

Fly Ash-Enhanced Aluminum Composites for Automotive Parts

Dean Golden, The Electric Power Research Institute (EPRI)

Dr. Pradeep Rohatgi, University of Wisconsin-Milwaukee (UW-M)

Report for April, 1998 to June, 1998

July 17, 1998

Objective:

- To produce and evaluate the use of aluminum "ashalloys" – metal matrix composites that incorporate coal fly ash – in the commercial manufacture of cast automotive parts.

Highlights:

- Ashalloy ingot with 'C' type fly ash was synthesized using stir casting techniques similar to the successful castings of 'F' type fly ash. Agglomeration was noted. Stirring periods were increased up to 45 minutes compared to the normal 5 minutes to determine whether the shear force of stirring would disagglomerate the clusters noted with this type of fly ash. (See Progress.) The resulting sample showed clustering.
- The ashalloy ingots of 'C' type fly ash were remelted and poured into permanent molds using a cloth filter to screen out clusters. There was no major reduction in clusters of fly ash particles in the composite since the filter with the mesh size larger than 1x1 mm was used. The composite melt would not flow through when filters with smaller openings were used.
- The fly ash sample from Wisconsin Electric Power Company was sent for classification.
- A 1 lb. sample of JTM-processed fly ash was sent to Wisconsin Electric Power Company for classification and 10 lb. of same fly ash was sent to The Jet Pulverizer Company for jet milling.
- Experiments on fly ash pretreatment as well as synthesis of ash alloy are continuing.
- Attempts are being made to apply high speed shear mixing with selected liquids to disperse the clusters noted in ashalloy with the 'C' type fly ash base.

Progress:

Stir casting processes have been developed to incorporate type 'F' fly ash of different sizes and measuring tensile data on cast bars. This data enables selection of the optimum size of fly ash to meet specific property requirements. Attempts are underway to develop stir casting techniques to incorporate 'C' type fly ash in cast aluminum alloys. (See Highlights). It is expected that the next milestone for making trial parts will be completed on schedule by June 1999.

Milestones:

Milestone 1 was met initially and iterates over project quarters. Milestone 2 was met for type 'F' fly ash (M-2: The optimum mix of fly ash and aluminum as well as the processing techniques capable of meeting the quantitative property requirements of the candidate components based on making tests samples and subsequent tests.) Milestones 1 and 2 are referenced in fax to P. Hughes dated September 4, 1997.

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Richard Rhudy, The Electric Power Research Institute (EPRI)
Dr. Pradeep Rohatgi, University of Wisconsin-Milwaukee (UW-M)
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Highlights:

- Wisconsin Electric provided both Class 'C' and 'F' type fly ash for comparative analyses of properties, component structures, and downstream parts production processes.
- A 300lb heat of ash alloy containing 'F' type fly ash using stir casting technique has been made at Eck Industries to gravity cast Tensile Bars, Brake Drums, and K Mold Stepped Bars.
- 'C' type fly ash was incorporated into aluminum alloy (A356) using a stir casting technique under laboratory conditions at UWM and industrial conditions at Eck Industries. However, the particles are agglomerated along with some porosity.
- Thompson Aluminum Casting (TAC) sectioned and analyzed Ash alloy ingot from UWM and Eck. Subsequently, TAC poured castings for analysis by the laboratory and UWM.
- Class 'C' fly ash was screened and deagglomerated using Air Jet Screening Equipment. However, there is a tendency to reagglomerate very quickly when exposed to air.
- The 'C' type fly ash was heat treated at UWM. The resulting sample was ground and screened. The coarser particles (larger than 75 microns) show good flowability and no agglomeration. However, part of the fly ash particles was sintered during heat treatment.

Progress:

Fly ash ('F' type) has been successfully incorporated into aluminum alloy (A356) melts both at UWM and the foundry, Eck Industries. Also, Ash alloy ingots have been successfully remelted at Eck Industries and cast into Brake Drums, Tensile Bars and K Mold Stepped Bars to measure modulus. It was observed that particle size consistency should improve parts properties significantly.

The second foundry, TAC, also remelted ingots from both UWM and Eck for parts casting. TAC observed that there appears to be a factor of 2 improvement of properties when parts are squeeze casted rather than traditional permanent mold casted.

Experiments on pretreatment of 'C' type fly ash as well as on synthesis of ash alloy are still ongoing.

Milestones:

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

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