Commercialization of Production Foundry Molds Made from Coal Combustion Byproducts (CCBs) for High Volume Automotive Applications

Promoting and supporting the commercially viable and environmentally sound recycling of coal combustion byproducts for productive uses through scientific research, development, and field testing.

Department of Energy National Energy Technology Laboratory

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Project Partners:
Energy Industries of Ohio
General Motors
Foundry Research Institute
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Project Objectives

- Investigate the feasibility of utilizing CCBs as a substitute for foundry sands
- Promote the use of CCB material by the automotive industry

Background

Currently, CCBs such as fly ash or bottom ash and spent foundry sands end up in landfills. These materials have much more in common than just being large volume byproducts of important industrial processes. CCBs are mostly amorphous in structure, they have a high melting point, and they have particle sizes similar to that of fine silica sand used in metalcasting.

Description

The research team is investigating the feasibility of utilizing CCBs as a substitute for foundry sands, replacing a portion of all of the virgin silica sand used for foundry molds and cores. This research builds upon an earlier study by defining and optimizing ash materials and then demonstrating their use as a suitable replacement for foundry sand. The defined/optimized materials will be subjected to actual qualification testing in a "live fire" production environment at General Motors Corporation's Powertrain Casting Plant in Defiance, Ohio. Actual molds and/or cores will be made from both currently available ashes and ashes that contain higher carbon content expected to result from future environmental requirements.

By demonstrating that various model core shapes and types can be produced using different ash/binder systems and successfully subjected to the casting process, the castings produced may be used as components in automotive production. As a quality control test, the surface finish and metallurgical properties of the trial castings will be compared to castings made from silica sand with the overall goal of having the CCB material qualified for use (commercialized) by the automotive industry.

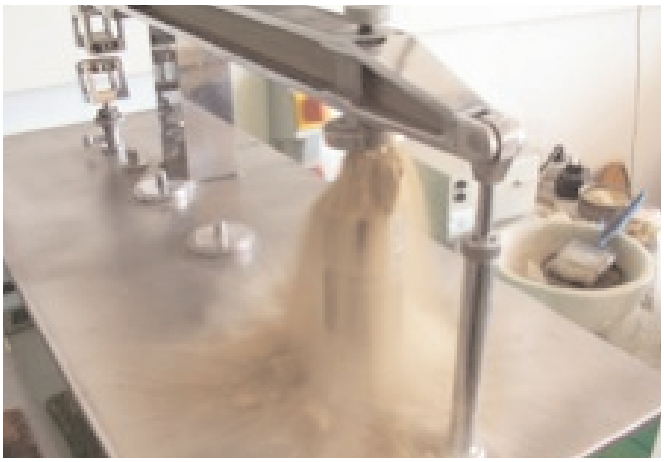
Preliminary Results and Status

The project team received fly ash samples from First Energy and sample mold/cores from General Motors. The fly ash came from the East Lake power station and consists of ash derived from blended coal that includes high sulfur eastern coal. The General Motors' cores came from an actual production lot in order to determine what is presently producing a quality product. Testing and analysis of the fly ash and cores and a profile of the characteristics of the current core/mold material is complete.

Researchers performed various trials of binder systems to insure that the current core/mold materials can be duplicated. They tried a number of combination organic/inorganic systems to determine the most likely process to yield success. Results indicate that using a combined binder system and employing a simple baking technique to remove the organics from the core/mold results in a very usable product with various levels of fly ash up to 100 percent.

Initial laboratory testing of the core systems is complete. Process sheets outlining the precise steps for producing these in a production environment are being finalized into "routers" or work instruction documents. This will insure that the laboratory experiments can be duplicated at the working foundry.

The demonstration project at the Casting Development Center will rely upon the process routing sheets to produce fly ash molds and cores. This task will validate the instructions as prepared or permit any fine-tuning needed for a production environment before "transporting" the process to the actual working foundry at General Motors' casting plant in Defiance, Ohio, for on-site demonstration, testing, debugging, and further processing.



Compression test at point of failure

Pour test using iron