Ceramic injection-molding technology produces cheaper, stronger complex ceramic parts

July 19 2016

Cars, rockets, cell phones and many other items could soon be manufactured faster, greener, less expensively and with more precision than traditional methods thanks to a ceramic engineering company commercializing a Purdue innovation.

Scientific Ceramic Engineering has licensed a Purdue ceramic injection-molding technology that utilizes room temperature molding, low-pressure machinery and less toxic materials to produce stronger, faster and less-expensive complex ceramic parts for a multitude of industries.

"A lot of people don't realize that ceramics and ceramic engineering are integrated in a lot of different everyday objects, from toilets to tiles to television sets and brick walls," said David Forster, CEO and co-founder of Scientific Ceramic Engineering. "The automotive industry is the biggest user of the world's metal and ceramic parts, using about 20 percent. Medical, health care, aerospace, dental, industrial machinery and electronics are also key industries that use ceramic parts. The metal and ceramic industry alone is expected to grow to $3.5 billion annually by 2020."

Matthew Kuhns, SCE's chief technology officer, said ceramic materials are generally used because of a range of benefits.

"Ceramic materials encompass high hardness and mechanical strength,

dimensional stability over a wide range of temperatures, wear and corrosion resistance, and great electrical insulation, making it a great material for a plethora of different devices and objects," he said. "However, its hard-to-use structure makes it difficult for ceramics to be a viable option for complex parts that require tight dimensions. Ceramic parts are extremely fragile prior to sintering and the hardness of the material, which makes machining processes difficult and expensive post-sintering, deterring manufacturers from using it."

SCE's innovation uses an injection molding technology to form high-temperature ceramic parts with complex dimensions by taking advantage of temperature flow properties of water-based ceramic suspensions. The molding technique lets ceramic materials be machined with high precision and accuracy.

"Traditional molding ceramic manufacturing requires very high heat and pressure environments that also uses toxic materials, which can cost companies a lot of money and are bad for the environment," Forster said. "Traditional methods can also take a long time to process while only being able to manufacture few iterations, so customers aren't able to test multiple versions of their design."

Kuhns said SCE's ceramic injection molding technology could provide customers with distinct advantages over traditional manufacturers.

"Our technology combined with a rapid die technology shortens cored ceramic casting processes from a usual 24 weeks to about 8 weeks, a 66 percent reduction in process time. This allows customers to get their products to market faster for a competitive advantage," he said. "Unlike traditional manufacturing, our system does not need to be heated and cooled before use, allowing quick preparation and machine changeover and saving on company overhead costs. Parts are sintered by slow-rising temperatures without the need for any pressurizing.

"Our products also use a non-toxic, water-soluble binder. This binder has proven to be so safe it's commonly used in oral medicines, soaps and surgical scrubs."

The technology also provides consistent dimensions after sintering for reliable accuracy and improved strength and toughness for a stronger finished product, Kuhns said.

Scientific Ceramic Engineering licensed the innovation through the Purdue Research Foundation Office of Technology Commercialization. SCE is a member of the Purdue Startup Class of 2016. Twenty-seven startups based on Purdue intellectual property were launched in the 2016 fiscal year. SCE intends to first market its technology to the aerospace industry.

"The aerospace industry relies heavily on advanced ceramic parts such as alumina, silicon nitride and aluminum nitride to make up high-efficiency and cost-effective technologies for space travel," Forster said. "Many critical aerospace components are made out of advanced ceramics because of their advantageous physical properties, making it a perfect material for use in aircrafts, space shuttles and aerospace equipment."

Scientific Ceramic Engineering is working to prove its process.

"Through cooperative research we have proven our ability to inject a mold with the ceramic materials, and after conducting several tests we plan to prove that the material properties of the parts are in fact consistent with parts proved in traditional means," Forster said. "Once we prove our process works we look forward to finalizing our commercialization approach and getting our product to market."

Provided by Purdue University