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Paper coating techniques may improve metal casting quality

The Department of Defense (DoD) needs lighter equipment to be able to move quickly. One way to make lighter equipment is to produce lighter castings, which means producing castings with thinner walls.

The goal of a multi-year DoD research grant overseen by the American Metalcasting Consortium is to develop the data on coatings that could lead to improved castings.

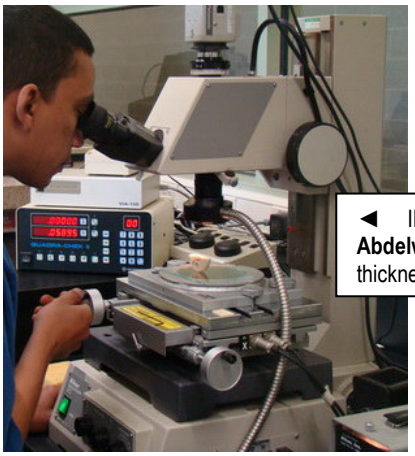
The principal investigators (PIs) of the grant research are **Dr. Sam Ramrattan**, Department of Industrial and Manufacturing Engineering (IME), and **Dr. Margaret Joyce**, Department of Paper Engineering, Chemical Engineering, and Imaging (PCI). Assisting the two professors is IME graduate student **Adil Abdelwahab**.

Ramrattan, a metal casting specialist, and Joyce, whose expertise includes paper coatings, are pooling their talents to evaluate how potential coatings used in the paper industry could improve the casting process.

"Multiple industries are seeking coating to add value to their products," Joyce said. "The basic components of foundry and paper coatings are similar. We have much to learn from each other's industries."

Coating paper is a well developed science; however, coating is relatively new in metal casting. "We can't use the types of coatings, but we can use similar coating control techniques in metal casting and we're coming up with alternative testing techniques, several of which we have borrowed from the paper industry," Ramrattan said.

When hot molten metal is poured into a sand mold, the heat causes the mold to expand, which leads to cracks and defects in the product. The heat can also dislodge grains of sand, which end up in parts where they are not wanted. "The defects can be extremely harmful if the part is a block or a coated head in an engine," Ramrattan said.



◄ IME grad student **Adil Abdelwahab** examines coating thickness under a microscope

To offset these problems, the research team is testing refractory coatings as interfacial barriers between the mold wall and the metal. "Having the right coating can lead to a smoother casting with a better surface finish," Ramrattan said. "It can also prevent sand from getting into the metal and eliminate cracking."

Dr. Sam Ramrattan

Dr. Margaret Joyce

In addition to finding the right environmentally-acceptable coating and determining the right amount to use to produce a quality casting is finding a way to be sure that the quality of the coating remains consistent throughout repeated use. Because the sand used in casting is recycled, particles in the coatings can settle out as the coating is reused.

"A control mechanism is needed to make sure the particles are not settling out, to maintain consistent coatings quality throughout the process," Ramrattan said.

According to Ramrattan, the current testing gauges in the casting industry are not designed for coatings used in the paper industry, but controlled tests measuring rheological characteristics in the paper industry show potential in the development of instruments for casting. "We are developing testing techniques and instruments for sand casting that included modified permeability and mold quality index tests," Ramrattan said.

Other research discoveries are related to the optimal dip time for refractory molds, data related to the effect of coating deposits that can affect the permeability of the dipped mold, which indirectly affects the casting quality, surface finish, dimensional properties, and other qualities.

Ramrattan said the first-year findings were officially reported to the DoD Logistics Department in June. "This is year-to-year work, and everyone seemed satisfied with our findings," he said. "We are continuing our search for a means to improve coating and to reduce defects."

For more information on this project, contact Ramrattan at sam.ramrattan@wmich.edu or Joyce at margaret.joyce@wmich.edu

Send your thoughts or suggestions for future topics to the editor at jerrie.fiala@wmich.edu Thank you.