



ORNL and licensee MVP join forces to make thermoset materials an option for large-scale 3D printing

Oak Ridge National Laboratory (ORNL) and Knoxville, Tennessee-based Magnum Venus Products, Inc. (MVP) have successfully created and deployed the world's first large-scale thermoset additive manufacturing machine.

The Reactive Additive Manufacturing (RAM) machine is the first product of its type and capabilities commercially available to industry for 3D printing of thermoset materials. RAM allows for a wide range of applications including low-cost fixtures, tools, and autoclave molds for a variety of industries such as marine, tub and shower, automotive, and aerospace.

Thermoset materials have a number of advantages over thermoplastics in additive manufacturing. Layering times with thermoset materials are shorter, printing requires less energy, and the cross-linking of polymers between printed layers results in stronger products that are more tolerant of high temperatures.

With a current print area of 16' x 8' x 3.5', the RAM machine has the ability to produce large-scale parts, in various resolutions, using thermoset materials. The patent-pending removable table decreases print-cycle time and streamlines post processing.

"Thanks to this innovation, research and development managers will be able to prototype faster and bring products to market faster," said Bob Vanderhoff, CEO of MVP. "Procurement departments will also enjoy shortened lead time on crucial molds—allowing for rapid deployment. This was made possible through ORNL software that allows the integration of multivariate print process parameters."

At ORNL, partnerships with industry—the additive manufacturing industry in particular—are a key success factor.

"Our researchers are delivering innovative breakthroughs in additive manufacturing to improve material properties and process technologies," said Moe Khaleel, associate lab director for Energy and Environmental Sciences at ORNL. "We value working closely with our industrial partners like MVP to ensure we're accelerating the path for commercialization to increase American competitiveness."

MVP is a leading manufacturer of composite application equipment for manufacturers in industries including automotive, aerospace, transportation, marine, railway, and oil and gas, and wind energy. Along with systems designed for composite application, MVP also has equipment that supports the foam and



Above: Printer head for MVP's Reactive Additive Manufacturing machine

polyurethane industries including polyurea, adhesives, and epoxies.

MVP has worked with ORNL under two cooperative research and development agreements (CRADAs). The funding for the first CRADA exceeded \$500,000 over 24 months, and led to the demonstration of additive manufacturing of thermoset cellular structures. Funding for the second CRADA was \$8.2 million over 36 months, focused on continued development of large-scale reactive polymer additive manufacturing platform and techniques to enable rapid 3D-printing of large objects.

In the second CRADA, MVP agreed to allocate \$4.1 million for in-kind contributions over three years, offering continued product research and development with ORNL. In addition, MVP has allocated equipment, technical expertise and assembling personnel to assist in the development.

ORNL licensed two technologies to MVP. The first was a non-exclusive license for the Reactive Polymer Fused Deposition Manufacturing technology solely developed by ORNL, which features patented methods and compositions for additive manufacturing that include reactive or thermosetting polymers, such as urethanes and epoxies.

The second agreement was an exclusive license for a segmented build platform co-developed by MVP and ORNL. MVP plans to exhibit the codeveloped system at tradeshows worldwide, produce marketing content and contributions to demonstration case studies. ☺