Research Programs

Active Filtration

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The affinity of molten aluminum towards oxygen creates a favorable environment for the formation of non-metallic inclusions. The chemical and mechanical erosion of casting refractories is another common source of impurities. The presence of these exogenous particles in aluminum casting alloys is deleterious to both the mechanical and aesthetic properties of solidified products. As a consequence filtration of the molten metal has become a necessary step to reduce the concentration of impurities and improve the overall quality of castings.

Ceramic Foam Filters are industrially the most common way to remove inclusions from the melt. As the metal travels through the filter, impurities are physically trapped on the filter walls. Use of Ceramic Foam Filters has proved to increase the purity of the cast metal. However, the weak adhesion between inclusions and filter materials allows previously attached inclusions to be released when variations of the metal stream take place. Therefore few non-metallic inclusions may still pass through the finest filters available, and reduce the quality of the cast product.

The objective of this internship program between MPI and Aluminum Pechiney was to develop a new generation of filters enhancing the capture and retention of inclusions. These devices will present higher filtration efficiencies compared to the systems presently used in foundries.

The research focused on interfacial phenomena between inclusions and filters in a molten aluminum environment. Due to the complexity of making observations on filtration mechanisms in-situ, the inclusion-filter-molten aluminum three-phase system had been dichotomized to separately study the interactions between the different components of the triplet.

Several ways of enhancing the contact between inclusions and filter materials have been studied. A list of materials of interest was determined through a thermodynamic study. Experiments have been conducted to investigate and assess different mechanisms susceptible of promoting the adhesion of inclusions to the filter: several "sintero-favorable" materials have been tested and their potential has been evaluated. Reactive filtration has been studied as well, and different candidate materials for improved efficiency filters have been assessed.