YTUESDAY, AUGUST 23, 2005, A.M.

SESSION 10: INTERNATIONAL SYMPOSIUM ON COMPUTATIONAL ANALYSIS IN HYDROMETALLURGY (35TH ANNUAL HYDROMETALLURGY MEETING)

SIMULATION I
Sponsor(s): Hydrometallurgy Section, The Metallurgical Society of CIM
Room: Herald
Chairmen: L. GUNNEWIEK and L. OSHINOWO, Hatch Associates Ltd, Canada

PAPER 10.1—9:00
A DYNAMIC CIP SIMULATION USING MATLAB SIMULINK.
J.W. COETZEE and H.E. DEIST, Cape Technikon, South Africa

Carbon-in-pulp (CIP) and Carbon-in-leach (CIL) processes are used extensively in the gold mining sector to recover aurocyanide from solution. This paper discusses the modelling of these operations, using various simplifying assumptions, in order to simulate the effect of changing operating conditions on the dynamics of the system. It is assumed that the adsorption and leaching rates are a function of concentration difference between the source phase and recipient phase. The simulation was set up using Matlab's Simulink interface. Plant variables are solved using a medium scale Newtonian search algorithm in Matlab, where the differences between the actual and predicted plant outputs are minimized on a continuous time-line.

PAPER 10.2—9:25
A FLOWSHEET-LEVEL APPROACH TO MODELLING AQUEOUS PHASE EQUILIBRIA AND SPECIATION IN A CIP/CIL GOLD PLANT.
S. MUNRO and J. RUMBALL, CSIRO Minerals, Australia

Operating CIP/CIL gold recovery plants in the arid regions of Western Australia face unique challenges due to water and ore quality issues. The presence of cations of Mg, Fe and Cu metals in water supplies and leached sulphide ores can have considerable effect on plant consumption of lime and cyanide, due to pH buffering and complexation effects. Reagent costs are critical to many of these operations. In this paper, computational modelling is used to analyse a number of process options to mitigate such issues. This requires careful consideration of the chemistry of the process system, and the ability to predict accurately the response of speciation and precipitation reactions to changing process conditions. The Mg-Fe-Cu-CN-H_2O system is specifically modelled in this application. The Gibbs Free Energy Minimisation thermodynamic framework has been selected to model equilibrium phenomena. Furthermore, this approach has been extended to the process flowsheet level, incorporating multiple unit operations and recycle streams in a steady-state mass balance model. The Gibbs equilibrium composition module of HSC Chemistry software has been successfully integrated into the commercial flowsheeting package SysCAD. Consideration of the Gibbs Energy Minimisation capabilities of other flowsheeting packages has also been given. This approach has been successful in simulating the aqueous process chemistry typical of such plants. It has resulted in a predictive capability where equilibrium states respond appropriately to process changes. Potential cost savings may be identified by examining alternative process conditions to minimise overall reagent consumption. This methodology may be extended to other hydrometallurgical plants where issues of solution ideality, temperature and other equilibrium processes are sufficiently understood.

PAPER 10.3—9:50
DYNAMIC MODELLING OF THE SHERRITT AMMONIA LEACH PROCESS.
N. DHADLI, G. FREEMAN, Sherritt International Corporation, Canada and
K. NIKKHAH, AMEC Mining and Metals Consulting, Canada

Ammoniacal pressure leaching operations have been in commercial use at the Fort Saskatchewan refinery of Sherritt International Corporation since 1954. Recent improvements have significantly increased the capacity of this circuit. The computer modeling of this process has proved to be a valuable tool in facilitating the evaluation of different operating scenarios in an effective manner. Reagent response in the ammonia leach of nickel and cobalt sulphides is examined using the dynamic process simulation capabilities of IDEAS™ software. The dynamic simulation enables accurate measurement of the sensitivity of the process to variables such as temperature, feed rate and ammonia concentration as well as compartmental analysis of metals concentration, pulp density, vent gas composition, and the formation of specific complexes. The complexity of the ammonia leach process makes it a logical choice for evaluation by computational analysis. The methodology for dynamic modeling of a pressure leach process is presented.

COFFEE BREAK—10:15-10:45

PAPER 10.4—10:45

MATHEMATICAL MODELLING OF THE SHERRITT-GORDON AMMONIACAL PRESSURE LEACHING PROCESS.

T.M. WOODWARD, P.A. BAHRI, Murdoch University, Australia and
D.G. DIXON, University of British Columbia, Canada

A comprehensive mathematical model of the Sherritt-Gordon ammoniacal pressure leaching process at Kwinana Nickel Refinery has been constructed. The process is comprised of six autoclaves functioning as a three-stage leach circuit, operating over the temperature and pressure ranges of 85–95˚C and 750–1000 kPa, respectively. The process chemistry forms a complex series-parallel reaction network, characterised by: (1) the gas-liquid mass transfer and reduction of oxygen, (2) the oxidation of eight distinct minerals, (3) the oxidation of sulphur, and successive reactions involving various intermediately oxidised sulphur species, and (4) the oxidation of Fe(II) to Fe(III), and subsequent precipitation as a hydrated ferric oxide. Material balances were developed for species in all three phases, and an energy balance to account for all reactions and phase conversions. The multiple convolution integral (MCI) statistical reactor model was employed for the scale-up of particle kinetics. The model has been validated against plant data, and simulation results are in agreement with plant performance.

PAPER 10.5—11:10

METSIM® AS A MASS BALANCING TOOL FOR PLATINUM-GROUP METAL CONCENTRATORS.

C. PANAOU, M. BELLINO, Hatch Africa, South Africa and
M. GREYLING, Anglo Platinum, South Africa

Commonly the most frequent method of calculating the overall mass balance of a multi mineral platinum-group metal (PGM) concentrator circuit in Southern Africa has been through the use of spreadsheets, typically Microsoft EXCEL®. While there are some advantages in using spreadsheet based mass balances during the conceptual design phase of the project, their use becomes limited in the detailed design phase of the project. This paper discusses the successful application of METSIM® for mass balancing of a PGM concentrator and highlights the benefits gained during the conceptual and design phase of the project.

PAPER 10.6—11:35

STUDY AND DEVELOPMENT OF LEACHING PROCESSES WITH THE AID OF MATHEMATICAL MODELING.

E.M. VIGDORCHIK, E.E. ZHMARIN and Y.M. SHNEERSON, Gipronickel Institute, Russia

One of the Gipronickel Institute activities is research and development of customized leaching technologies. The work is performed in several steps. Leaching kinetics are studied on a lab-scale according to a special procedure. Experimental data are processed using mathematical models of batch and continuous processes. Reliability of kinetic data and preliminary calculations is verified experimentally in laboratory reactors of various capacities. If necessary, certain parameters of the mathematical model are adjusted after pilot plant tests in continuous mode (4-reactor train, each with 25 L capacity). The specified kinetic characteristics along with the mathematical model are used for further development of industrial leaching technology.