

TUESDAY, AUGUST 24, 2004, P.M.

**SESSION 26: FOURTH INTERNATIONAL SYMPOSIUM ON ADVANCES IN
REFRACTORIES FOR THE METALLURGICAL INDUSTRIES**

ALUMINUM (III)

Sponsors: Materials Science and Engineering, The Metallurgical Society of CIM, The Refractory Ceramics Division of the American Ceramic Society and The Canadian Ceramic Society.

Room: Webster B

Chairmen: O.-J. SILJAN, Norsk Hydro ASA, Porsgrunn, Norway, and
Y. DUBÉ, Minteq, Montréal, Québec, Canada

PAPER 26.1 — 14:00

**MOLTEN ALUMINUM TEMPERATURE MEASUREMENT WITH THE USE OF A NOVEL
THERMOCOUPLE ASSEMBLY.**

**C. ALLAIRE, École Polytechnique of Montréal, Montréal, Québec, Canada,
J.-B. PINEAULT, Groupe RÉFRACO, Chicoutimi, Québec, Canada, and
A. CADIEUX, RDC Controle Ltd., Blainville, Québec, Canada**

The temperature measurement of the molten metal in the aluminum transformation process is of prime importance. This is particularly the case for aluminum treatment furnaces, such as holding and melting furnaces. Such reverberatory type of furnaces involve a thermal gradient across the metal line which limits the life of conventional thermocouple protective ceramic shields, due to the action of locally induced thermal stresses. This paper presents a novel thermocouple assembly using a composite refractory protective shield allowing long term resistance to such above conditions. Example of results obtained from various tests in aluminum holding furnaces are presented. The results confirm the superiority of the novel thermocouple assembly, as compared to conventional thermocouple units.

PAPER 26.2 — 14:25

ABRASION WEAR OF ALUMINOSILICATE REFRACTORIES.

**N. NTAKABURIMVO and C. ALLAIRE, École Polytechnique of Montréal, Montréal,
Québec, Canada**

This paper presents an innovative experimental set-up which simulates refractory degradation by separate and simultaneous action of abrasion, erosion and partially or totally immersion corrosion whether dynamic or static. It also presents abrasion testing results obtained from five commercial aluminosilicate refractories used in aluminium melting and holding furnaces. Abrasion wear was quantified by measuring the weight loss and the depth of wear, as well as by determining materials properties degradation, such as the residual rupture force and the residual modulus of rupture. Results were correlated to as-fired materials properties, such as rupture force, flexural strength, elastic modulus, toughness, and apparent porosity; in order to establish which property could be used for refractory abrasion wear prediction. They were also related to the critical length of pre-existing defects and to those generated by the abrasion process. Positive correlation was established between abrasion resistance and mechanical properties, particularly for refractory castables. For similar mechanical strength, the castables tested offered less abrasion resistance than the brick sample.

PAPER 26.3 — 14:50

**AL KIN - A NEW GENERATION OF FLUXING AND PURGING TECHNOLOGY FOR A CLEANER
ALUMINUM.**

K. GAMWEGER and A. FILZWEISER, RHI Refractories, Vienna, Austria

The process of gas purging in molten aluminum has been an industrial practice in Europe for many years. The advantages are a reduction in the hydrogen content and impurities in the melt, as well as a homogenization of the temperature and chemical analysis in the molten metal. Formerly used wands (lances) or impellers are being replaced by porous plugs which are installed at the bottom of the furnace. This special product of RHI Refractories has proven its efficiency in primary melting as well as in die cast, sheet and extrusion plants.

COFFEE BREAK — 15:15 – 15:45

PAPER 26.4 — 15:45

COMPUTATIONAL FLUID DYNAMICS – MODELING IN THE ALUMINIUM INDUSTRY.

O. ZACH and K. GAMWEGER, Veitsch-Radex GmbH&Co, Leoben, Austria

The process of gas purging in molten aluminium has been an industrial practise for many years. The melting of alloying elements and their rapid distribution in the bath is very important. To improve the mixing and homogenisation process, at RHI NON FERROUS METALS ENGINEERING GMBH a lot of CFD calculations were done. The so developed new “purging program” was tested at Alumino Catalan S.A., Spain. The results of the testtrials were very satisfactory and correspond very well with the calculated data.

PAPER 26.5 — 16:10

PRACTICAL HEAT LOSS CALCULATIONS FOR MOLTEN METAL TRANSPORT CRUCIBLES.

E. FERGUSON, Groupe Réfraco Inc., Chicoutimi, Québec, Canada

In evaluating refractory designs for cast house applications, thermal calculations are frequently performed to determine cold face shell temperatures, temperature profiles and metal freeze plane locations within the refractory layer, and heat loss in the steady state condition. A problem arises when looking at molten metal transport crucible designs in that these structures are usually operating under non-steady state conditions throughout their production cycle. Because the molten metal temperature varies with time, and material properties such as thermal conductivity are temperature dependant, mathematical solutions are at best... complicated. This paper presents a relatively simple, iterative solution that can be set up on a standard computer spreadsheet program, to calculate heat transfer in non-steady state conditions. These calculations can provide curves for (1) molten metal temperature vs. time and (2) cumulative heat loss vs. time, given variable starting conditions, to aid in the evaluation of molten metal transfer crucible refractory designs.

PAPER 26.6 — 16:35

BEHAVIOUR OF FIRECLAY BRICKS USED IN ALUMAR OPEN ANODE BAKING FURNACE FLUEWALL DURING OPERATION.

W.M. SILVA, V.P. RAMOS, C. PAGLIOSA NETO, L.R.M. BITTENCOURT, Magnesita S.A., Contagem, Brazil,

M.A.P. SILVA and P.A.P. MIOTTO, ALUMAR – Consórcio de Alumínio do Maranhão, Brazil

The major cause of breakdown of anode baking furnace fluewalls is chemical corrosion, which leads to deterioration of the properties of the bricks. Subsequent deformation of the fluewalls occurs, and also extensive cracking of the lining is observed.

The present work studies the major changes of the brick during the operation of the furnace, after 22, 60 and 90 cycles of baking; in two different regions: upper and lower. Due to excellent cleaning conditions of the butts, negligible amounts of fluorine were found in the bricks. The major contaminants found were carbon, sulfur and alkali compounds, all of them present in the anode baked during the process.