SPONSORED RESEARCH

Evaluation of Alternate Aggregates for Use in Green Sand Systems

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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 costs associated with continued use of silica sand, such as additional engineering and ventilations controls, as well as medical surveillance and testing.

Technical Need

The new regulation by Occupational Safety and Health Administration (OSHA) reduces the permissible exposure limit (PEL) for respirable crystalline silica. This will require foundries to implement extensive engineering controls, which can be cost prohibitive for small to medium-sized metalcasting facilities. One possible solution for foundries will be to utilize a non-silica aggregate in their green sand systems. 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 the University of Northern Iowa to investigate non-silica molding media for use in green sand casting.

Project Goals

Identify alternate aggregates and characterize for baseline properties to help utilize non-silica aggregates within green sand systems.

Sample step-cone casting used in the study

Technical Approach

Performance testing consisted of testing two aggregates over several cycles for green sand properties, core sand properties and casting quality. One thousand-pound batches of green sand were prepared from each aggregate using 8% western bentonite and 1.6% sea coal. Step-cone cores were produced using a phenolic urethane cold box binder system, using a resin content of 1.25% based on sand weight. Tensile strength tests were conducted using the core sand and PUCB resin. Double step-cone molds, weighing 330 lbs. each, were prepared using the green sand mixture. Step-cone castings were poured using class 30 grey iron, using a pouring temperature of 2600 °F. The resulting castings were photographed and evaluated. Additionally, thermal expansion tests were conducted on the green sand mixtures for each cycle. Sinter temperature was calculated from the thermal expansion results. After each cycle, shakeout green sand was separated and sent to an outside lab for reclamation using a wet reclamation process. Reclaimed sand was evaluated for AFS clay and M.B. clay and used as core sand for subsequent cycles. Step-cone cores and tensile specimen were produced using the reclaimed sand. The step-cone castings were evaluated for veining and penetration defects using a ranking methodology.

Findings and Conclusions

From the results, both ceramic aggregates were observed to have a better performance in attrition, core sand tensile strengths and green sand strengths, when compared to silica sand. Both ceramic samples were measured to have similar green sand strength properties. No veining defects were observed in the castings from both aggregates. Comparing the two ceramic aggregates, Ceramic A was observed to have higher green sand permeability, when compared to Ceramic B. Further, Ceramic A was generally observed to show lower sinter temperature across all cycles. The sinter temperature results were further verified by the castings, where Ceramic B showed a larger extent of penetration defects in the thicker sections of the castings. This trend was observed over all cycles conducted.

For a copy of the final report, more information on this project or other **AFS Research**: contact the **AFS Technical Department** at 847-824-0181.