mineral industries. However, the interaction mechanisms of these biopolymers and solids have not been established. In this work, the interaction mechanism and conformation of hydrophobically modified ethyl (hydroxyethyl) cellulose (C(14)-EHEC) have been investigated using spectroscopic, AFM and allied techniques. Comparison was made with corresponding unmodified analogue in order to investigate the effects of the hydrophobic modification. Electrokinetic studies showed that polysaccharides adsorption decreased the negative zeta potential of talc but did not reverse the charge. EHEC adsorption on talc was not found to be affected significantly by changes in solution conditions such as pH and ionic strength, ruling out electrostatic force as the controlling factor. However, HM-EHEC adsorption was found to increase markedly with increase in ionic strength from 0. 1 to 1 suggesting a role for the hydrophobic force in this adsorption process. Fluorescence spectroscopic studies conducted to investigate the role of hydrophobic bonding using pyrene probe showed no evidence of the formation of hydrophobic domains at talc-aqueous interface. Urea, a hydrogen bond breaker, reduced the adsorption of HM-EHEC on talc markedly. In FTIR study, the changes in the infrared bands, associated with the C-O stretch coupled to the C-C stretch and O-H deformation, were significant and therefore support strong hydrogen bonding of HM-EHEC on the solid surface. Moreover, Langmuir modeling of the adsorption isotherms suggests hydrogen bonding to be a major force for the adsorption of EHEC and C(14)-EHEC on solid since the adsorption free energies of these polymers were close to that for hydrogen bond formation. All of the above results suggest that the main driving force for EHEC adsorption on talc is hydrogen bonding rather than electrostatic interaction or hydrophobic force. For hydrophobically modified C(14)-EHEC, hydrophobic force plays a synergetic role in adsorption along with hydrogen bonding. From computer modeling and AFM imaging, it is proposed that C(0)-EHEC and C(14)-EHEC adsorb flat on talc with ethylene oxide side chains and hydrophobic groups protruding out from the surface into bulk water phase.

24. Simultaneous adsorption of chlorophenol and heavy metal ions on organophilic bentonite

Andini, S; Cioffi, R; Montagnaro, F; Pisciotta, F; Santoro, L
APPLIED CLAY SCIENCE, Vol. 31, 2006, pp. 126-133.
10.1016/j.clay.2005.09.004

Abstract: Organophilic bentonite obtained by ion exchange with benzyldimethyl octadecylammonium chloride has been used for multiple adsorption of 2-chlorophenol and the metals Pb(2+) and Cd(2+). This is of interest for the stabilization of wastes in which simultaneous organics/heavy metals contamination occurs. In such cases cement-based processes take advantage from the addition of quaternary ammonium salts exchanged bentonite. The results have shown that any

of the contaminants is adsorbed according to a multilayer cooperative mechanism. Due to its organophilic nature, exchanged bentonite is able to adsorb 2-chlorophenol to a very high extent (about 0.7 g/g) when the organic is the only solute. On the other hand, each of the two metal ions is adsorbed to a much lesser extent when alone in solution (about 22 and 2.8 mg/g for Ph(2+) and Cd2+, respectively). In the case of simultaneous presence of 2-chlorophenol and Ph(2+) in solution, the adsorption isotherms of both solutes change to monolayer type and the adsorption capacity strongly decreases (about 0.3 g/g for 2-chlorophenol and 0.6 mg/g for Ph(2+)). In the case of the 2-chlorophenol/Cd(2+) systems, the adsorption capacity of about 0.3 g/g for 2-chlorophenol is retained, while Cd(2+) is not adsorbed at all. In all the cases in which the bentonite is in contact with one of the metal ions, it has been checked that no exchange with the ammonium ions takes place. Finally, FT-IR analysis has shown that in all the cases investigated physical adsorption takes place and no new chemical bonds are formed.

25. The development of heavy suspension techniques for high density sink-float separations (Replacement of Clerici's Solution)

Klutke, C; Koromikova, L; McKnight, S; Hall, S

AusIMM New Leaders' Conference 2006: RIDING THE BOOM. THE MINERALS INDUSTRY INTO TOMORROW, 2, 2006, pp. 73-83.

Abstract: Mineral sands represent an important new resource being developed in the Murray Basin, including parts of western Victoria. This paper will outline a simple methodology for mineral sands characterisation, developed as part of the AMIRA-managed project P777 'The Development of Heavy Suspension Techniques for High Density Separations (Replacement of Clerici's Solution)'. This project is currently sponsored by three multinational mining companies (De Beers Consolidated Mines, Iluka Resources Limited and Rio Tinto Limited) and is developing an innovative laboratory mineral characterisation procedure that will allow the replacement of the currently employed highly-toxic chemicals. Mineral sand resources almost always contain more than one valuable (and relatively heavy) mineral. Titanium minerals are found with a large range of titanium contents, giving rise to density variation and often subjective mineralogical descriptions. Companies tend to rely on laboratory heavy liquid separation in the evaluation of samples arising from exploration, mining or metallurgical processes. Unfortunately, there are only a limited number of high density ('heavy') liquids and these tend to be more toxic as their density increases. Low-toxicity inorganic solutions, based on tungsten compounds, have been developed that can be utilised at relative densities (RD) up to 3.0. However, beyond this value currently only organic liquids can be used. Diiodomethane (methylene iodide) having a relative density of 3.31 is commonly used; however, this presents significant health and safety hazards. Mixtures of thallium formate and thallium malonate were found in the early 1900s by Clerici to provide liquids having specific gravities between 4.0 and 5.0, hence 'Clerici's solution'. For the characterisation of the heavy components of mineral sand deposits (eg anatase sg 3.9, rutile sg 4.2, ilmenite sg 4.4-4.7 and zircon sg 4.6-4.8) there is currently no heavy liquid alternative to Clerici's solution. Clerici's solution is highly toxic and testing is now

conducted by very few laboratories worldwide with costs reflecting the chemical costs (though extensive efforts are made to recover and reuse the liquid, plus the requirement of its removal from the mineral samples), the infrastructure costs and health and safety regimes (eg blood testing of exposed staff, inventory management). A simple laboratory technique of density fractionation is being developed, employing suspensions of fine tungsten carbide particles in lithium heteropolytungstate (LST) solutions, that can replace Clerici's solution in the evaluation of fine mineral sands samples (eg -250+150 microns). The developing methodology that can achieve low-cost, low-toxic separations at relative densities above 5.0 will be outlined and the comparison of results with Clerici's solution presented.

26. Female undergraduates in the mining and minerals industry

Andrews, LJ; Melkle, J

AusIMM New Leaders' Conference 2006: RIDING THE BOOM. THE MINERALS INDUSTRY INTO TOMORROW, 2, 2006, pp. 111-112.

Abstract: A projected image is not always a true representation of a situation, or indeed an industry. This is often the case of the mining and minerals industry, which has frequently been portrayed in a negative light with a male dominance stigma attached. However, these issues can be combated for both the industry and its future, current undergraduate students, through undergraduate industry experience. In particular, vacation work enables female students to dispel many myths surrounding the industry and realise that the mining and minerals field offers career development for both genders. This paper will discuss how vacation work enables students to make important career decisions even before they have graduated. Industry experience provides undergraduates with the opportunity to gain practical knowledge relevant to their field of study. Additionally it allows students to observe the nature of the industry and the sacrifices necessary to advance careers. The prior insights into an industry are relevant to all students, but particularly female students, who might otherwise be dissuaded from a career in mining. This paper is written from the perspective of two female undergraduate students studying Mining and Minerals Processing Engineering.

27. Why the mining - Greenhouse industry is critical to sustainable development gas emissions policy, a case study

Sarder, M

AusIMM New Leaders' Conference 2006: RIDING THE BOOM. THE MINERALS INDUSTRY INTO TOMORROW, 2, 2006, pp. 155-158.

Abstract: Mining epitomises the challenge of sustainable development, because few sectors have such a direct impact on the natural environment, yet few are more important to the economic and social health of almost every region in the globe. In a global industry, with increasing competition for exploration and mining investment dollars, sustainable development must also be resolved within an international competitiveness framework. In formulating a response to the challenge of

sustainable development, the State and Federal Governments do not fully appreciate the extent to which technology drives the solution on a range of issues. In some cases' a dangerous fatalism about the state of science has led to an unhealthy 'stop production' attitude that puts our industry and economy at risk. As a technical institute representing the professionals in the minerals sector, The Australasian Institute of Mining and Metallurgy (The AusIMM) sees one of its roles as being to highlight the way in which industry innovation can facilitate solutions. The AusIMM is currently evolving a greenhouse gas emissions policy. As a case study it throws into sharp relief the way in which irresponsible 'limits to growth' policies could have a negative impact on the sustainability of the sector, as well as the importance of a technology-based solution. With 80 per cent of greenhouse gas emissions in the next twenty years projected to come from developing economies, such as India and China, major reductions will only be achieved if cost-effective, low emissions energy technologies are deployed in developing countries, and more energy efficient processes of producing key commodities for them are brought online. As a supplier of the key energy resources and materials that will be in high demand to feed developing economies, and with knowledge intensive industries with excellent R&D links across mining and manufacturing, Australia is well positioned to contribute to develop key low emissions technologies. However, we will only be able to take advantage of this position if the Federal Government commits to a holistic greenhouse emissions policy that does not penalise industry. We need effective 'push' polices aimed at leveraging investment in low emissions R&D that are closely linked in to 'pull' policies aimed at stimulating technology uptake.

28. Understanding element distribution during primary metal production

Broadhurst, JL; Petrie, JG; von Blottnitz, H

Green Processing 2006, AUSTRALASIAN INSTITUTE OF MINING AND METALLURGY PUBLICATION SERIES, Australian-Institute-of-Mining-and-Metallurgy New Leaders Conference, APR 11-12, 2006, Kalgoorlie, AUSTRALIA, pp. 9-24.

Abstract: The selection and design of process options to deliver outcomes consistent with sustainable development requires simultaneous consideration of multiple objectives, within a climate of uncertainty including the environmental and social aspects of technology management in addition to the technical and economic aspects of such. An issue of particular relevance in primary metal production is the deportment of minor and trace components within orebodies, products and wastes and the implications of such deportment for eco-efficiency in particular, the long-term environmental impact of solid waste management practices. The identification of opportunities to enhance recovery of valuable by-products and simultaneously improve the environmental acceptability of final waste output requires a clear understanding of the distribution of the relevant ore components, which results from the choice of processing route and unit operation efficiency. This is challenging, given that process streams generated during primary metal production are generally poorly characterised and the behaviour and deportment of trace to minor and trace components is not well understood. This paper demonstrates how current data gaps

and inconsistencies can be systematically addressed through the meaningful reconciliation of empirical plant data with a fundamental understanding of the mechanisms and parameters influencing element behaviour and deportment during the formation and subsequent beneficiation of mineral ore deposits. On this basis, quantitative distribution data and a comprehensive and comprehensible inventory of unit process inputs and outputs as a function of ore compositions and processing technology options can be generated, which is consistent with early design stage information requirements, both in terms of detail and accuracy, ie is 'first-order' in nature. This predictive approach to element distribution during primary metal production provides decision-makers with key information in the early design stages of a project (in terms of developing processes within the context of sustainability), whilst simultaneously guiding further data collection and environmental impact prediction studies.

29. Fundamental limits for recycling - Formulating environmental legislation on the basis of first principles

Reuter, MA; van Schaik, A; Ignatenko, O

Green Processing 2006, AUSTRALASIAN INSTITUTE OF MINING AND METALLURGY PUBLICATION SERIES, 3rd International Conference on Sustainable Processing of Minerals and Metals, JUN 05-06, 2006, Newcastle, AUSTRALIA, pp. 31-40.

Abstract: Environmental legislation for the process and manufacturing industries is frequently formulated without considering the fundamental limits of physics, chemistry and thermodynamics within process technology. Recycling of end-of-life goods is used in this paper to show how the limits can be evaluated on the basis of the theory of minerals processing and metallurgical engineering. This theory has been applied on European Union level to re-examine the legislation for automobile recycling in a recent stakeholder discussion involving the automotive industry (http://www.assurre.org). This theory and our models are finding their way into the computer aided design (CAD) tools of the automotive industry, developments that form part of a project to design the super light car of the future (http://www.superlightcar.com). Only such fundamental approaches will in future be able to provide the basis to argue and define realistic and sensible environmental legislation.

30. Characterisation of Australian electric arc furnace (EAF) dusts and the application of simple physical separation techniques to upgrade them

Bruckard, WJ; Davey, KJ; Woodcock, JT

Green Processing 2006, AUSTRALASIAN INSTITUTE OF MINING AND METALLURGY PUBLICATION SERIES, 3rd International Conference on Sustainable Processing of Minerals and Metals, JUN 05-06, 2006, Newcastle, AUSTRALIA, pp. 43-48.

Abstract: Australian steelmakers produce up to 30 000 t/yr of electric arc furnace (EAF) dust. Current disposal techniques include sending EAF dust to landfill,

stockpiling, and paying zinc smelters or registered waste removalists/processors to take the dust. Many of the complex overseas pyrometallurgical and hydrometallurgical treatment routes cited in the literature are not considered economic. Governmental, environmental and social pressures on producers to consider more sustainable disposal options are mounting, and there is now a strong push to consider recovering potentially valuable or recyclable components, such as zinc and iron units, from EAF dust. As well, there remain strong economic drivers for producers to find lower cost disposal solutions. Characterisation studies undertaken at CSIRO Minerals have revealed important physical differences in the nature of the zinc- and iron-bearing phases contained in domestic EAF dusts. These differences have been exploited using simple and cheap mineral processing techniques such as water washing, wet cycloning and wet magnetic separation. This has allowed a significant upgrade in the zinc content of EAF dust to be achieved, together with a reduction in the levels of key smelter penalty elements, such as chlorides and fluorides. The zinc-rich portion of the dust is now a more attractive smelter feed while the iron-rich part of the dust could potentially be briquetted or pelletised with a reductant and recycled to recover iron, and thus close the loop on dust processing. The basis of the separations tested together with laboratory results from several Australian dust samples are presented and discussed in this paper.

31. Benefits and success factors of regional resource synergies in Gladstone and Kwinana

Corder, GD; van Beers, D; Lay, J; van Berkel, R

Green Processing 2006, AUSTRALASIAN INSTITUTE OF MINING AND METALLURGY PUBLICATION SERIES, 3rd International Conference on Sustainable Processing of Minerals and Metals, JUN 05-06, 2006, Newcastle, AUSTRALIA, pp. 83-92.

Abstract: The development of regional resource synergies in intensive areas with concentrations of minerals processing industries provides a significant avenue towards sustainable resource processing. Gladstone (Queensland) and Kwinana (Western Australia) are two of Australia's major heavy industrial areas. There are a number of successful regional synergies in both areas. In addition to the existing regional synergies in both areas, more potential synergy opportunities appear to exist which, upon implementation, could benefit industry, the environment and the community. To further enhance the development of such potential regional synergies, the Centre for Sustainable Resource Processing (www.crsp.com.au) commissioned research projects to facilitate the identification of potential synergies and assist with their implementation in both regions. This paper presents a selection of specific examples from both regions to illustrate the sustainability benefits from regional synergy developments. Although the composition of industries in the Gladstone and Kwinana regions is different both in terms of geography and industry diversity, similarities in synergy developments for both regions are apparent. Consequently, the examples discussed in this paper are organised around the key themes of water, energy and inorganic by-products. Comparison on a theme basis

highlights success factors of successful synergies and demonstrates the range of benefits resulting from their implementation.

32. Opportunities and constraints for regional resource synergies in minerals processing regions

van Berkel, R; Bossilkov, A; Harris, S

Green Processing 2006, AUSTRALASIAN INSTITUTE OF MINING AND METALLURGY PUBLICATION SERIES, 3rd International Conference on Sustainable Processing of Minerals and Metals, JUN 05-06, 2006, Newcastle, AUSTRALIA, pp. 113-122.

Abstract: The Kwinana (Western Australia) and Gladstone (Queensland) industrial areas are among the few dozens of heavy industrial areas globally that demonstrate significant levels of regional resource synergies. Such synergies are also referred to as 'industrial ecology' or 'industrial symbiosis'. Fundamentally they involve the exchange of by-products or sharing of utilities between companies in close geographic proximity to achieve competitive advantage and environmental benefit. A concerted research effort is currently underway to foster greater realisation of regional resource synergies in minerals processing intensive regions, in Australia and internationally. This paper summarises current insights from the foundation research into engineering tools and technologies and enabling mechanisms for regional resource synergy developments. Regional resource synergy developments were reviewed for 16 international and two Australian regions. It was found that Kwinana and Gladstone compare favourably with the well-regarded international examples of regional synergy development. Given the fairly strong evidence that self-organisation is critical for regional synergy developments, an implementation model has been proposed that captures entry points for synergy developments at the level of platform (industry collaboration), process (developing synergy opportunities) and project (assessing and implementing specific synergies). It was also found that regional synergies have so far developed in the absence of specific methods for identification and screening of synergy opportunities. Moreover, very limited attention has been paid to the associated technological and engineering challenges. The current technical research effort therefore targets: 1. the development of a toolset for the identification and development of potential synergy opportunities; and 2. assessment of technology needs and opportunities for regional synergies involving water, energy and materials recovery and reuse.

33. Sustainable water use in minerals and metal production

Norgate, TE; Lovel, RR

Green Processing 2006, AUSTRALASIAN INSTITUTE OF MINING AND METALLURGY PUBLICATION SERIES, 3rd International Conference on Sustainable Processing of Minerals and Metals, JUN 05-06, 2006, Newcastle, AUSTRALIA, pp. 133-141.

Abstract: In this paper, life cycle assessment methodology has been used to assess the variations in water use associated with different metal production and

processing routes and provide insights into the value derived from water usage in the minerals sector. Using water consumption data derived from the literature it has been shown that the 'cradle-to-ptc' water consumption (or embodied water) for production of the various metals considered in the study ranged from 2.9 m(3)/t for steel up to 252 087 m(3)/t for gold. The results largely reflect the grade of the initial ore used to produce each metal, and can be approximated by the following equation: W = 167.7 G(-0.9039) where W = embodied water (m(3)/t refined metal) G = grade of ore used to produce metal (per cent metal) The study showed that indirect water consumption in the metal production life cycle, in particular that due to electricity generation, can make a significant contribution to the embodied water value, eg aluminium production. When expressed in terms of m(3)/t ore, the results for all metals considered indicated that the embodied water is roughly, on average, three times the water consumption of the mining and concentration stage. It was also shown that the economic value per m(3) of water consumed for the minerals industry exceeds that for the agricultural and industrial sectors, supporting the view that allocating water resources to the minerals industry has a strong underlying economic basis. Water reforms currently taking place in Australia aim to address issues such as competition for water access, reduced security of supply and increase in cost. Consequently the minerals industry, along with others, can be expected to come under increasing pressure to reduce fresh or raw water use and to integrate water use across sectors. While water recycling is an obvious candidate to help reduce water consumption in the minerals industry, issues such as water quality, among others, will influence the extent to which this can be achieved. In addition, wastewater volumes can be minimised using techniques such as pinch analysis to establish and use the minimum water requirement for the process. The use of dry or near-dry processing technologies, for which the demand for water is small or zero, may be a more radical solution to the water consumption problem; however, it is possible that the introduction of dry processing would bring with it a new set of problems, including dust.

34. Sorption of Sr(II) and Eu(III) onto pyrite under different redox potential conditions

Naveau, A; Monteil-Rivera, F; Dumonceau, J; Catalette, H; Simoni, E
JOURNAL OF COLLOID AND INTERFACE SCIENCE, Vol. 293, 1, 2006, pp. 27-35.
10.1016/j.jcis.2005.06.049

Abstract: Understanding sorption processes is fundamental for the prediction of radionuclide migration in the surroundings of a deep geological disposal of high-level nuclear wastes. Pyrite (FeS2) is a mineral phase often present as inclusions in temperate soils. Moreover, it constitutes an indirect corrosion product of steel, a containment material that is candidate to confine radionuclides in deep geological disposals. The present study was thus initiated to determine the capacity of pyrite to immobilize Sr(II) and Eu(III). An air oxidized pyrite and a freshly acid-washed (non-oxidized) pyrite were used in background electrolytes of varying reducing-oxidizing ability (NaCl, NH3OHCl, and NaClO4) to study the sorption of both cationic species. The sorptive capacity of pyrite appeared directly correlated to the oxidation of the

surface. Non-oxidized pyrite had nearly no affinity for the studied cations whereas Sr(II) and Eu(III) species were significantly retained by oxidized pyrite surface. Using the surface complexation theory, sorption mechanisms were modeled with the FITEQL v3.2 and the JCHESs 2.0 codes. Sorption of both Sr and Eu was well fitted, assuming hydroxylated species as the major surface species. This study demonstrates that not only the components of a barrier but also the redox conditions and speciations should be well characterized to predict transport of contaminants in the surrounding of a nuclear wastes disposal. (c) 2005 Elsevier Inc. All rights reserved.

35. Maximum bubble loads: Experimental measurement vs. analytical estimation

Gallegos-Acevedo, PM; Perez-Garibay, R; Uribe-Salas, A
MINERALS ENGINEERING, 19, 1, 2006, pp. 12-18.
10.1016/j.mineng.2005.04.002

Abstract: This paper presents an experimental technique to measure maximum bubble loads, which are then compared with geometrical model estimations. The geometrical models studied assume that a particle monolayer, having a square arrangement, covers the entire bubble surface. Comparison of the experimental and analytical results gave a fairly high statistical correlation (R-2 = 0.89), when a shape factor was used for particle volume estimation (lambda = 0.32-0.41; [Kelly, E.G., Spottiswood, D.J. Introduction to Mineral Processing, John Wiley & Sons, 1982, p. 491]). This supports the applicability of geometrical models for maximum bubble load estimation. (c) 2005 Elsevier Ltd. All rights reserved.

36. Treatment of pyritic matrix gold-silver refractory ores by ozonization-cyanidation

Elorza-Rodriguez, E; Nava-Alonso, F; Jara, J; Lara-Valenzuela, C
MINERALS ENGINEERING, Vol 19, 1, 2006, pp. 56-61.
10.1016/j.mineng.2005.06.003

Abstract: Most of the gold and silver produced worldwide are extracted by the cyanidation process. The recovery of the precious metals involves two distinct operations: the oxidative dissolution of gold and silver by an alkaline cyanide solution, and the reductive precipitation of metals from the solution. From the cyanidation point of view, gold and silver ores can be classified as free milling, and refractory ores. The term "refractory ore" defines those materials that when submitted to a conventional cyanidation process, show low recoveries (< 80%) or high consumption of reactants [Weir, D., Berezowsky, M., 1984. Gold Extraction from Refractory Concentrates, Sherrit Research Centre, Alberta, Canada, pp. 1-26; Haque, K.E., 1992. The Role of Oxygen in Cyanide Leaching of Gold Ore, CIM Bulletin 85963, pp. 31-38]. These refractory ores are usually pretreated by some oxidizing process after which gold and silver can be recovered by standard cyanidation process. Since ozone gas (O-3) is a strong oxidizing, it may be regarded as a promising alternative in the treatment of refractory ores. The present work summarizes the results obtained when two pyritic refractory ores from Mexican sites

(samples A and B), were pretreated with an oxygen/ozone stream in acid media before cyanidation. Two contacting methods were studied: the indirect method (contacting the ore three times with ozone saturated water), and the direct method (direct addition of ozone to the mineral slurry). Sample A did not show any difference in recoveries with indirect pretreatment, while the direct pretreatment reduced the cyanidation time for maximal gold and silver recovery from 40 to 24 h. Sample B, only tested with indirect contact method, increased the gold recovery from 53% to 88% and the silver recovery from 26% to 78%. (c) 2005 Elsevier Ltd. All rights reserved.

37. Combined application of different collectors in the floatation concentration of Turkish feldspars

Bayat, O; Arslan, V; Cebeci, Y
MINERALS ENGINEERING, Vol 19, 1, 2006, pp. 98-101.
10.1016/j.mineng.2005.06.015

Abstract: The application of different cation collectors in the floatation concentration of feldspar has been investigated. Raw material (Kaltun Mining Co.) from Cine, Aydin in Turkey was used. The results showed that for floatation of feldspars, combined application of AERO 3030C and AERO 801 + AERO 825, performed better than the application of these collectors alone. They were more selective, and with their application a higher mass recovery of feldspar was obtained. However, the chemical compositions of the feldspar concentrates were not significantly different no matter which of these reagents was used. A higher quality of feldspar concentrate: 67.06% SiO2; 19.49% Al2O3; 0.018"/o Fe2O3; 0-135% TiO2; 0.98% CaO; 0.02% MgO; 11.02% Na2O; 0.22% K2O; 0.02% P2O5 was obtained when a combination of these collectors was applied. (c) 2005 Published by Elsevier Ltd.

38. Development of steam reforming for the solidification of the cesium and strontium separations product from advanced aqueous reprocessing of spent nuclear fuel

Tripp, J; Garn, T; Boardman, R; Law, J
SEPARATION SCIENCE AND TECHNOLOGY, Vol. 41, 10, 2006, pp. 2147-2162.
10.1080/01496390600742914

Abstract: Steam reforming is one option currently being investigated for stabilization of the cesium/strontium strip products from spent fuel reprocessing solvent extraction processes because it can potentially destroy the nitrates and organics present in these aqueous, nitrate-bearing solutions, while converting the cesium and strontium into leach resistant aluminosilicate minerals, such as pollucite. To produce pollucite and other mineral analogs of the alkaline metals, the feeds must be mixed with aluminosilicate compounds and thermally sintered or calcined to activate solid-state crystal formation. Scoping tests completed indicated that the cesium/strontium in these organic and acid solutions can be converted into aluminosilicate materials using steam reforming.

39. **Replacing mechanical flotation cells by a flotation column at the pilot plant of the Sarcheshmeh copper mine**
Yahyaei, M; Banisi, S; Javani, H
SEPARATION SCIENCE AND TECHNOLOGY, Vol. 41, 16, 2006, pp. 3609-3617.
10.1080/01496390600956894

Abstract: A flotation column could be considered as one of the major breakthroughs in the field of mineral processing in the last decades. Due to an increase in the trend of the use of these type of cells in the mineral processing plants, an investigation regarding the performance of these cells was initiated. The flotation column at the Sarcheshmeh pilot plant with some modifications was restarted. When all necessary measures were taken, the possibility of using the flotation cell in the cleaner and recleaner stages was investigated. Replacing the cleaner cells by the column flotation increased the separation efficiency by 7%. When the column cell was used as recleaner and both cleaner and recleaner, an improvement of 10% was observed. It was found that using a column cell instead of mechanical cells in addition to a decrease in repair and maintenance costs could result in 76% and 83% reduction in energy cost of cleaner and cleaner-recleaner stages, respectively, at the pilot plant.

40. **Beyond NPV - A review of valuation methodologies and their applicability to water in mining**
Evans, R; Moran, CJ; Brereton, D
WATER IN MINING 2006, PROCEEDINGS: MULTIPLE VALUES OF WATER, pp. 97-103.

Abstract: In this era of rising focus on the social and environmental costs and benefits of mining operations, the valuation methodologies used to assess such impacts become increasingly important. Within an industry dominated by an engineering culture that places emphasis on net present value (NPV) calculations using high discount rates, difficulties often arise when attempting to justify projects with longer-term, harder to quantify benefits. This is particularly so when these benefits fall in the social and environmental domains and involve other stakeholders. In this paper, we summarise the results of a recent literature review on this subject, which focused on the valuation of 'Beyond Compliance' initiatives in the mining sector. We discuss a range of approaches including the quantification of hidden internal costs, financial methods of incorporating risk into calculations, the integration of quantitative and qualitative information, and also the valuation of 'externalities' or costs and benefits home by others. We then use a series of examples relating to the management of water in the minerals industry to illustrate how some of these approaches could be applied. There are high-level commitments from both individual companies and groups such as the ICMM to incorporate sustainable development criteria into decision-making processes within the industry. We conclude the paper by arguing that, to meet these commitments, there is a need for the industry to adopt a broader range of valuation methodologies than appears to be the case at present.

41. Modelling demand for water in the mineral extraction and processing industry - How useful is the theory?

Robinson, J; Keddie, A

Water in Mining 2006, Proceedings: MULTIPLE VALUES OF WATER, pp. 127-130.

Abstract: Standard microeconomic theory suggests that the behaviour of mineral extraction and processing firms with respect to their demand for water can be modelled and a market demand for water subsequently derived. Such a model, although an abstraction of the real world, should be able to predict the responsiveness of quantity of water demanded to change in price, and, change in demand to a range of factors including: expectations about reliability of supply, changed commodity prices for mineral production, and change in water technology and storage at mine site. This paper demonstrates that the price of water is particularly responsive to changes in demand and that although price increases would result in some additional supplies, physical constraints on supply suggest that the industry will be paying considerably higher prices for water in the future. It is recommended that the mining industry undertakes quantification of possible price increases to position itself to minimise the impact on their operating costs as well as to make responsible capital investment decisions to facilitate future expansion or commissioning of new mines. Substantial investment is required to commission a new mining venture with expected rates of return subject to risk and uncertainty due to fluctuations in world commodity markets as well as reliability of secure supplies of inputs. If a reliable supply of water was subject to uncertainty and water was a critical input for production, then the initial mine design would typically consider a range of production decisions contingent on levels of uncertainty with respect to water supply. These states or sets of water supply, will affect production decisions and future water demand. Modelling production decisions contingent on different states of nature, termed the state-contingent approach, provides a number of insights about producer behaviour under uncertainty. This paper investigates the assumptions underlying the derivation of the market demand for water by the mineral resource industry and identifies the drivers of demand and the responsiveness of the industry to change in price and supply, particularly in relation to capital investment in water-use technologies. The usefulness of these models to the mining industry is considered by reference to the increasing demand for water by the industry in Queensland, in a climate of water shortages.

42. A sustainable mine water treatment initiative to provide potable water for a South African city - A public-private partnership

Gunther, P; Mey, W; van Niekerk, AM

Water in Mining 2006, Proceedings: MULTIPLE VALUES OF WATER, pp. 189-198.

Abstract: Coal mining has an impact on the water management of the water scarce Upper Olifants River Catchment. A prefeasibility study was carried out by Anglo Coal and Ingwe Collieries Limited to establish the water supply and demand in the catchment. A geohydrological model was used for the coalfields to determine the stored water and excess water available. Two distinct collective and treatment

systems were proposed for the Witbank and Middelburg municipalities to treat excess water from the Anglo Coal and Ingwe Colliefies Limited. The Emalahlem Water Reclamation Project for Witbank was initiated first. Water management and treatment experience gained at Anglo Coal was the cornerstone to develop the collection. treatment and distribution system. A full enquiry was issued to Keyplan, Veolia, Bateman Africa and IST Technik to construct, commission. operate and maintain a 20 ML/day desalination plant to treat acidic. saline mine waters to a South African National Standard (SANS) 0241 Class 0 potable water. After the technical and financial adjudication, Keyplan were awarded the contract. An integrated regulatory process was adopted through consultation with all the relevant regional and head office staff of the Department of Minerals and Energy, Department of Water Affairs and Forestry and the Mpumalanga Department of Land Affairs via an authority's steering committee. A rock engineering evaluation was done to select both the plant and waste disposal sites as all possible sites are undermined. Various contracts are required with the individual mines for water supply, the Emalahleni Local Municipality for the delivery of potable water and for the disposal of wastes.

43. Selecting suitable methods for treating mining effluents

Kuyucak, N

Water in Mining 2006, Proceedings: MULTIPLE VALUES OF WATER, pp. 267-276.

Abstract: During operations, mining and metallurgical processes may generate effluents such as tailings water, acid mine drainage (AMD) and seepage and process acid streams. Depending on the type of ore and the metallurgical process, these effluents may contain one or more toxic compounds (eg acidity or alkalinity, cyanide, ammonia and/or nitrate, heavy metals, total suspended solids (TSS), sulfate) in elevated concentrations requiring treatment before their discharge to the environment or recycle/reuse in the process. Natural oxidation of sulfide minerals present in mining wastes (eg tailings and waste rock) at mining sites may generate AMD, which is characterised as a low pH, high acidity effluent containing heavy metals and sulfate. If generation of AMD cannot be controlled and/or prevented, AMD needs to be collected and treated for neutralisation of acidity and reduction of metals and TSS to meet regulated water quality standards. It is important to note that some of these compounds may persist in run-off from mine sites, even after the mine and processing facilities are decommissioned. Treatment of mining and metallurgical process effluents can be accomplished by means of various physical, chemical and/or biological methods. The mode of process application may vary from the use of either specific-ally designed, controlled and automated facilities or passive systems. Lime neutralisation and precipitation is the most common method used in the mining industry to treat AMD. To reduce the problems associated with disposal and long-term storage of the resulting sludge, the use of a high-density sludge process (HDS) has become a preferred option. The use of other chemical reagents, waste or by-products from other industries, and biological sulfate reduction methods can also be considered as viable options for site-specific situations. Recently, several passive treatment systems have been designed and successfully operated, even in the cold North American climate. This paper will discuss available options

and provide insights for selecting a suitable method for a given situation using case studies from projects conducted by Golder Associates around the world over the last decade.

44. A systematic approach to water quality management in the minerals processing industry

Levay, G; Schumann, R

Water in Mining 2006, Proceedings: MULTIPLE VALUES OF WATER, pp. 277-287.

Abstract: Mining companies often view water quality as an environmental issue. The importance of water quality as a production related issue in mineral beneficiation is greatly underestimated at many mineral processing operations. While most mine sites have comprehensive water balance data for water quantity. the information regarding the quality of water supplies available on site is limited, inadequate or non-existent. The seasonal variations in process water quality and changes in the composition of various water streams are not known. Despite the fact that water represents about 80 to 90 per cent of the volume of mineral pulp processed in a flotation plant. the influence of process water composition on flotation performance is often poorly understood. The process water used at mineral processing operations is made up from a number of available water sources, which can be classified as recycled water streams or make-up waters. The recycled water streams are commonly the tailings and concentrate thickener overflows, filtrate from the concentrate filtration plant and tailings dam return water. Make-up waters can originate from a variety of sources: surface waters (rivers. lakes, reservoirs, dams). groundwater (wells and springs), mains water (potable water), treated and untreated sewage waters and industrial effluents. Mineral processing plants are increasingly recycling water to reduce demand for fresh water and minimise the discharge of wastewater to the environment. However, increasing water recycling can have adverse effects on process water quality and ultimately on the performance of mineral separation processes. The main reasons for reduced plant performance due to water recycling are the accumulation of organic and inorganic compounds in the process water and increased microbiological activities. Other detrimental effects of water recycling can be increased reagent consumption and inefficient dewatering of tailings and concentrates. Recycling of water also tends to accumulate very fine suspended particles. Excessive amounts of slimes in the process water can also have an adverse effect on mineral beneficiation processes. The main constituents of process water are dissolved gases (oxygen, nitrogen, carbon dioxide), colloidal and suspended solids of inorganic and organic nature (including micro-organ isms: dead or alive), dissolved organics (natural organic matter, residual reagents, reaction and decomposition by-products of chemical reagents, impurities in the reagents and metabolites originating from microbiological activities) and inorganic compounds (acids, alkalis, inorganic salts, metal ions, anions and heavy metals). Inputs to the chemical composition of process waters are: dissolution of soluble mineral phases present in the ore, surface oxidation followed by dissolution of mineral particles during grinding and mineral processing. the chemical composition of various make-up waters and recycled water streams, and reagent additions during mineral

processing. The beneficial or detrimental impact of process water quality on flotation performance can be attributed to a number of subprocesses: adsorption and/or precipitation of inorganic and organic species present in the process water onto the surface of mineral particles, chemical reactions between process water constituents and the chemical species present on the surface of mineral particles and interactions between the chemical and microbiological species present in the process water and the various reagent species added in solution during mineral processing. Dissolved chemical species such as calcium, magnesium, iron, copper, lead. zinc. nickel. sulfates. phosphates and carbonates can have a strong effect on the electrokinetic properties of oxide and sulfide minerals, at cerain pH ranges. Several reactions can occur at the solid-liquid interface that can play an important role in determining surface adsorption of reagents. Solid-liquid interfacial properties of mineral particles can be significantly affected by the conformation of adsorbed and precipitated reagent layers, which in turn are determined by solution chemistry. The chemical and microbiological constituents of process water can have a significant effect on liquid-gas interfacial properties and have a strong influence on froth height, strength and stability during flotation. Water chemistry can play an important role in determining the interactions between minerals present in the ore and the chemical reagents added in the mineral processing plant by altering the reagent-solution and mineral-solution equilibria. These interactions can include dissolution, micellisation and precipitation of reagents, dissolution of minerals contained in the ore followed by hydrolysis, complexation, adsorption and precipitation of dissolved chemical species and reactions between dissolved ions and various reagent species present in solution. All of the above mentioned subprocesses can ultimately have a significant effect on the efficiency of mineral processing operations. In this presentation, a systematic approach for assessing the composition of water supplies available at the mine sites and for investigating the influence of process water quality on the efficiency of mineral processing operations will be discussed. The consequences of mining different quality water streams to produce the required volumes of process water for some flotation plants will be highlighted. To substantiate the water quality issues described in this paper some examples are given from a metalliferous processing perspective. However, the topics described in the paper are not only relevant to metalliferous processing but to all other type of mineral processing operations as well. In fact the principles described in this paper have also been successfully applied to the coal flotation industry.

45. Water use in the mining industry - Threats and opportunities

Levy, V; Fabre, R; Goebel, B; Hertle, C

Water in Mining 2006, Proceedings: MULTIPLE VALUES OF WATER, pp. 289-295.

Abstract: The mining industry maintains a 'love-hate' relationship with water. Dewatering. aquifer, water disposal, irrigation, process water, tailings water. run-off water, seepage, leachate and sumps are all terms that are used on a daily basis in the mining industry, highlighting the numerous water usages on site and their associated quality. According to the Australian Bureau of Statistics (2001), each year the mining industry consumes over 530 000 ML of water. The increasing recognition

of water as a limited and valuable commodity, and the associated environmental concerns with the management of water disposal to the environment has led the industry into improving on-site water management. Progressively, water balance models and water reuse strategies are being developed, incorporating more sophisticated water treatment processes. By way of example, membrane technologies, once restricted to industries such as the pharmaceutical industry or the drinking water industry, are now entering the mining world with the aim of producing clean water of suitable quality for ore processing or for advanced treatment prior to release to the environment. This paper will provide a review of the threats and opportunities linked to water use and recovery/reuse in the mining industry in Australia. It will open with an overview of current water usage and associated quality for various mineral industries and continue with identifying the threats and limitations associated with the quality of available water. It will then present how newly developed water treatment technologies and assessment tools can be incorporated into the system to enhance the recovery and reuse of water on site, reduce the risks associated with securing long-term water supply and further improve production, environment and safety (health risk control).

46. Tailings dewatering dry screening and water clarification for reduced water usage

Mathewson, D; Norris, R; Dunne, M
Water in Mining 2006, Proceedings: MULTIPLE VALUES OF WATER, pp. 315-322.

Abstract: Substantial efforts by the industry, as well as by process and equipment designers, have resulted in many innovative developments that provide cost effective reductions in water usage. This paper showcases four emerging best practices in industry including examples of recent installations. Belt press filters are a small fraction of the operating and capital cost of alternative 'dry' tailings technologies. This gives operators who must 'dry' their tailings a competitive advantage and makes such operations much more sustainable. The new generation of belt filter presses use less energy, produces lower cake moistures and better disposal stacking properties. The need for tailings storage facilities may be eliminated or in some cases high-grade tailings can be dewatered and sold as a low value product. Mining applications include sand tailings, sinter plant waste, coal tailings and power station fly ash. Flip-flow screening machines are proven worldwide in the dry classification of coal and other minerals, reducing the size of beneficiation plants, whilst reducing energy, water demand and media consumption. They also allow the screening of wet/sticky materials not able to be sized using conventional screens. Lamella separators are used for toxic water clarification and/or sludge thickening in many downstream metal industries with the underflow often dewatered in a belt filter press. Such low cost, high capacity thickeners could also be used instead of conventional thickeners at smaller mines. The simple and reliable continuous washing upward flow (CWUF) sand filters have been used for treatment of waste water from coal preparation plants and steel works as well as in the production of potable water. The filtered waste water from mining processes can

then either be reused or discharged from site. Other installations include cleaning mine water to prevent the blocking of dust suppression spray nozzles.

47. Sustainable water use in minerals and metal production

Norgate, TE; Lovel, RR
Water in Mining 2006, Proceedings: MULTIPLE VALUES OF WATER, pp. 331-339.

Abstract: In this paper, life cycle assessment methodology has been used to assess the variations in water use associated with different metal production and processing routes and provide insights into the value derived from water usage in the minerals sector. Using water consumption data derived from the literature it has been shown that the 'cradle-to-gate' water consumption (or embodied water) for production of the various metals considered in the study ranged from 2.9 m(3)/t for steel up to 252 087 m(3)/t for gold. The results largely reflect the grade of the initial ore used to produce each metal, and can be approximated by the following equation: W = 167.7 G(-0.9039) where: W = embodied water (m(3)/t refined metal) G = grade of ore used to produce metal (per cent metal) The study showed that indirect water consumption in the metal production life cycle, in particular that due to electricity generation, can make a significant contribution to the embodied water value, eg aluminium production. When expressed in terms of m3/t ore, the results for all metals considered indicated that the embodied water is roughly, on average, three times the water consumption of the mining and concentration stage. It was also shown that the economic value per m(3) of water consumed for the minerals industry exceeds that for the agricultural and industrial sectors, supporting the view that allocating water resources to the minerals industry has a strong underlying economic basis. Water reforms currently taking place in Australia aim to address issues such as competition for water access, reduced security of supply and increase in cost. Consequently the minerals industry, along with others, can be expected to come under increasing pressure to reduce fresh or raw water use and to integrate water use across sectors. While water recycling is an obvious candidate to help reduce water consumption in the minerals industry. issues such as water quality, among others, will influence the extent to which this can be achieved. In addition, wastewater volumes can be minimised using techniques such as pinch analysis to establish and use the minimum water requirement for the process. The use of dry or near-dry processing technologies. for which the demand for water is small or zero, may be a more radical solution to the water consumption problem; however, it is possible that the introduction of dry processing would bring with it a new set of problems, including dust.

48. Reporting mineral resources and Mineral Reserves in the United States of America - Technical and regulatory issues

Rendu, JM
6th International Mining Geology Conference, 2006, pp. 11-19.

Abstract: The Committee for Mineral Reserves International Reporting Standards (CRIRSCO) was formed in 1994 to promote development and adoption of

international standards for estimation and reporting of exploration results, mineral resources and mineral reserves. The CRIRSCO standards have been accepted by most mining companies and professional societies worldwide. Market regulators from Australia, South Africa and Canada require that these standards be followed when releasing public information. Among these requirements is the use of specific definitions for what constitutes exploration results, mineral resources and mineral reserves. If such information is publicly disclosed in must be estimated by a Competent or Qualified Person. In the United States of America, public disclosures are regulated by the US Securities and Exchange Commission. The SEC does not recognise the CRIRSCO guidelines, and some of the SEC requirements for public release of information are materially different from those applicable in other countries. The CRIRSCO definitions and the Competent Person requirements are reviewed and compared with those of the SEC. The organisation of the SEC and its rule making process are briefly discussed. Ongoing efforts to bring the US regulatory requirements closer to those applicable in other countries are presented, as well as other activities that CRIRSCO is entertaining with the United Nations, the International Accounting Standard Board and other international organisations to reach the objective of worldwide standardisation of reporting procedures.

49. Mineralogical face-mapping using hyperspectral scanning for mine mapping and control

Fraser, SJ; Whitbourn, L; Yang, K; Ramanaidou, E; Connor, P; Poropat, G; Soole, P; Mason, P; Coward, D; Phillips, R

6th International Mining Geology Conference, 2006, pp. 227-232.

Abstract: The potential of hyperspectral mineral mapping within a mine environment is demonstrated. Central to this capability has been the development of portable or vehicle-mounted, hyperspectral mine face-mapping systems. Data from these systems were used to detect subtle mineralogical variations and map their distribution across rock faces in a fashion that previously was not possible. In one study, the data usability was enhanced by 'draping' the mineralogical determinations over a three-dimensional 'model' of the rock-face. The eventual melding of the spectral mine face-mapping and three-dimensional spatial technologies will result in a new generation of mineralogical and structural information becoming available to mine geologists, engineers and metallurgists. Specific uses for spectrally-derived, mineral mapping data sets could include: ore grade mapping systems based on either direct detection of ore minerals themselves (eg iron and nickel oxides), or mineralogies that may be used as surrogates for ore-grade information (via various alteration minerals) after a suitable orientation survey; detecting mineralogies that have a deleterious effect on milling, metallurgical processing or have occupational health implications (talc, swelling clays, carbonates, asbestos, etc); selective mining and blending by collecting, processing and displaying such mineralogical images in near real-time to monitor ore grade and quality, and allow the separation of ore from waste during loading operations at the mine face; a mineral detection and mapping capability to assist in structural and geotechnical mine planning applications; and an enhanced geological detection and mapping capability for ore mineral species or

alteration mineralogies that may be used to vector further mineralisation, update the existing mine ore model, or provide input to assist in the control of autonomous mining equipment. Within the Woodlawn open pit, Fe- and Mg-chlorites and phengiticmicas associated with sulfide mineralisation were detected and mapped. Subsequent studies using a second generation face-mapping system demonstrated the direct detection of ore-grade materials for iron-ore and nickel laterite mining activities. Satisfactory and meaningful results were extracted from data that were collected under a variety of challenging conditions. However, these non-ideal climatic and operational conditions would be expected under most operational situations in a mine environment. Development of a system using artificial illumination, permitting night-time (and eventually underground) operation and elimination of atmospheric absorption effects is underway.

50. Working in metallurgy research

Emery, S

AusIMM New Leaders' Conference 2006: RIDING THE BOOM. THE MINERALS INDUSTRY INTO TOMORROW, 2, 2006, pp. 125-128.

Abstract: When studying minerals degrees at university, all the emphasis is towards sending the graduates into the bush to work at a remote mine; however, that is not the only option available to new graduates. There are positions in equipment supply companies, commercial laboratories, research organisations, engineering companies and contractors of many types. The aim of this paper is to show metallurgy graduates that there are non-mine site based career options available to them that offer outstanding career development. This is illustrated by outlining the research being undertaken by Magotteaux Australia and by telling the story of a graduate metallurgist working in Magotteaux's small research group. Magotteaux is an international supplier of grinding media and wear resistant components for the mining industry. The Australian research group is focused on determining the effects that the choice of grinding media has on subsequent processing, for example flotation and leaching, by using newly developed tools and techniques.

51. Cost-effective dry screening, dewatering and water treatment

Mathewson, D; Norris, R; Dunne, M

Green Processing 2006, 3, 2006, pp. 125-132.

Abstract: Mining and mineral processing is expected by society and obliged by law to operate in an environmentally friendly fashion, minimising the impact on and avoiding damage to the environment. Substantial efforts by the industry, as well as by process and equipment designers have resulted in many innovative developments, which show that operating in an environmentally responsible manner can be achieved in a cost-effective way. This paper showcases five emerging equipment best practices in industry including installation examples. Flip-flow screening machines are proven worldwide in the dry classification of coal and other minerals, reducing the size of beneficiation plants whilst reducing energy, water demand and media consumption. They also allow the screening of wet/sticky

materials not able to be sized using conventional screens. The belt press filter is a small fraction of the operating and capital cost of alternative dry tailings technologies. This gives operators who must dry their tailings a competitive advantage and makes such 'green' operations much more sustainable. The filtercake is disposed with other plant rejects, eliminating the need for tailings dams to be constructed and thus also often increasing mine reserves. Mining applications include coal tailings, sand tailings, sinter plant waste and power station fly ash. Screen-scroll and vibrating centrifuges are widely used in the coal, potash and salt industries to dewater the product to low surface moistures. Inclined plate Lamella separators are used for toxic water clarification and/or sludge thickening in many downstream metal industries with the underflow often dewatered in a belt filter press. Such low cost, high capacity thickeners could also be used instead of conventional thickeners at smaller mines. The simple and reliable continuous washing upward flow (CWUF) sand filters have been used for treatment of waste water from coal preparation plants and steel works as well as in the worldwide production of potable water. The filtered waste water from mining processes can then either be reused or discharged from site. Other installations include cleaning mine water to prevent the blocking of dust suppression spray nozzles.

52. Framework for strategic water management in the minerals industry

Balfe, M

Water in Mining 2006, Proceedings: MULTIPLE VALUES OF WATER, pp. 149-150.

Abstract: Access to secure and reliable water resources is fundamental to the minerals industry. In recognition of that requirement, and cognisant of extensive contemporary public water debate and reform initiatives in Australia. the Minerals Council of Australia (MCA) approached the Ministerial Council on Mineral and Petroleum Resources (MCMPR) proposing the establishment of a Joint Working Group to prepare a framework of strategic principles to ensure responsible water management at a site and corporate level, manage risks and identify opportunities. The Framework provides high-level guidance on issues that should be addressed in water decision making across Australia in relation to mining and associated processing operations. It identifies principles and objectives for adoption in four areas, viz: valuing water, strategic water planning, implementation, and e ngaging stakeholders. Given the high level nature of the Framework, and its national application. it does not seek to replicate detailed guidelines already widely available in each state and territory on operational water management practices and associated regulatory issues at mine sites. The Framework includes a series of case studies from across Australia that demonstrate where strategic thinking, wise water management and close consultation with stakeholders has delivered better water use, more profitable operations and excellent community/stakeholder relationships. The Framework was formally launched on behalf of MCMPR by the Western Australian Minister for Resources at the MCA's Sustainable Development Conference in Perth in October 2006.

53. Like liquid gold - Towards a resource industry position on water

Barger, A

Water in Mining 2006, Proceedings: MULTIPLE VALUES OF WATER, pp. 151-158.

Abstract: Launching the Queensland Water Plan 2005 - 2010 in August 2005, Premier Peter Beattie compared the state's water resources with liquid gold. Queensland's peak industry body for the minerals and energy sector, the Queensland Resources Council (QRC), believes the analogy is appropriate. During early development of an industry water strategy, it has become apparent that water is like liquid gold, in that it is revered, hoarded, recycled, priced on purity, a magnet for speculators, both difficult and expensive to transport effectively, heavily regulated and fundamentally linked to issues of security. To date it has generally been economic and relatively straightforward for the resources sector to secure water. Although production has not been compromised, this must not be grounds for complacency as there is every indication that water will continue to become increasingly expensive. more tightly regulated and, relative to a growing demand for a finite water supply, increasingly scarce. During 2006, QRC has developed and is implementing a voluntary industry water strategy to address a range of challenges confronting the resource sector's security of access to water. As a consequence of, at times, protracted community consultations over Queensland's catchment-based water planning processes it has become clear that many community stakeholders have outdated perceptions of the state's resources sector. Once established, QRC's water strategy will incorporate a community engagement campaign to present the industry's credentials as a leader in water resource management. The development of QRC's water strategy, and the challenges the strategy is designed to address, provides insight into the fundamental reforms that are occurring in how water is managed and regulated in Queensland. These reforms have implications for how government policies are designed and administered and also for how industry engages with communities during this transition process.

54. Rio Tinto floating module

Takos, J; Vagias, N; Shaw, R; Coghill, M; Easman, W

Water in Mining 2006, Proceedings: MULTIPLE VALUES OF WATER, pp. 369-372.

Abstract: Rio Tinto Technology and the Rio Tinto Foundation for a Sustainable Minerals Industry have funded the development of a practical floating module that can reduce water losses through evaporation from water dams at mining and mineral processing facilities by about 75 per cent. The modules, which are also suitable for use by farmers and communities, were designed for easy deployment, to allow the water to 'breathe'. harvest rainfall and resist wind speeds of more than 100 km/h. A large-scale demonstration trial will be conducted at the Northparkes Mine. located near Parkes (New South Wales, Australia). The objective of the trial is to demonstrate to Rio Tinto business units, community, farming and government groups the module's operating costs and water saving potential.

55. The role of the mining geologist - A Codelco vision

Carrasco, P

6th International Mining Geology Conference, 2006, pp. 3-5.

Abstract: The main asset of a mining company is the mineral resource; without resources there is no mining business and the infrastructure is useless. In this context the role of the mining geologist is to always keep the resource inventory to an optimum level for the mining business and to maximise the transformation of the resources into reserves in a multidisciplinary work environment. In short, a 'good mining geologist has to always provide the best ore to the mill'. To do his/her work properly, several technical skills are needed: to know how to observe and describe nature in order to optimise the data acquisition process, particularly when mapping; to have a good understanding of natural variability in order to develop proper sampling strategies and sample preparation protocols to minimise all the errors generated by the sampling process; to have a good understanding of assaying practices: their limitations as well as their assaying errors; to carefully and properly store the geological data and information and to preserve the geological patrimony; to fully understand ore forming processes to generate the best possible geoscientific models, which are fundamental for the mining business; to continuously validate and improve geological practices and models by continuous data collection and observation of geomining-metallurgy processes. Some very important behavioural competencies are also needed: long-term vision, passion for excellence and value generation, strategic influence, systemic and innovative thinking, and knowledge and experience transfer. Last but not least, it is important to point out that a deep knowledge of the mining business is essential to add value by using geology best practices.

56. An approach to more objective classification of Mineral Resources

Shaw, WJ; Godoy, MC; Muller, G; Larrondo, P

6th International Mining Geology Conference, 2006, pp. 85-89.

Abstract: The categories of Mineral Resources and Ore Reserves that may be used for public reporting in Australasia are defined in the current JORC Code (2004). Most internationally accepted codes emphasise the principles of transparency, materiality and competence in classifying resources. They also provide some guidance in considering the impact of data quality. There is no method recommended in the JORC Code to classify a Mineral Resource into the allowed categories of Measured, Indicated and Inferred for public reporting. A clearly defined procedure is desirable for many reasons, including consistency, repeatability and auditability. The demonstrated use of geological knowledge in the classification method is desirable. In deposits with abundant historical data there can be large variations in data type and quality. Quantification of the error of the estimates may also be considered. Ways to formally incorporate such information into the resource classification process are presented as a first step towards establishing an objective, repeatable methodology that allocates resources into appropriate categories based on defined criteria of accuracy and precision.

57. Mineral resource classification - It's time to shoot the 'spotted dog".

Stephenson, PR; Allman, A; Carville, DP; Stoker, PT; Mokos, P; Tyrrell, J; Burrows, T
6th International Mining Geology Conference, 2006, pp. 91-95.

Abstract: Classification of mineral resource estimates is one of the most important responsibilities of the Competent Person. In recent years, classification decisions have been driven more by the detailed block-by-block attributes generated by the now widely applied geostatistical estimation methods, and less by a general geological overview. This is increasingly resulting in 'Spotted dog' outputs, in which blocks of Inferred Resources or unclassified material separate blocks of Measured and/or Indicated Resources, or individual drill holes are surrounded by annuli of Measured and Indicated Resource blocks. Not only are such outputs potentially misleading, since they ignore fundamentals such as continuity of geology and mineralisation between drill holes and the imprecise nature of resource estimation, they can also cause substantial problems for engineers undertaking mine designs and estimating ore reserves, particularly for underground mines. Competent Persons for mineral resources must keep in mind the purpose of their work, and should use their experience and judgement to avoid or smooth out 'spotted dog' classifications, providing a result commensurate with the level of geological and resource estimation confidence. For their part, ore reserve Competent Persons must understand the resource estimation and classification process, and should question resource classifications that are not consistent with the level of geological and resource estimation confidence.