SPONSORED RESEARCH

Alternative Granular Media for Green Sand Casting

RESEARCHERS: S. Ramrattan, M. Alsagour and D. Moradinezhad, Western Michigan University

Impact: Replacing silica sand with non-silica alternatives for use in green sand casting can help foundries comply with new regulations on respirable silica, protect workers, and minimize additional compliance costs that would be associated with silica sand use, such as additional engineering and ventilations controls, as well as medical surveillance and testing.

Technical Need

Newly enacted legislation regulating silica dust exposure in the foundries may lead some smaller foundries to the eliminate silica altogether and use alternate, non-silica material for sand molding. However, there had been little published research to validate that ceramic and other non-silica media could be effectively used in clay-bonded green sand casting operations. AFS contracted Western Michigan University to validate non-silica molding media for use in green sand casting. The study also examined reclamation processes to determine breakdown of the media during potential in-house reclamation and reuse, which is key to economic viability of some alternative materials.

Project Goals

The purpose of the research is to validate if non-silica media can offer satisfactory molding performance and economic advantages when in-plant recycling and reclamation processes are used. The study is limited to clay-bonded green sand, so a basic requirement for any media is whether it can bond together with bentonite clay and water. Any alternative media must substitute for silica sand and produce mold quality equal to or better than the silica mold. Any alternative molding medium must also offer the foundry measurable benefits in terms of cost, availability, environmental compliance and casting quality.

	Primary Composition and Technology
A	Al_2O_3 - Sintered
B	Al_2O_3 - Sintered
C	Al_2O_3 - Fused
D	Al_2O_3 - Fused
E	Olivine sand melt processed & granulated
F	Al_2O_3 - Natural Blend
G	SiO_2 - Natural (Control)

Granular Media Selected for Study

Technical Approach

The project will document the baseline properties of various alternative green sand systems at a defined clay level and compactability. Multiple different commercially available non-silica granular materials were tested. A typical silica sand used in the foundry industry was used as a control sample for comparison. All alternative media tested represented the grain size used in a typical cast iron green sand system (targeted 55-60 AFS-GFN) with no more than three screen distribution. Standard sand testing and newer dynamic sand tests were conducted on the as-mulled green sand at a target compactability level (35%). Methylene blue clay and AFS clay provided information relating to the bond, and LOI indicated the percent carbonaceous material present. Standard AFS 2x2 specimens were used for testing, following the procedure in the AFS Mold and Core Test Handbook. Additional sand tests included the hot friability, hot permeability, modified cone jolt and wet tensile tests to detect additional differences. A pulverization test was developed to determine the durability of the various granular media and mimic the breakdown of foundry sands during molding, melting, filling, shakeout and reclamation.

Findings and Conclusions

This research has identified several alternative non-silica media that will provide superior green sand properties. The study showed that alternate materials are suitable for reclamation. Changes in sand processing will be required as different alternative green sand systems required varying amounts of moisture to achieve the target compactability. In addition, mulling time and behavior varied for the different material systems. Certain granular media are tougher and more wear-resistant during use and reclamation.