METAL CASTING

Project Fact Sheet

NATURAL AGING ALUMINUM CASTING ALLOYS

BENEFITS

- Update Mechanical Property database for natural aging alloys.
- Improved casting competitiveness by reducing cost per pound.
- Reduced energy requirements by an estimated 2200 Btu per pound.
- Reduced energy requirements will reduce carbon dioxide emissions.
- Reduced hot cracking propensity through grain refinements

APPLICATIONS

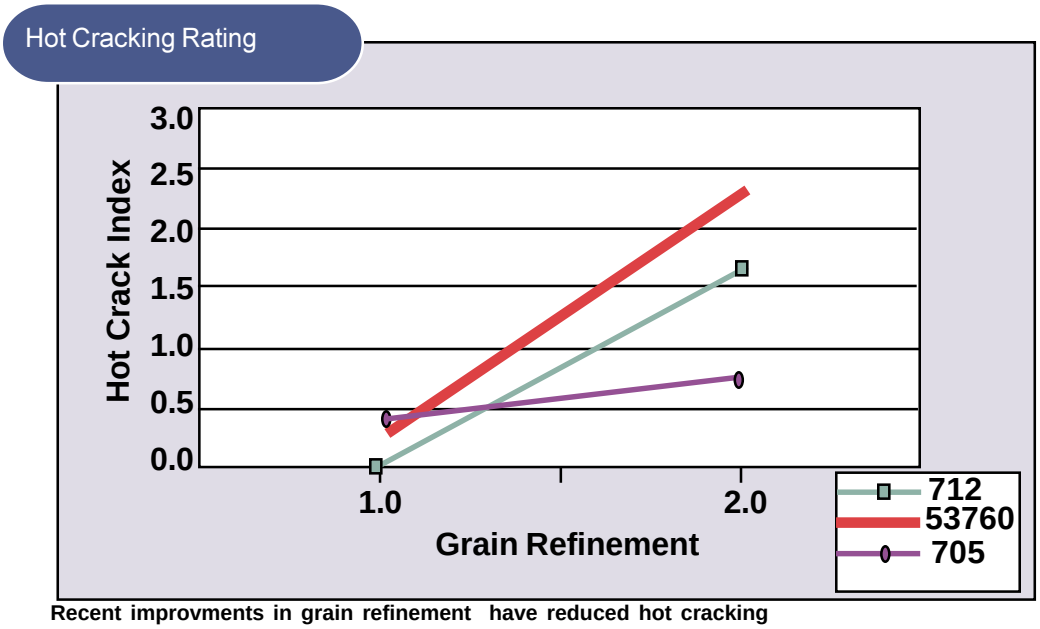
The results from this project can be used by design engineers in the casting industry and in their customer industries. Specifically, these results can impact:

- An estimated 120 million pounds/year in automotive castings markets.
- An estimated 120 million pounds/year in non-automotive applications for castings.

ELIMINATING ELEVATED TEMPERATURE HEAT TREATING SAVES ENERGY

Naturally aging Al-Zn-Mg (7xxx) casting alloys have excellent mechanical properties. No separate solution heat treatment or elevated temperature aging is required and holding 30 days at room temperature produces the desired strength. Consequently these alloys can be used to produce high-quality castings and realize cost savings of $0.20 per pound; a significant amount in today's highly competitive casting market. An energy savings of 0.2 kWh (2,200 Btu) per pound is realized by eliminating the requirement for high-temperature solution heat treating.

Despite their advantages, these alloys have been seldom used due to their propensity for hot cracking. Moreover, there is a lack of sound data on the mechanical properties and corrosion and stress corrosion resistance of these alloys. A recent improvement in the grain refinement of these alloys reduces their hot cracking susceptibility (see figure below). This research will address barriers to the adoption of 7xxx alloys. GKS Engineering Service and industry partners will lay the technical foundation needed for commercial application of natural aging alloys. Specifically, this research will provide information regarding the corrosion and stress corrosion resistance of these alloys. The R&D will also provide more current information regarding these naturally aging alloys and demonstrate how an improved grain refinement process can be used to produce crack-free castings. The potential use of naturally aging alloys to produce castings of equivalent strength at reduced cost and energy consumption makes aluminum castings more competitive.



Recent improvments in grain refinement have reduced hot cracking susceptibility

Project Description

Goals: The goals of this research are as follows:

- Demonstrate grain refining practices to mitigate hot cracking in 7xx alloys, and thereby establish 7xx natural aging alloys are a commercially viable alternative to the casting alloys used today, such as A356-T6 castings.
- To develop mechanical property data for these alloys by measuring casting tensile properties and hot cracking resistance as a function of alloy composition.
- Gain more detailed scientific knowledge about the aging process in 7xx series aluminum alloys.
- Develop understanding to optimize alloy composition within specification for a particular casting.

Progress and Milestones

This R&D project's planned tasks include:

- **Phase I** – A survey of the technical literature on the aging of Al-Zn-Mg alloys will be conducted. Aging studies will be made with the test bars poured at Stahl Specialty: hardness and tensile strength will be determined versus aging time at various controlled temperatures. From these results a set of time-temperature-transformation curves will be constructed. A second set of bars will be allowed to age for 60 days. Other bars will be tested for corrosion properties. These bars will be compared with conventional Al-Si (3xx) and Al-Si-Cu (2xx) alloys. This information obtained will be used to develop a statistical model of alloy properties. From this model, two alloys will be selected for Phase II.
- **Phase II** – The two alloys selected from Phase I will be melted and a significant number of bars, step wedge, and at least one commercial casting will be poured. Hot cracking trials will be performed. The castings will be subjected to three aging processes. They include: a natural age for at least six months, an aging treatment at slightly higher temperature (60-100 °C, to be determined based on results of Phase I), and a step aging process. The results will be tabulated, summarized and presented at the Annual Congress of the American Foundry Society.

Project Partners

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