Application of 3D Printed Sand Molding for Complicated Castings

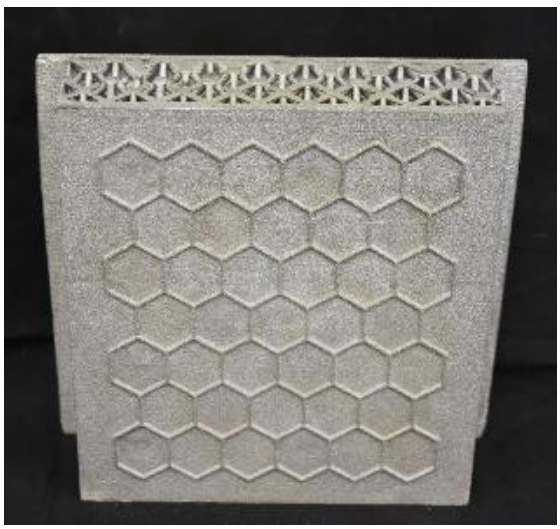
AMC
AMERICAN METALCASTING CONSORTIUM

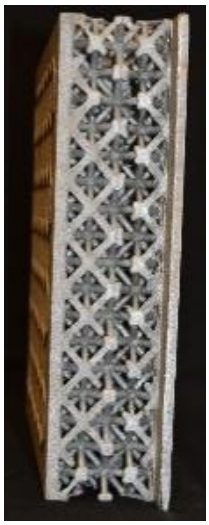
Program Overview and Objectives: The AMC research project lead by Virginia Tech and sponsored by the American Foundry Society (AFS) is using 3D printed sand molding for the production of complex, metal-ceramic composite castings. This gives the designer significantly more freedom than conventional green sand or bonded sand molding. The project builds upon prior research in 3D printed sand molding and the design of complicated, energy absorbing castings containing ceramic or hard metal inserts to scale-up and implement this technology in a variety of materials and applications.

SUCCESS STORY

Problem: Low volume castings are extremely expensive and have long lead times due to the production of tooling. Lattice structures are lightweight and can effectively absorb and dissipate energy during a crash, but are difficult to produce and cannot be cast using conventional molding techniques.

Solution: This project is demonstrating that complicated castings, such as metal-ceramic composite lattice castings that can be used in energy absorbing applications, can be produced using 3D printed sand molding. Modeling the performance of these castings is also being done to enable them to be designed to meet critical design requirements and constraints.





Complex lattice casting produced by Eck Industries in A206 alloy reinforced with 1% TiC nanoparticles

Benefits: Robust mold designs that take advantage of the 3D printed sand process have been demonstrated to be capable of producing features as small as 3 mm diameter in non-ferrous and ferrous alloys. Modeling has shown that a 42.5 mm thick, solid block of aluminum alloy A356 would produce similar energy absorption results to a cast 65 mm thick lattice containing 6 mm thick SiC tiles. The cast lattice structure with SiC tiles and a nano-reinforced A206 aluminum alloy would result in a weight savings of approximately 18% and would absorb energy instead of transferring loads. 3D printed sand molding is a cost-effective solution for producing complex castings at low volumes and can benefit research programs, new product development, and legacy castings.

"That fact that we were able to successfully produce a complex lattice casting with no hot tears using a 3D printed mold in a production foundry demonstrates the potential of nano-reinforced aluminum alloys to produce large cast structures out of strong alloys, eliminating one of the major impediments to their use."—

David Weiss, VP Research and Development, Eck Industries

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