

WEDNESDAY, AUGUST 25, 2004, A.M.

SESSION 42: INTERNATIONAL SYMPOSIUM ON LIGHT METALS AND METAL MATRIX COMPOSITES

RAW MATERIALS AND REDUCTION

Sponsor: Light Metals Section, The Metallurgical Society of CIM

Room: 202

Chairmen: A. BOLDUC, Alcan International, Montréal, Québec, Canada, and

D. KSINSIK, Silicium Becancour, Bécancour, Québec, Canada

PAPER 42.1 — 8:30

ACCURATE ASSESSMENT OF THE HIRAKUD SMELTER ALUMINIUM REDUCTION CELL THERMAL BALANCE USING ONLY TEMPERATURE MEASUREMENTS.

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A. KOSHIE, V. JANAKIRAMAN, Indian Aluminium Company Limited, Sambalour, Orissa, India,

S. KARTHIKEYAN and D. SARAVANAN, Confederation of Indian Industry, Chennai, India

In the present study, the heat balance of the Hirakud smelter aluminium reduction cell has been accurately assessed using only a surface thermocouple and a pyrometer. As it is well known that using a single linear relationship to estimate the heat flux from the measured surface temperature does not provide the accuracy required too close the cell heat balance, this approach was not used in this study. Instead, the fundamental natural convection and radiation heat flux equations were used systematically for each measurement point. Practically, this means that the ambient air temperature and at least one ambient radiative temperature must also be known in addition to the surface temperature for each measurement point. Sometimes, the radiative heat flux could not be accurately estimated using a single ambient radiative temperature. In those cases, a more accurate estimation based on two ambient radiative temperatures and corresponding view factors has been used instead. It turns out that although at least three temperature measurements are required to estimate a single heat flux, it takes a lot less time to make those temperature measurements using a pyrometer than directly measuring the heat flux using an expensive heat flux meter. Furthermore, no loss in accuracy was detected when using this approach as the cell heat balance could be closed within 5%, the level of accuracy typical of cell heat balance assessment using heat flux meter.

PAPER 42.2 — 8:55

A SIMPLIFIED CORRELATION FOR THE TOTAL VAPOUR PRESSURE OF CRYOLITIC MELTS.

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Reduction cells use cryolitic melts at a temperature of about 960°C to dissolve alumina and to produce primary aluminium. At these temperatures cryolitic melts with an acidic composition have a significant vapor pressure, which contributes substantially to the evolution of fluorides from these cells. Laboratory measurements of the total vapor pressure, composition and temperature are usually correlated by using the Antoine equation. The correlations in the literature have more than 20 constants, in order to allow for the effects of melt composition. The present work proposes a simplified correlation, which has only 13 constants. The simplified correlation was compared to published correlations using melts of 12 different compositions. It was shown that the simplified correlation is sufficiently accurate for industrial purposes.

PAPER 42.3 — 9:20

THE ELECTROCHEMICAL BEHAVIOUR OF PHOSPHORUS COMPOUNDS IN CRYOLITE-ALUMINA MELTS AND THE ROLE OF PHOSPHORUS DURING ELECTROWINNING OF ALUMINIUM.

G.M. HAARBERG, M. KEPPERT, E. THISTED and J. THONSTAD, Norwegian University of Science and Technology, Trondheim, Norway

Electrochemical techniques, mainly linear sweep voltammetry and potential step chronoamperometry, were used to study the behaviour of dissolved phosphorus species in cryolite-alumina melts. The presence of AlPO_4 or Na_3PO_4 gave rise to voltammetric current waves due to dissolved P(V) and P(III) species at potentials where dissolved alumina is stable in cryolite melts. Data from industrial cells were used to determine mass balances for phosphorus. For cells being fed with secondary alumina, more phosphorus tends to end up in the produced metal. Laboratory experiments to study the effect of phosphorus in the bath on the current efficiency for aluminium were also carried out.

PAPER 42.4 — 9:45

ANALYTICAL SYSTEM OF LONG-TERM FORECASTING OF WORLD PRICES FOR PRIMARY ALUMINIUM.

B. ARLYUK, St-Petersburg, Russia

The complex system has been developed for long-term assessment of world prices and sale volume of primary aluminium when using the analytical model of the market and market supply forecasts as well as economy development in the Western countries characterized by the industrial production indices. The model has been developed for forecasting of the degree of capacities utilization rate of smelters depending on the aluminium and alumina price level in the world. The model contains a statistic part corresponding to the capacities distribution by the production cost, and a dynamic part determining the deviation from the static depending on the price variation dynamics. The special model was created defining the prices of alumina as function of market supply /demand balance. The developed complex model of long term forecast of primary aluminium and alumina prices has been identified by the actual data of conservation and reactivation of aluminium production, and alumina supply/demand balance in the Western countries within the period from 1985 to 2003. The complex model was used for long term forecast of primary aluminium and alumina prices, capacity utilization rate of smelters till 2020.

COFFEE BREAK — 10:10 – 10:40

PAPER 42.5 —10:40

SHORT-TERM PRICE FORECASTING FOR PRIMARY ALUMINIUM.

B. ARLYUK, St-Petersburg, Russia

On the basis of research of relations among the market participants the analytical model has been created which connects the price of primary aluminium at stock exchange with volume of sales and the stock of the sellers and buyers. Also a model was developed for assessment of these parameters of the market status by the actually fixed stock exchange and general market indicators. The composition of these models made it possible to create reliable system of short-term price forecasting for primary aluminium up to one quarter ahead. Imperfectability of creation a model for reliable price forecasting by purely statistic methods (by the “black box” principle) was shown. A model of price behavior qualitative forecasting till one quarter ahead has been developed, which determines the probability of reaching in future of the given level as well as of the price maximums and minimums. Optimal values of threshold probability were determined for forecasting the future price maximums and minimums securing the maximum profit from the forecasting system application for commercial activity. The developed system of forecasting was identified for primary aluminium at the period of 1990-2003. The system was tested daily during 20 months period for speculations