

Research Programs

Casting Characteristics of Aluminum Die Casting Alloys

Partners:

The Cast Metal Coalition (CMC)

The North American Die Casting Association (NADCA)

Research Team:

Dr. Libo Wang

Prof. Diran Apelian

Prof. Makhoul Makhoul

Castability of an alloy refers to a set of characteristics that determine the suitability of the alloy to the casting process and to the production of sound cast components. These characteristics include the alloy's feeding properties, and its tendency to hot tear, form porosity, segregate, solder to the die, and form excessive sludge, as well as its ease of machining after casting. The relative importance of each of these characteristics depends on the casting process. The objective of this project is to quantify the casting characteristics of selected aluminum die casting alloys. The research evolved from an earlier program funded by DOE and NADCA and titled "Alloy-Microstructure-Performance Interactions in Aluminum Die Casting Alloys", where the effect of ten alloying elements and some of their interactions on the microstructure and properties of aluminum die casting alloys was investigated. In the earlier work, the optimum composition for maximizing each of several mechanical and physical properties was projected. In this program of research, the casting characteristics of alloys with these optimum compositions were evaluated. Five alloys were investigated. These alloys were projected to have the highest as die-cast yield strength, ductility, fatigue life, thermal conductivity, and impact toughness. For comparison, a commercial A380.0 alloy was examined. The casting characteristics evaluated for each of the alloys include the alloy's ability to flow, its ease of machining, its tendency to solder to metal dies, and its tendency to form sludge.

The results indicate that the casting characteristics of the experimental alloys are comparable to those of the industry's "work horse" alloy-A380, and some of the experimental alloys are already being used in applications that require their optimized properties and excellent casting characteristics. For example, a die caster member of the ACRC has patented one of the alloys, is using it to die-cast a complete line of heat sinks used by the electronics industry, and plans to initiate a new facility dedicated to producing heat sinks made of this alloy as well as other alloys that are based on its chemistry.



Publications:

M.M. Makhoul, D. Apelian, and L. Wang, "Sludge Formation Tendency of Selected Aluminum Die Casting Alloys," Proceedings of the Twenty First International Die Casting Congress, pp. 265-271, Oct. 2001.

L. Wang, D. Apelian, and M. Makhlof, "Iron-Bearing Compounds in Al-Si Die-Casting Alloys: Their morphology and conditions under which they form," AFS Transactions, vol. 146, pp. 231-238, 1999.