MONDAY, AUGUST 22, 2005, P.M.

SESSION 8: INTERNATIONAL CONFERENCE ON NICKEL AND COBALT

PROCESS TECHNOLOGY I
Sponsor(s): The Non-Ferrous Pyrometallurgy Section, Metallurgical Society of CIM
Room: Doll
Chair(s): M. KOZLOWSKI, Hatch Associates, Canada and
N. STUBINA, Horne Smelter, Canada

PAPER 8.1—14:00
FLUIDIZED BED TECHNOLOGY APPLICATIONS FOR NICKEL EXTRACTION.
K. ADHAM, C. LEE, and J. SARVINIS, Hatch, Canada

In nickel extraction, the following four applications of the fluidized bed technology have been commercialized.

1. Sulfide ore roasting
2. Nickel sulfide (matte) roasting
3. Nickel oxide reduction
4. Nickel chloride pyrohydrolysis.

Each application treats a different feed under unique processing conditions, but all of them benefit from the fast reaction kinetics and the high heat and mass transfer rates in the fluidized bed reactors. This paper examines the issues surrounding the application of fluidization technology to the above processes, from the stand point of the engineer modelling the process and designing the key equipment. Using the available data, flow sheets are developed for each process, which highlight the key features of each application.

PAPER 8.2—14:30
COPPER COOLING DESIGN, INSTALLATION AND OPERATIONAL RESULTS FOR THE SLAG CLEANING FURNACE AT WATERVAL SMELTER, RUSTENBURG PLATINUM.
H. JOUBERT, B. NOURSE, Pyromet Technologies Pty. Ltd., South Africa
B. MASTERS and R. HUNDERMARK, Anglo Platinum, South Africa

The new 30 MVA slag cleaning furnace at Waterval Smelter, Rustenburg Platinum, has been in operation since switch-in on 10 March 2003. The furnace design and operation face a number of challenges including a wide variety of feed materials and resulting bath conditions. Furnace feed varies in combinations of granulated Ausmelt converter slag (WACS), hot fed Pierce Smith converter slag, concentrate and reverts. Coke is added as reductant. The resulting slag composition varies considerably and regularly. For the case feeding WACS an almost pure fayalitic slag (60%+ FeO, 30%+ SiO_2) with a very low viscosity results. Due to the widely varying slag conditions, including a super heated fayalitic slag with high fluidity, a robust sidewall design is required adjacent the slag bath. For this reason the furnace sidewall is equipped with Pyromet's MAXICOOL® high intensity copper cooling system. The design and installation of the copper coolers as well as tap holes are discussed. To cope with the variation in bath conditions and high slag super heat (350°C when tapped at 1650°C), the copper coolers are capable of removing peak sidewall heat fluxes above 500 kW/m^2. Feedback is included on the performance of the Pyromet MAXICOOL® copper cooling system for the first two years of operation. The paper further includes an overview on the design and performance of the tap holes, furnace shell, electrode columns, furnace roof and copper slag spouts.

COFFEE BREAK—15:00-15:30

PAPER 8.3—15:30
DYNAMIC SIMULATIONS FOR OFF-GAS SYSTEM DESIGN.
D. BERKLEY, HG Engineering Ltd., Canada

Off-gas systems often become the limiting factor in production increase and environmental projects. Any upgrade or new off-gas project needs to address control instability issues, instabilities that can result in safety hazards, significant loss of system capacity and/or emissions to the environment [1]. In addition, the design engineer must optimize the configuration and equipment size of the system for the new operating conditions, to have a technically feasible and economically viable project. Dynamic simulations can be used for addressing both the control stability and the design optimization issues. This paper illustrates how the dynamic simulation of transient processes and of their control system can be used in "real life" situations for these purposes, presenting the example of an electric furnace off-gas system design.

PAPER 8.4—16:00

AVOID PROCESSING OF WASTE AND TURN YOUR WASTE PILES TO MONEY.

H. KROOG, R. FECHNER, Scan and Sort GmbH, Germany and
S. PALOMBO, W.S. Tyler Canada, Canada

The opto-electronic sorters type MikrSort are supplied over 300 times. From Scan and Sort GmbH, Wedel/Germany, in special executions for sorting of ores and minerals as per color, brightness, size or form. Material sizes from 2 mm up to 250 mm are detected and sorted by very quick working valves with compressed air. Different machine sizes and executions fit for nearly every material, e.g. ores like gold, and, platinum, gems like diamonds, emeralds and tanzanite, minerals like calcite, talc and limestone. Especially for the sorting of nickel, copper, zinc and cobalt Scan and Sort just developed the new MineSorter, working with inductive sensors only. The high costs of sorting with DSM can be avoided with these new systems. Valuable waste piles can be turned to money.

PAPER 8.5—16:30

OUTOKUMPU'S TECHNOLOGIES FOR EFFICIENT AND ENVIRONMENTALLY SOUND NICKEL PRODUCTION.

T. MAKINEN, K. FAGERLUND, Y. ANJALA and R. NUPPONEN, Outokumpu Technology, Finland

This paper deals with the nickel smelter and refinery concepts Outokumpu has applied at Harjavalta and several other plants. Also other process routes and modifications developed and tested by Outokumpu during the recent years are highlighted. Outokumpu started nickel production in Harjavalta in 1959. Until 1995 the Flash Smelting/Peirce-Smith (PS) converting route was applied. High grade nickel matte from the converting step was further refined by means of leaching and electrowinning to produce cathode nickel. In 1995 the nickel production capacity was increased from 17 000 t/a to 52 000 t/a based on the Direct Outokumpu Nickel Smelting Process (DON). In the DON process PS converting is eliminated and high grade nickel matte with low Fe-content is directly produced in the flash smelting furnace (FSF). Metal values from the smelting slag are recovered in the electric furnace (EF) as iron containing Ni-matte. The DON process can be operated with either two matte concept, where high grade FSF matte and EF matte are produced, or a single matte concept, where EF matte is recycled to the smelting furnace and thus only one type of high grade matte is obtained. The additional refinery capacity at Harjavalta is based on hydrogen reduction producing nickel powder and briquettes. Leaching of two types of matte was resolved by setting up separate leaching circuits for each matte. Copper in matte is recovered as sulphide. Cobalt and minor impurities are removed from the nickel sulphate solution by solvent extraction and thereafter the solution is fed to the electrowinning and hydrogen reduction plant. In the process concepts operated and developed by Outokumpu, it is possible to deal with the issues often related to nickel production: MgO content, PGM and cobalt recovery. Outokumpu Technology is able to provide process solutions to yield nickel and other valuable elements with high recovery from various types of concentrates in profitable and efficient methods considering also environmental and occupational aspects.

PAPER 8.6—17:00

ROLE OF TECHNICAL INNOVATION ON PRODUCTION DELIVERY AT THE POLOKWANE SMELTER.

J. NDLOVU, D. WANBLAD, B. DE VILLIERS, Anglo Platinum, South Africa
L. NELSON and F. STOBER, Hatch, Canada

The single six-in-line furnace of the Polokwane Smelter is the largest installed high-intensity furnace for platinum group metals (PGM) base metals sulphide smelting in the world. The furnace employs state-of-the art technology to deliver a planned throughput of 650 000 t/a dry concentrate at a design 68 MW power input. This furnace, at double the capacity of previously existing PGM furnaces, offers low unit operating and capital cost through the resulting economies of scale. Key features of the design include:

- use of water-cooled copper HATCH matte tapblocks, Waffle, plate and flanker coolers
- patent-pending air-cooled copper fin radiator sidewall cooling of matte zone
- patent-pending wall hold-down spring system
- effective 3-dimensional furnace binding system
- patent-pending HATCH electrodes
- operation aided by HATCH Integrated Furnace Controller (IFC).

Paramount to the design of the furnace was consideration of the process requirement to achieve high-intensity smelting of a high proportion of UG2 feed containing up to 4% Cr_2O_3 content. Operation at higher slag Cr_2O_3 levels leads directly to higher bath temperatures. It also increases the potential for undesirable precipitation of solid spinel phases at the matte-slag interface, or as build-up on the hearth. Fundamental to addressing the chrome issue was selection of adequate transformer capacity to permit operation at deep electrode immersion (immersed up to 75% of the slag layer thickness) and ability to operate at high hearth power density (up to 250 kW/m^2) to substantially prevent build-up of spinel on the hearth. Such build-up, if not otherwise controlled, rapidly reduces the effective bath volume for smelting, and can lead to premature furnace stoppage. Adoption of the water-cooled HATCH Waffle coolers in the slag zone is key to permitting sustainable operation at the high resulting sidewall heat fluxes (design of 220 kW/m^2 average, over 440 kW/m^2 peak). It also permits operation with reduced lime addition as a basic slag conditioner, so lowering the specific energy requirement for smelting. A further, but little appreciated metallurgical benefit of highly stirred high-intensity smelting of concentrates, is the exceptionally low slag PGM losses that result. These and other

pertinent operational features facilitated by the up-front selection of an appropriate high-intensity furnace design will be presented.