**Prevention of Molten Aluminum-Water Explosions**

**Benefits**
- Development of safe casting operations, resulting in safer work environments
- Improved productivity and concurrently reduced liability
- Optimized coating global market share and sales revenue for U.S. paint/coating manufacturers

**Applications**
Aluminum-water explosions are a widespread safety concern in aluminum casting plants. These explosions are caused when the steam film and the interface between water and aluminum breaks down to cause atomization of aluminum and rapid vaporization of water. The results from this project will provide alternatives to Tarset coating of pits used in the past to mitigate these explosions.

**New Methods Will Prevent the Onset of Explosions in Aluminum Casting Pits**

Aluminum-water explosions are a widespread safety concern in aluminum casting plants. These explosions occur when a bleedout during chill casting permits liquid aluminum to spill into water in aluminum casting pits. Such explosions have been mitigated in the past by coating the pits with Tarset, a coal, tar-based material, which stabilizes the steam film to prevent triggering of the explosion. Because Tarset is no longer manufactured, the need to develop alternative methods for explosion prevention, such as coatings, non-condensible gas injection, or other equipment process changes exist.

New preventive methods, based on data generated in this project, will help prevent the onset of explosions in aluminum casting pits. The project will develop methodologies to investigate explosivity of various surfaces, and develop novel prevention techniques based on fundamentals, via injection of non-condensible gases at vulnerable locations.

Schematic of the Steam Explosion Triggering Studies (SETS) facility in Oak Ridge, TN.
Project Description

Goal: Improve the aluminum industry’s understanding of the conditions that trigger aluminum-water explosions, including the reasons and the extent to which certain coatings prevent explosions.

Project partners plan to achieve this goal through the development of a basic understanding of the entrapment of heat transfer over submerged coated and uncoated surfaces, and by studying the effects of non-condensible gas injection for preventing the onset of explosion. This project directly supports the Aluminum Industry Technology Roadmap industry-wide health and safety performance targets.

Progress and Milestones

Oak Ridge National Laboratory (ORNL) has designed and developed the SETS facility at ORNL, where the fundamental issues of explosions are being investigated with the emphasis on triggering events. Solid tungsten, which has thermo-physical properties similar to liquid aluminum, is used during experiments at the SETS facility. Using tungsten allows the apparatus to be instrumented, and the phenomena associated with the breakdown of steam film and triggering investigated, without the hazards associated with the use of large amounts of liquid aluminum in such experiments.

ORNL has produced significant data to assess suppression capability for various coatings with full curing times. However, the impact of shorter curing times (resulting in reduced down time of pits), as well as the study of impact of bare spots, are issues that need resolution. Further collection of data for selected coatings with different degrees of curing, together with the effects of the introduction of non-condensible gasses, remain the subjects of Phase II at ORNL.

Commercialization Plan

The Aluminum Association, Inc. and Alcoa Incorporated will establish commercialization plans based on the coatings and the other prevention methods identified after the completion of the Phase II work.