WEDNESDAY, AUGUST 25, 2004, P.M.

SESSION 55: FIFTH INTERNATIONAL SYMPOSIUM ON WASTE PROCESSING AND RECYCLING IN MINERAL AND METALLURGICAL INDUSTRIES

BASIC RESEARCH

Sponsors: Hydrometallurgy, Non-Ferrous Pyrometallurgy, Iron and Steel Sections and Environment Committee of the Metallurgical Society of CIM and the Environmental Society of CIM

Room: Chedoke A

Chairmen: T.T. CHEN, CANMET, Ottawa, Ontario, Canada, and
C.Q. JIA, University of Toronto, Toronto, Ontario, Canada

PAPER 55.1 — 14:00

DISTRIBUTION BEHAVIOR OF HEAVY METAL BETWEEN MOLTEN CHLORIDE AND SLAG.

E. SHIBATA, T. NAKAMURA, IMRAM, Tohoku University, Sendai, Japan, and
K. FUKUDA, Kobe Steel Ltd., Kobe, Japan

The volatilization behavior of heavy metal in electric ash melting furnaces must have a strong relation with its distribution between molten salt and slag. In this study, the distribution ratios of heavy metals between molten salt and slag were measured using a hermetic cell. It was observed that a heavy metal was vaporizing with an almost fixed distribution between molten salt and slag. The distribution ratios of Pb and Zn decreased with increase in basicity of slag. The mechanism of this effect can be explained by the chlorinated reaction of Pb and Zn by CaCl2.

PAPER 55.2 — 14:25

KINETIC STUDY ON RECOVERY OF METAL VALUES IN ANODE SLIME FROM USED LEAD BATTERIES.

S. ITOH, J. ONO, M. HINO and T. NAGASAKA, Tohoku University, Japan

With respect to the recycling of used lead-batteries, a pure lead is required to prepare a lead-calcium alloy electrode for a new maintenance-free battery. The pure lead can be obtained by means of electrolytic and/or pyrometallurgical refining. In the lead electrorefining, antimony is concentrated in anode slime. From the viewpoint of the recycling and recovery of metal values from used lead-batteries, especially from anode slime, oxidation experiments were conducted for pure liquid antimony in the temperature range between 973 and 1373 K to elucidate the oxidation kinetics and mechanism. Furthermore, since lead anode slime generally consists of antimony, lead and bismuth, experiments were also carried out using antimony-lead-bismuth alloy. The equation relating to the mass transfer characteristics in the gas phase was then applied to analyze the oxidation kinetics. The kinetic analysis indicates that the mass transfer step in the gas phase mainly controls the overall rate. Therefore, the anode slime treatment, that is, an oxidation of antimony concentrated in anode slime followed by evaporation as antimony oxide Sb4O6, should be operated with sufficient amount of gas flow rate. Feasibility of anode slime treatment will also be discussed.

PAPER 55.3 — 14:50

IONIC EQUIBLIRA AND PRECIPITATION REACTIONS OF SLAG COMPONENTS IN SEA WATER.

Y. OYAMA, H. MIURA, S. YAMAGUCHI, University of Tokyo, Tokyo, Japan, and
A. YOSHIDA, Nagoya Institute of Technology, Nagoya, Japan

A discussion is given on ionic equilibria and precipitation reactions based on thermodynamic analysis, in order to understand the solubility of nutrient salts from steelmaking slag for marine phytoplankton. The stable phase and solubility of constituent ions in equilibrium with solid phase are determined using thermodynamic data. It is proposed that a $\log P_{CO2}$ should be considered as an additional parameter to the Eh- pH diagram for the ionic equilibrium of slag components in sea water, since carbonate formation reactions of Mg and Ca ions determine the solubility of ligand ions in nutrient salts, such as phosphates and silicates. Further discussion on the supersaturation of the ions will be given to explain the behavior of precipitation reaction of inorganic solid compounds.

COFFEE BREAK — 15:15 – 15:40

PAPER 55.4 — 15:40

ON THE POSSIBILITY OF UTILISING ZINC OXIDE FOR DESULPHURISING HOT METAL

R.V. KUMAR, University of Cambridge, Cambridge, U.K and
F. TAILOKA, University of Pretoria, Pretoria, South Africa

In order to use ZnO laden dust as a possible desulfurisation reagent, it is important to evaluate thermodynamics of the Zn-O-S system. At temperatures greater than 1450 K, there is an uncertainty in the thermodynamic data for the reaction of zinc with sulfur to form Zinc sulfide. In this work, the standard free energy has been determined using an electrochemical cell: Pt, Mo, MoO_2/YSZ/ZnO, ZnS, SO_2, Pt., between 1198 and 1602 K. ΔG^o varies from -145,880 to –88,100 J (± 2500) , with a phase change to ZnS (g) by sublimation occurring between 1450 and 1460 K. This is supported by thermo gravimetric analysis which shows about 80% weight loss in ZnS from 1273 to 1473 K. Feasibility reactions were also performed and confirmed that ZnS (g) is formed when ZnO reacts with FeS (1473 to 1653 K) or with Fe-Csat-S(1473-1673 K). There is therefore potential for the utilization of ZnO laden waste as an additional or alternative reagent for desulfurisation.

PAPER 55.5 — 16:05

MINERALOGICAL CHARACTERIZATION OF WAELZ KILN PRODUCTS.

T.T. CHEN, J.E. DUTRIZAC and G. POIRIER, CANMET, Ottawa, Ontario, Canada

In the Waelz kiln process, EAF dust is converted to an Fe-rich slag, a (Zn, Fe)-rich dust that is recycled to the kiln and the Zn-rich Waelz oxide which is subsequently up-graded for the recovery of zinc. To clarify the reactions occurring, the Waelz kiln products from a European Waelz plant were characterized mineralogically to determine the mineral species present, their micro-textures and the metal carriers. The EAF dust contains 27 % Zn, and consists mainly of $ZnFe_2O_4$ and ZnO, together with minor to trace amounts of NaCl, $PbCl_2$, KCl, CaO, $Ca_2Fe_2O_5$, Fe_2O_3, FeO, Pb oxide and various Ca-Fe-Al-Mn silicates. The KCl and NaCl sometimes agglomerate the other particles. The slag consists of nodules which often exhibit colloform structures. The slag contains of variable amounts of Fe, FeO(OH), FeO, gypsum, $Ca(OH)_2$, Ca_2SiO_4 and various Ca-Fe-Al-Mg-Mn silicates as well as minor to trace amounts of $ZnFe_2O_4$, Cr-Fe oxide, Mn-Fe oxide and other species. The Waelz oxide contains 57-61 % Zn, and consists predominantly of ZnO, with minor to trace amounts of KCl, NaCl, Pb(OH)Cl, $Pb_2O(SO_4)$, Pb chloride, $ZnSO_4$, $ZnFe_2O_4$, Ca_2SiO_4, $Ca_2Fe_2O_5$, Ca-Fe silicate and $NaZn_4(SO_4)(OH)_6Cl.6H_2O$. The KCl agglomerates the other particles in the Waelz oxide. The recycled dust appears to be a mixture of EAF dust and Waelz oxide, but it contains relatively more coarser-grained metallic Pb and Pb oxide particles.