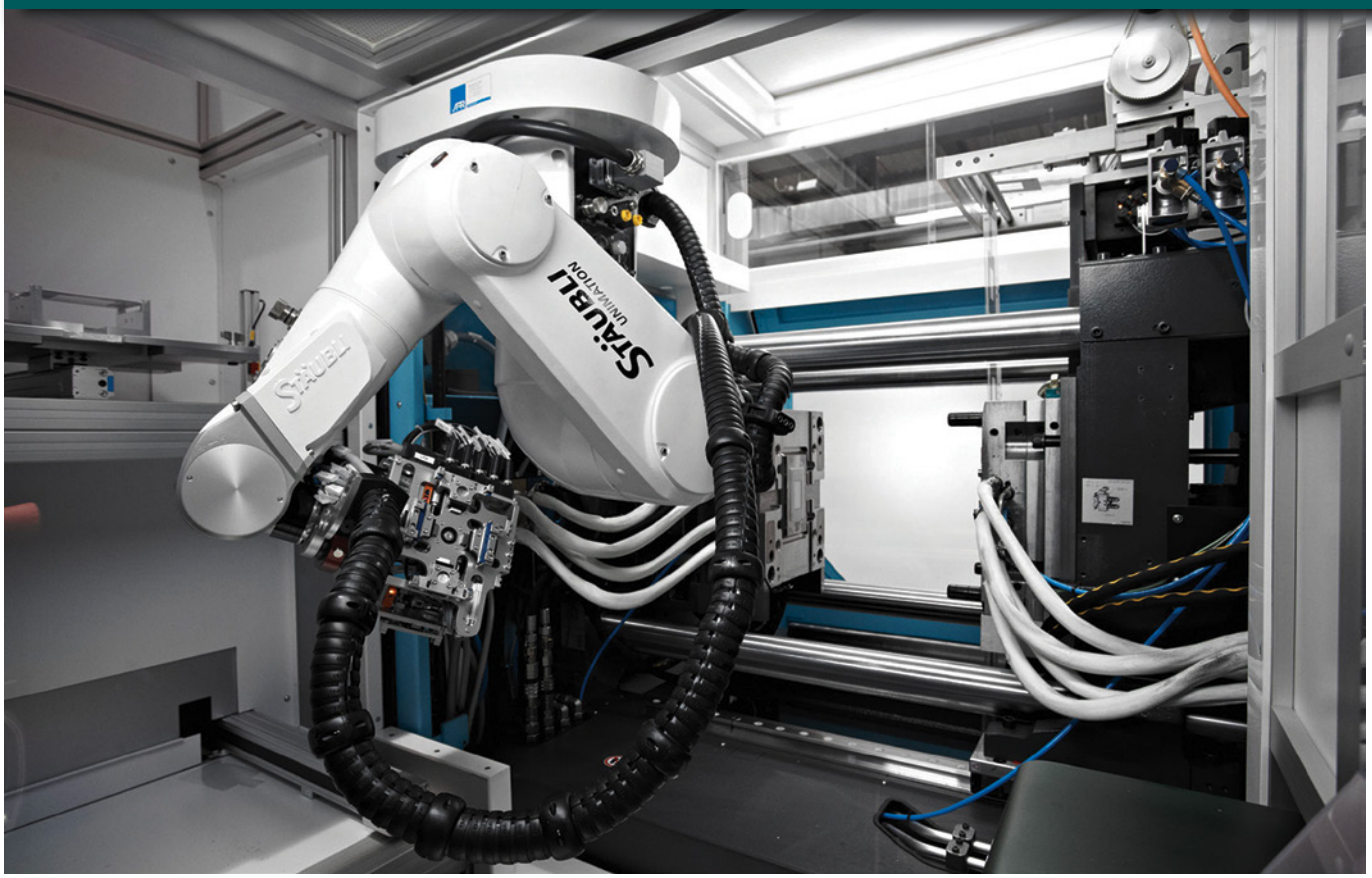
Sumitomo (SHI) Demag called on its expertise in combined IML and IMD systems for the automotive industry to develop a process for single-step production of touch-sensitive electronic panels



In touch with electronics

Electronic devices play an increasingly important role in modern life with most of us interacting with several every day. However, realising the interface between human and electronics can be both costly and complex. The latest developments in transparent conductive polymer foils open up new opportunities for manufacturing touch-sensitive interfaces. What's more, these foils lend themselves to today's state-of-the-art injection moulding techniques, presenting electronics companies with the potential to improve product design, simplify manufacturing and reduce cost.

Injection moulding machine maker Sumitomo (SHI) Demag demonstrated such a system during the Fakuma fair late last year, producing multi-function touch sensitive displays in a single production step. It combined the use of in-mould labelling (IML) and in-mould decorating (IMD) injection moulding technology with transparent conductive PolyTC foils developed by Germany-based PolyIC, a subsidiary of decorative foil manufacturer Leonhard Kurz Stiftung

PolyIC's PolyTC foils comprise a PET-based substrate which carries a thin metallic coating and high resolution conductor structure. The materials allow the production of extremely thin, flexible and transparent touch sensors that are said to be able to replace the more costly indium tin oxide (ITO) products used in the majority of touch sensor applications today.

Aside from the material cost saving, the PolyTC foils are also suited to roll-to-roll production, which uses digital print-based technologies to allow individually-adaptable conductor structures to be produced at high rates. The resulting functional foils are suitable for processing as single labels using the IML injection moulding technique to provide enhanced design

Main image: A single suspended robot with multiple sided gripper system takes on all handling operations in the complex touch-sensitive panel production process

Above: IML and IMD were combined to produce this multi-touch PolyIC display in a single moulding step – IML for function, IMD for decoration

freedom.

Sumitomo Demag worked with PolyIC and Kurz and a number of process and automation specialist partners to design a modular production system for combination of the IML/IMD processes based on a 210 tonne hydraulic Systec moulding machine. These partners included HBW-Gubesch Kunststoff-Engineering for the injection moulding tool, SAR Electronic for robot-supported automation, Max Petek for the clean room equipment, and Kist Maschinenbau for UV foil curing and cleaning.

The PolyTC production process developed by Sumitomo Demag is a novelty, but the modular system concept realised for production of the multi-touch display is based on IML/IMD installations supplied to the automotive industry, according to Markus Hausmann in Sumitomo Demag's technical marketing department. IML/IMD combinations are becoming common in the car industry, he says. Volkswagen, for example, uses 13 IML/IMD units for components in the Golf VII at its production site at Braunschweig in Germany.

This system concept has now been expanded to include magazine feeding and handling of the PolyTC sensor foils. "In this manner we were able to implement this unique new IML/IMD technology from PolyIC in a custom-tailored form using a practice-tested cell concept. An important aspect for users, who naturally place great value on maximum flexibility and availability", says Hausmann.

The system, which is based on a Systec 210-430 moulding machine, uses a single cavity mould from Emskirchen, Germany-based HBW-Gubesch producing a multi-touch PMMA display within a decorative frame. A feed unit from Kurz is installed on the clamping side of the mould space to insert a backing foil carrying a decorative coating of an individual image from above the mould into the cavity. This foil, which is also produced by Kurz, is positioned precisely in the mould during the tool closing operation.

At the same time as the decorative foil is being positioned, a suspended six-axis TX90 robot from Stäubli removes the PolyIC pre-cut functional foil label from the IML magazine and places it on the injection side of the mould tool. The foil is fixed precisely in the mould to a tolerance of ±0.2 mm and is retained in place by means of a vacuum. The mould is then closed and the PMMA injected through a film gate to produce the display panel.

Mould temperature regulation is achieved using a Variotherm tool tempering unit from GWK. The Systec machine is also equipped for transparent plastics processing with a multi-layer screw feed and a four-piece coated non-return valve , which ensures high melt quality and appearance.

During the injection moulding process, the decoration on the IMD foil separates from the backing and attaches itself to the front of the moulding while the IML functional foil is back-moulded to form the rear of the display. Electronic connection is provided by flexible film contact elements integrated within the PolyTC foil. In this manner, a transparent multi-touch display with a high quality decorative frame is produced in one shot.

To ensure proper function of the display the entire

From left to right: Placing of the PolyTC IML label on the injection side of the tool; Positioning of the decorative foil; Removal of the finished touch sensitive display

Right:The decorative IMD transfer foil, which runs through the tool from the top, is positioned precisely during the tool clamping operation

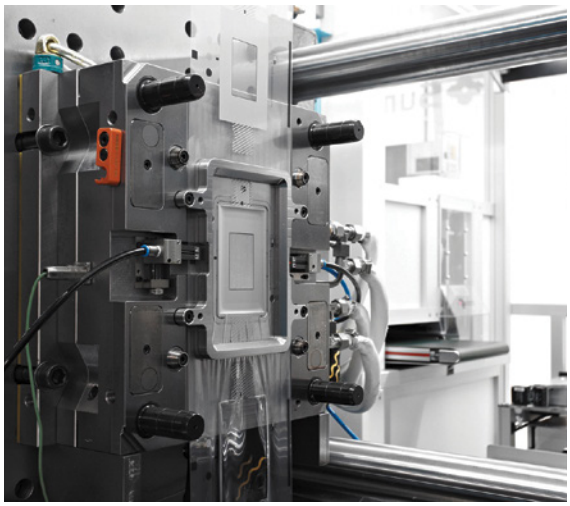
production is carried out under clean room conditions within a laminar flow module from Radolfzell, Germany-based Max Petek Clean Room Technology. This purifies the air coming in to the processing area using a filter fan unit. The system meets Clean Room Class ISO 7 requirements. However, the cell concept goes significantly beyond the usual requirements for this type of clean room module to include the machine and automation areas. This allows all subsequent processing steps, such as the separation of the sprue, UV curing and cleaning, to be carried out in encapsulated system modules which are sealed by bulkheads.

While all of the functional and decorative aspects of the display are defined in the mould itself, the finishing steps carried out outside of the tool play a major role in ensuring the quality of the final component. The six-axis robot uses a three-sided gripper system to remove the injection moulded display from the mould prior to inserting a new IML label, then places the component onto a workpiece carrier. The carrier transports the component to the encapsulated laser separation station, where a CO_2 laser with evacuation cleanly removes the film sprue. A separate conveyor belt removes the separated film sprue directly from the cell, while the component itself travels on in the workpiece carrier to the robot access area.

Below: The production system, including robotic automation, foil handling, clean room, foil cleaning and UV curing, is all contained within a single enclosure

The robot again picks up the display and transfers it to the Cleanmaster 3D UV curing unit supplied by Dresden, Germany-based Kist, where the finish from the decoration foil is hardened. The robot then picks up the component again and transfers it to the Cleanmaster 3D Combination cleaning station, which is located below the UV station. From here, brushes ensure careful and thorough removal of all of the foil residues from the peripheral edges of the moulding, with any separated particles again evacuated by vacuum.

"Here we use an absolutely practice-tested, reliable



form of cleaning for IMD production", says Hausmann. "Clean room tests have shown that, particularly on high gloss surfaces such as piano black, UV curing with subsequent cleaning is advantageous for removing traces of still unhardened finish paint."

Not all foils develop the same amount of flake. One of the benefits of Kist's Combination unit approach, according to Hausmann, is that the curing and cleaning sequence can be adapted to suit the sensitivity of the process and the tendency of the decoration system to create flakes.

The Sumitomo Demag production cell is based on a modular design, which makes it possible to use the same cell concept worldwide. Starting with the same basic equipment design, modules can be added or removed to achieve the desired degree of automation depending on the wage cost level at the production location.

In addition, the standardised interface between the injection moulding machine and automation ensures short start-up times and maximum flexibility, according to the company. Using a single industrial robot to perform all of the handling functions for the component and functional label contributes to quicker start-up and a reduction of overall system complexity. The suspended six-axis robot and extremely compact automation housing also reduces the floor space required by the complete cell to a minimum, says Sumitomo Demag.

Click on the links for more information:

- **www.sumitomo-shi-demag.eu**
- **www.kurz.de**
- **www.polyic.com**
- **www.jacobplastics.com (HBW Gubesch)**
- **www.reinraumtechnik.com (Max Petek)**
- **www.staubli.com**
- **www.gwk.com**