TUESDAY, AUGUST 24, 2004, A.M.

SESSION 13: FOURTH INTERNATIONAL SYMPOSIUM ON ADVANCES IN REFRACTORIES FOR THE METALLURGICAL INDUSTRIES

ALUMINUM (II)
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: A. TABEREAUX, Alcoa Inc., Alcoa, Tennessee, U.S.A., and
L. MUNDAY, RHI-Canada, Boucherville, Québec, Canada

PAPER 13.1 — 8:30
INTERACTION OF ALUMINUM WITH SILICA BASED REFRACTORY CERAMICS.

J.M. SOTO, W.G. FAHRENHOLTZ and J.D. SMITH, University of Missouri – Rolla, Rolla, Missouri, U.S.A.

Interactions between A356 aluminum (Al-Si alloy) and dense fused silica (FS) riser tubes used for low-pressure casting of aluminum alloys were evaluated using a sessile drop approach. The tubes have a short service life, but cost and thermal shock resistance make them an effective solution. The main problem encountered during use is the reaction of aluminum with silica to form alumina and silicon, which causes failure. Tests have been conducted on as-fired (uncoated) and modified (coated) tubes. Experiments were carried out in a horizontal furnace at 1225ºC under argon to minimize the effect of the aluminum oxide on the interactions at the alloy-silica interface. Images of the drop were acquired and contact angle values were estimated for uncoated and coated samples, but no significant differences in the contact angles were observed. Scanning electron microscopy revealed the presence of cracks at the interface between the reaction zone and the unreacted silica. The presence of reaction products (silicon in the reacting alloy and aluminum in a reaction zone between the alloy and the unaffected silica) has been confirmed using energy dispersive spectroscopy. A two layer coating system was found to be effective in reducing penetration of the aluminum alloy..

PAPER 13.2 — 8:55
STUDY OF INTERACTION ZONE BETWEEN ALUMINUM AND ALUMINA UNDER STATIC AND DYNAMIC FLOW CONDITIONS.

Z. KUNT, D. KOCAEFE, Y. KOCAEFE, Université du Québec à Chicoutimi, Chicoutimi, Québec, Canada, and
C. ALLAIRE, École Polytechnique of Montréal, Montréal, Québec, Canada

The interactions between bed media and aluminum have been studied under static and dynamic flow conditions. An experimental system was set up simulating a small filter. Desired flow field can be created around alumina particles and velocities can be adjusted. A mathematical model was developed to predict the velocities, and this was validated using data from a visualization study. The interaction zone on the surface of the particles was analyzed with optical microscopy and SEM. This paper presents the study and compares the results under static and dynamic flow conditions.

PAPER 13.3 — 9:20
INTERACTION OF REFRACTORY THERMO-PHYSICAL PROPERTIES WITH MOLTEN AL – 5% MG.

A. INNUS, Alcan International Ltd, Jonquière, Québec, Canada,
C. ALLAIRE and R. PELLETIER, École Polytechnique of Montréal, Montréal, Québec, Canada

Refractory used for molten aluminum confinement is typically assessed separately for thermo-physical properties and molten aluminum resistance, and not in combination. This present work provides a case study comparison of 4 commercial refractory products that were subjected to a test procedure that combined mechanical impact, thermal shock and molten aluminum contact.

PAPER 13.4 — 9:45

REFRACTORIES FOR ALUMINIUM MELTING AND HOLDING FURNACES.

M. SPREIJ and M. HOGENBOOM, Corus Research, IJmuiden, The Netherlands

Refractory lining performance of aluminium melting and holding furnaces and downtime due to refractory re-linings, are important parameters for increasing the aluminium output of a cast house and decreasing costs. The importance of refractory materials testing is illustrated by examples of improvements made in refractory lining concepts, quality control and introduction of alternative and newly developed materials. These examples also show that the information given by product definitions of refractory suppliers will in many cases be insufficient to judge the risks and benefits of using alternative materials.

COFFEE BREAK — 10:00 – 10:40

PAPER 13.5 — 10:40

REFRACTORY SELECTIONS FOR ALUMINUM CAST HOUSES.

M. DELUCIA, Harbison-Walker Refractories Co., Moon Township, Pennsylvania, U.S.A.

Over the past 15 years, technical innovations have improved the properties and performance of monolithic refractories. As these improvements have occurred, aluminum cast-house refractory selections have changed from brick to monolithic refractories supplied as either cast in place, or precast, “Big-Block” installation. A review of the advantages of brick refractories and monolithics for aluminum melting and holding furnaces is presented. Operating conditions and issues such as temperature, salt fluxing, corundum growth and other variables are also reviewed.

PAPER 13.6 — 11:05

PROTECTION OF ALUMINOSILICATE AGGREGATES AGAINST CORROSION BY MOLTEN ALUMINUM.

S. AFSHAR and C. ALLAIRE, École Polytechnique of Montréal, Montréal, Québec, Canada

Several studied have recently shown that the use of non-wetting additives is not always a sufficient solution to improve the corrosion resistance of refractories against molten aluminum. Once in contact with liquid aluminum, the coarse aluminosilicate aggregates, which do not benefit from the protective effect of non-wetting additives in the matrix, may be corroded. In some cases, the corrosion of aggregates, especially those containing a significant amount of free silica and/or alkalis, promotes corrosion in the surrounding matrix. The present work explores the possibility to protect the poor corrosion resistant aggregates via a lining procedure. A slip casting method, using either alumina or celsian-like composition based slurries, has been applied for lining of a series of aggregates. The results from this study show that such linings may prevent efficiently the corrosion of aluminosilicate aggregates. This work also analyzes the effects of firing temperature and lining quality on the corrosion behavior of aggregates.