Aluminum-Fly Ash Metal Matrix Composites for Automotive Parts

Report for October, 1998 to December, 1998
January 15, 1999

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Highlights:

- Material development, process development, and part validation are occurring simultaneously on a fast track schedule.

- Prior project activity has resulted in a program emphasis on three components – manifolds, mounting brackets, and motor mounts; and three casting techniques – squeeze casting, pressure die casting, and sand casting.

- With the project focus, it appears possible to offer manifolds and mounting brackets for automotive qualification testing on a schedule in line with the PNGV Year 2004 goal.

- Through an iterative process of fly ash treatment, MMC ingot preparation, foundry process refinement, and parts production, both foundries (Eck Industries and Thompson Aluminum Casting Company) are addressing the pre-competitive issues of:
  - Optimum castability with fly ash shapes and sizes;
  - Best mechanical properties derived from fly ash shapes and sizes;
  - Effective fly ash classification processes;
  - Mechanical properties resulting from various casting processes and fly ash formulations.

Progress:

Eck and TAC continued experiments with batch ingot provided by both Eck and the University of Wisconsin at Milwaukee. Castings were run that contained varying amounts of fly ash and different size fractions. Components were cast using cenosphere material to ascertain the effects of squeeze casting and to determine whether the pressure would break the cenospheres.

Test parts are currently being machined into substandard test bars for mechanical testing. Also, the affect of heat treatments on ashalloy are being studied through comparison to two lots, one heat treated and one in the 'as cast' condition.

Milestones:

Program tasks leading to milestones are iterative over quarters. The next milestone, making trial parts in preparation for parts qualification, will be completed on schedule as expected in June, 1999.

Aluminum-Fly Ash Metal Matrix Composites for Automotive Parts

Report for January 31, 1999 to March 31, 1999
April 21, 1999

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Highlights:

- Following the preparation of laboratory-scale 20 pound heats and foundry-scale 400 pound heats, Eck Industries (Eck) produced a large-scale heat of aluminum-fly ash composites. Further process development is being undertaken to retain higher percentage of fly ash in future melts.

- Pressure die casting was successfully used at Eck to make aluminum alloy (A380)-fly ash composite bracket. Fly ash particles were within the pressure die cast components. The ability to make a pressure die cast bracket is a major step. Additional production runs will be directed at improving the distribution and amount of fly ash in pressure die castings.

Progress:

The Eck large-scale heat was accomplished by the stir casting technique. Brackets were cast by pressure die casting process. Samples taken from these castings were prepared for microstructure analysis. Using ultrasonic instruments, properties of density, hardness, and elastic modulus were measured.

Fly ash collected, as is, from Wisconsin Electric plants has been sent to UMW and to Eck for stir casting runs. In addition, fly ash is being classified by size to remove particles greater than 100 microns. This will enable comparisons of castings with fly ash of different treatments.

Milestones:

By May 1999, the size-classified (100 micron) fly ash will be received from Wisconsin Electric and a second round of sand castings, die castings, permanent mold castings and squeeze castings will be made by the end of July.

The castings will be examined by the end of September to determine their properties. Should the properties prove acceptable, the parts will be sent to auto industry test facilities by the end of December.

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