Sweet new approach discovered to help produce metal casting parts, reduce toxicity

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Simple table sugar may be able to replace some of the toxic chemicals now used as binders in sand molds for the multi-billion dollar foundry industry. Credit: Oregon State University

(Phys.org)—Based on a new discovery by researchers at Oregon State University, the world's multi-billion dollar foundry industry may soon develop a sweet tooth.

This industry, that produces metal castings used in everything from water pumps and jet engines to railroad and automobile parts, dates back thousands of years to before Greek and Roman times. It was important in the advance of human civilization, but still continues to evolve.

Some modern technologies use various types of "binders" to essentially

glue together sands and other materials to form sophisticated molds, into which molten metals are injected to create products with complex shapes. Existing approaches work, but some materials used today, such as furan resins and phenol formaldehyde resins, can emit toxic fumes during the process.

However, experts in adhesion science in the OSU College of Forestry have discovered and applied for a patent on a new use of a compound that appears to also work surprisingly well for this purpose. They say it should cost less than existing binders, is completely renewable and should be environmentally benign.

It's called sugar.

"We were surprised that simple sugar could bind sand together so strongly," said Kaichang Li, an OSU professor of wood science and engineering. "Sugar and other carbohydrates are abundant, inexpensive, food-grade materials.

"The binder systems we've developed should be much less expensive than existing sand binders and not have toxicity concerns," Li added.

Sugar is a highly water-soluble food ingredient, as anyone knows who has ever put a teaspoon of it in a cup of coffee. The OSU researchers discovered a novel way to make strong and moisture-resistant sand molds with sugar. An inaccurate reading of temperature in a baking oven helped lead to the important discovery, they said.

Li and an OSU faculty research assistant, Jian Huang, identified combinations of sugar, soy flour and hydrolyzed starch – or even just sugar by itself – that should work effectively as a binder in sand molds for making various types of metal parts.

This novel sand binder technology is ready for more applied research and testing, they said, and the university is seeking investors and industrial partners to commercialize it. Private sector financing of OSU research has increased 42 percent in the past two years, to $35 million, as part of its increasing emphasis on university/industry partnerships.

Sand-based moldings, which comprise about 70 percent of all metal castings, are used to make many metal products, often from aluminum or cast iron, but also from bronze, copper, tin and steel. They are a major part of the automobile industry, along with applications in plumbing materials, mining, railroad applications and many other areas.

Sugar and the other agricultural products used for this purpose should have no environmental drawbacks, since they largely decompose into just carbon dioxide and water. With the techniques developed at OSU, the use of sugar as a binder allows the creation of sand molds that gain strength rapidly and remain strong in high humidity environments, which is necessary for their effective use in industrial applications.

Li's laboratory at OSU has developed other related products in recent years, such as a natural resin made from soy flour that is already being used commercially to replace the use of formaldehyde-based adhesives in the manufacture of some wood products.

For that achievement, five years ago he was given the Presidential Green Chemistry Challenge Award by the Environmental Protection Agency, which recognizes innovators who have helped reduce waste or toxins in manufacturing processes.

Provided by Oregon State University

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