TUESDAY, AUGUST 24, 2004, P.M.

SESSION 31: INTERNATIONAL SYMPOSIUM ON LIGHT METALS AND METAL MATRIX COMPOSITES

CASTING AND SOLIDIFICATION II
Sponsor: Light Metals Section, The Metallurgical Society of CIM
Room: 203
Chairmen: R. GHOMASHCHI, UQAC, Chicoutimi, Québec, Canada, and
J.-P. MARTIN, NRC-Aluminium Technology Center, Chicoutimi, Québec, Canada

PAPER 31.1 — 14:00
THE ROLE OF EXORTHERMIC OF INTERMETALLIC REACTIONS IN THE DISSOLUTION AND RECOVERY OF ADDITION IN LIQUID ALUMINIUM.
K. SUN, S. ARGYROPOULOS, University of Toronto, Ottawa, Ontario, Canada, and
T. KOSTO, Milward Alloys Inc., Lockport, New York, U.S.A.
In this research work the dissolution of compacted powder additions into liquid aluminum was studied. Cylindrical powder compacted additions were manufactured. The dissolution of these additions into liquid aluminum was examined using the load cell technique. In this way, the apparent weight of addition was monitored during the dissolution. In addition, various thermocouples were used to detect the temperature of the addition and the liquid aluminum. A 10 kg commercial purity aluminum melt was used. Upon immersion into liquid aluminum the temperature of the specimen increased. When this temperature reached certain point an exothermic reaction was triggered. At the same time a swelling action in the immersed specimen was initiated. Following this swelling action the addition starts to disintegrate and be dissolved into liquid aluminum. Various composition manganese aluminum compacts were used in this research work. The effects of various parameters, like compact composition and melt temperature, into dissolution and recovery will be presented. The role of exothermic intermetallic reactions in the dissolution will be analyzed.

PAPER 31.2 — 14:25
IMPACT OF SWIRLING AND SUPERHEAT ON MICROSTRUCTURAL EVOLUTION OF A356 ALLOY IN SEED SLURRY-ON-DEMAND PROCESS.
O. LASHKARI, S. NAFISI, R. GHOMASHCHI, A. CHARETTE, Center for University Research on Aluminum (CURAL), University of Québec at Chicoutimi, Chicoutimi, Québec, Canada,
J. LANGLAIS, Alcan International Limited, Arvida Research and Development Center, Jonquière, Québec, Canada, and
B. KULUNK, Société des Technologies de l'Aluminium S.T.A.S, Chicoutimi, Québec, Canada
Swirling Enthalpy Equilibrium Device (SEED) is a new patented slurry-on-demand processing route. The semi-solid slug preparation is carried out by off center swirling of aluminum melt in a metallic mould. As part of the current research program on the semi-solid, the morphological evolution of A356 aluminum foundry alloy microstructure is reported here. Semi-solid slugs were prepared using different process conditions, i.e. swirling speeds and initial pouring temperature ranging from 0 to 150 rpm, and 645 to 695˚C, respectively. Morphological evolution of the semi-solid microstructure was characterized using image analysis through measuring of primary Al-particle size, number and distribution, shape factor, and sphericity along with the grain size. The possible correlation between micro- and macro-structure characteristics of semi-solid material was also studied.

PAPER 31.3 — 14:50
DISSOLUTION OF ALTISI INTERMETALLIC COMPOUNDS IN A356 AL-SI ALLOY.
A. JAFARNIA, R. GHOMASHCHI, A. CHARETTE Center for University Research on Aluminum (CURAL), University of Québec at Chicoutimi, Chicoutimi, Québec, Canada, and
X.G. CHEN, Alcan International Limited, Arvida Research and Development Center, Jonquière, Québec, Canada
Aluminum alloys are frequently grain refined during solidification in order to promote the formation of an equiaxed grain structure in the casting. The application of grain refiners and/or Ti containing master alloys for improving mechanical properties may result in formation of Al-Ti based intermetallics. Although the grain refinement produces many desirable qualities in aluminum castings such as improved castability and mechanical properties, the addition of Ti to Al-Si foundry alloys may lead to the formation of some undesirable intermetallic particles such as Al3Ti(Si) and cause a number of operational problems such as nozzle blockage due to segregation and agglomeration of aluminide particles within the nozzle. There are several questions to be clarified when minor amount of Ti is added

to Al-Si alloys. They include nucleation and growth of AlTiSi particles, their morphologies and orientation relationships with aluminum matrix and the dissolution of these intermetallics during the course of solidification and/or post solidification treatments. The current study was initiated to study the process and possible mechanism of aluminide dissolution and the related phenomena such as segregation and agglomeration. It will report the results found during reheating of laboratory prepared Ti-added A356 alloy at three temperature ranges of below solidus, mushy zone and above liquidus.

COFFEE BREAK — 15:15 – 15:45

PAPER 31.4 — 15:45

IN-SITU THERMAL ANALYSIS TECHNOLOGY FOR ALUMINUM FOUNDRY ALLOYS.

C. ZHANG, S. MUSMAR, F. MUCCIARDI, J. GRUZLESKI, McGill University, Montréal, Québec, Canada, and
F.H. SAMUEL, University of Québec at Chicoutimi, Chicoutimi, Québec, Canada

To produce high quality castings, one must monitor such parameters as the melt quality, the grain refinement and silicon inoculation and modification during the production of the commercial casting. Thermal analysis is a tool one can use for both monitoring and for providing input to the process control of the operation. The current technique of performing thermal analysis in commercial foundries is to pour a relatively small quantity of the molten aluminum alloy into a sampling cup and to then acquire the cooling curve. This approach is limited in that one has limited control of the cooling rate and hence the solidification rate of the sample. Moreover, this process requires a fair amount of user intervention and effort. In the past, studies have been conducted in an attempt to develop a system for conducting thermal analysis in-situ. In a study at McGill University, an alkali based heat pipe system was developed for conducting thermal analysis in-situ. While the concept was deemed as very desirable, the complexity of the equipment and procedure was a substantial negative component. In order to improve the technique of accomplishing real-time thermal analysis with an in-situ probe, a new method that is based on McGill heat pipe technology was developed. In the new system, a controllable and flexible water based heat pipe probe is used to solidify a small quantity of metal while residing in the melt. The solidified aluminum is remelted after completing the thermal analysis. This is a key feature of the probe. It resides continuously in the melt yet it is able to both solidify a sample of the melt and then to subsequently remelt it. Various solidification rates encountered in commercial castings are attainable by adjusting the heat extraction rate of the unit.

PAPER 31.5 — 16:10

SURFACE MORPHOLOGY, MICROSTRUCTURE AND PHASE MODIFICATIONS AFTER GAS NITRIDING OF A TI-6AL-2SN-4ZR-2MO ALLOY.

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A commercial titanium alloy Ti-6Al-2Sn-4Zr-2Mo has been gas nitrided in this work, in pure nitrogen atmosphere in order to improve its surface properties. The nitriding was performed at two different temperatures, 950 and 1050°C, and for different periods of time. The influence of the initial surface roughness on the diffusion process and on the surface properties of this material was studied. The influence of the processing parameters of gas nitriding on the surface roughness, phase modifications and the microstructure of the nitrided layers has been analyzed using atomic force microscopy (AFM), X-ray diffraction and optical microscopy. Microhardness profiles were obtained on cross-sections of the samples after gas nitriding applying a Knoop indenter.