



Safer Coatings for Molds Used in Manufacturing

GVD Corporation
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Environmental Problem

Many consumer products—including virtually all everyday products with plastic or rubber parts, like kitchen utensils, children’s toys, shoe soles, combs, keyboards, DVDs, automotive tires, casings and packaging—and industrial and medical devices are manufactured with parts made using molds. To free the parts from those molds, manufacturers use special coatings. These coatings typically are made of organic solvents that release volatile organic compounds (VOCs) during the drying and curing process. VOCs from mold-release coatings negatively affect air quality. They have been linked to health problems such as eye, nose and throat irritation; headaches and nausea; loss of coordination; and damage to the liver, kidney and central nervous system.

Alternative mold-release coatings that are water-based also contain some chemicals that can be harmful to people. One such chemical, perfluorooctanoic acid (PFOA), is used to produce Teflon®-like mold-release coatings for a wide range of mold types, including rubber, compression and plastic molds. The coating reduces mold “stickiness” just as the fluoropolymer Teflon® prevents food from sticking to cookware and stains from sticking to clothing. Because of its use in fluoropolymer manufacturing, PFOA is found widespread in the environment. The chemical persists for a long time in the human body and can lead to cancer. The U.S. Environmental Protection Agency (EPA) recognizes the dangers of PFOA.

In 2006, EPA invited eight major fluoropolymer manufacturers to join a global stewardship program to eliminate PFOA and related chemicals by 2015.

SBIR Technology Solution

With support from EPA’s Small Business Innovation Research (SBIR) Program, GVD Corporation created a mold-release coating made of highpurity polytetrafluoroethylene (PTFE) that uses no organic solvents or PFOA. As a result, air quality is improved inside manufacturing facilities. These facilities, in turn, release less toxic emissions into the environment. To apply the coating, GVD developed a novel vapor deposition process called initiated chemical vapor deposition (iCVD). In GVD’s iCVD process, a Teflon®-like coating is created on mold cavities by heating the coating chemicals, which are in



Mold coating takes place in a fully automated chamber (above) without exposing workers to toxic chemicals (below).



gas form, on a metal filament while the surface of the mold stays at room temperature. This process helps keep machine operators safe from chemical exposure, maintains cleaner facilities and eliminates the energy-intensive drying or curing step after application. In addition, molds do not need to be cleaned as frequently, further decreasing operator exposure to harmful substances. A greener process reduces consumers' exposure to any residual chemicals from the final products.

GVD's technology uses less energy because the coating can be applied at lower temperatures than those required for conventional application methods. In addition, the thin coating (0.01 to 20 μm —about one-fifth of the thickness of a human hair) uses and wastes fewer raw materials. Another major advantage of GVD's technology is that it can coat molds made of virtually any material. Because it forms from a gas, iCVD also produces uniform coatings even for molds with very small features or difficult geometries like undercutting. As a result, the common problems of excess pooling, buildup and thinning of coatings in critical areas are eliminated. In addition, during the application process, GVD can optimize the coating's specific characteristics, such as surface energy, adhesion and durability.

Commercialization Success

EPA's SBIR funding has helped GVD Corporation partner with a major automotive parts manufacturer who uses GVD's vapor-deposited PTFE mold-release coatings to streamline tire manufacturing. Millions of tires produced using GVD coatings are now on the road. GVD also has partnered with a major semiconductor parts manufacturer, providing dry-film lubricity services for applications such as gaskets, O-rings, seals, plungers and stoppers. A technology that offers exceptional lubricity will allow engineers to create highly complex, intricate designs that will be safe from tearing during release. Additional applications of GVD's coating

technology are in the consumer, electronic, medical and semiconductor industries. GVD coatings can be used for mold release, dry lubrication, electronics protection and custom coating solutions. GVD's coatings are especially beneficial for electronics protection (e.g., printed circuit boards, radio frequency electronics, sensors, LED boards).

Company History and Awards

GVD Corporation was founded in 2001 as a spinout company from a technology developed in the Department of Chemical Engineering at the Massachusetts Institute of Technology (MIT) in the laboratory of Dr. Karen Gleason, co-founder of GVD. With its headquarters based in Cambridge, Massachusetts, GVD has a manufacturing facility located in Greenville, South Carolina. GVD has received funding for its innovative technology platform from the National Science Foundation, Department of Energy, National Institutes of Health and Department of Defense. GVD's co-founder, Dr. Hilton G. Pryce Lewis, has a long history of research in environmentally benign alternatives to current manufacturing practices. In 1999, he Received the SRC/SSA SEMATECH Excellence Award for Research in Manufacturing and Environment, Safety and Health. In 2014, GVD received a MassVentures START award in a competition hosted by the Commonwealth of Massachusetts. With 15 permanent employees, GVD Corporation has been profitable since 2003. GVD predicts that sales will grow to \$10 million within the next 3 to 5 years as the company expands its operations in the Southeast United States and establishes additional service centers in Europe and, ultimately, Asia.

