**Modified RIM Process for Electronic Encapsulation of 'Smart Cards'**

Reaction assisted molding process (RAMP), an offshoot of RIM, has been developed by CardXX of Englewood, Co., to encapsulate electronics into 'smart cards'. Whereas RIM is based on high pressure and high temperature dispensing of polyurethane, the new proprietary RAMP technology is based on low pressure and low temperature. CardXX has been awarded a U.S. Patent for utilizing RAMP as a method for manufacturing Smart Cards. The RIM equipment selected for this application is from Graco Inc.'s Gusmer | Decker RIM group, Lakewood, N.J. CardXX' director of business development Paul Reed attributes this to the equipment's "unique ability to deliver very small, gram-level quantities of reaction injection molding material reliably and accurately."

RAMP is being used to securely integrate a radio frequency identification chip and antennae, an integrated circuit, and other electronic components, including batteries, into a 'small form factor' smart card, such as standard credit card, key fob, smart tag, memory cards and other similar devices that fit into a person's palm. As with standard 'smart cards', RAMP precisely positions computer chips and electronic components within a mold between two sheets of PVC, Polycarbonate (PC), or other suitable film. However, a polyurethane is then injected at low temperature and low pressure to completely immerse the electronic element. The electronic element is securely encapsulated when curing is completed in under an hour.

According to CardXX, the PUR adds flexibility and durability, provides high bonding strength (20-30 lb/in), and has excellent thermal stability with a transition temperature of approximately 250 degrees Fahrenheit. The complete encapsulation of electronics in PUR reportedly provides superior protection, impact resistance, and shock absorption. Also, it provides improved manufacturing efficiency compared to "mill and glue" lamination-based smart card.

RAMP utilizes high-pressure impingement mixing, and low pressure dispensing into the mold cavity. The PUR is dispensed at a low temperature of about 100 F. Pressures achieved in the mold cavity are approximately 50-200 lb/sq.in. , depending on form factor and geometry of the cavity. Gusmer | Decker's RimCell Select Series metering and dispensing units are well suited to RAMP because they can be customized for mixing that yield low flow rates, which is needed to minimize the forces that might disrupt the high-precision placement of electronic components within the smart cards.

A customized RimCell Select high pressure 20 unit was coupled with the L-Style MixHead. The machine is designed with dual-switch station, which allows the operator to pour offline for prototyping without interrupting the RAMP production line. The L-Style MixHead is a direct impingement, self-cleaning unit that reportedly reduces pressure spikes and continuously purges the interior passages of any mixed material. This molding system allows a wide variety of shot sizes and fast cycle times while assuring metering accuracy with strict tolerances and its ability to provide low-temperature delivery enables high production volumes due to minimized cycle times.

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ART: RAMP Process.jpg

Caption: In this picture, the molds are moved along the conveyor from left to right. The open molds on the left will be closed by the mold closure apparatus directly in the center of the photo. After the molds are closed, they are conveyed to the RIM head apparatus. In the picture, on the far right, the closed molds can be seen approaching the RIM head station where the PUR is injected into the mold cavity after the mold is clamped at the station. After the PUR has been injected, the closed molds are conveyed to the left in the background to a demolding station after about 30 seconds of curing.