

Three at One Blow

KraussMaffei and Leonhard Kurz Optimize the Combined IMD and IML Film Processes

In one of the cavities, a control display is created in so-called dead-front design with a touch sensor. In the adjacent cavity, a component is made with faux-concrete surface aesthetics that can be lit from behind. At the Fakuma trade show, KraussMaffei and Leonhard Kurz demonstrate the degree of functional integration made possible by combining the IMD and IML film processes. The new IMD SI Duo film feed is the first-ever solution capable of positioning two decorative strips independently of each other. The first series application is already up and running.

Even larger and more complex: Ever since capacitive operation using touch surfaces began making its way into automotive interiors and electronic household appliances, the demands on plastic components have been growing. In addition to an attractive decor, the integration of various functions (e.g. electronic ele-

ments like touch sensors or certain surface properties) has been gaining in importance. And everyone wants fast production, too.

Virtually no manufacturer of premium quality visible parts can do without the IMD (in-mold decoration) and IML (in-mold labeling) film processes, since both

processes are so well suited to integration. In the IMD process, a printed film passes through the mold and transfers its coating package onto the hot plastic. This process can apply decorative and functional layers (top coats) at the same time, for example, to give surfaces anti-reflection or make them resistant to scratching.



The free space below the clamping unit creates the conditions for film routing, even for automation tasks with two film strips (© KraussMaffei)

The IML process is used to integrate touch sensors, which are inserted into the injection mold as single labels using a fully automated method. The special feature of the sensor label is an integrated primer layer that allows for inseparable adhesion to the plastic material. The more successfully these processes are intertwined, the more efficient production becomes.

Leonhard Kurz has been studying coating technologies in depth for a long time. The company develops paint finishing systems and devices for decorative and functional coatings applied to backing films. KraussMaffei is known as a manufacturer of precise injection molding machines and automation solutions. The two companies have now combined their knowledge to create an exhibit in regards to Fakuma. The fully automated system demonstrates how three individual processes can be implemented at the same time. A new development by Kurz is paving the way for this innovation. It is the patent-pending IMD SI Duo film feed, which was first presented at KraussMaffei's Competence Forum in June and has already been used by the two partner companies in initial series production.

Initial Independent Positioning of Two IMD Strips Yields Clear Benefits

Until now, IMD single-image decors could only be processed one at a time, especially if the article to be manufactured was not completely flat. Because a vacuum pulls the IMD film into the cavity after the stentering frame closes, the positioning of printed images was dependent on how the adjacent images were positioned. Here, there was a risk that at least one of the printed images would be compromised and, for example, the desired frame edges of a display would have a skewed appearance. This risk increased for components with more pronounced 3D geometry, as this meant higher film deformation.

This meant that multi-cavity molds only could process IMD continuous decors reliably. The IMD SI Duo film feed is the world's first-ever solution capable of positioning two film strips running side by side individually in the x- and y-directions, and it is accurate down to a few hundredths of a millimeter. As a result, it can supply two-cavity or multiple-cavity molds. This solution makes it possible to



Fig. 1. Compact and flexible at the same time: the all-electric PX 320 with integrated automation cell combines the IMD and IML processes (© KraussMaffei)



Fig. 2. Function and decor rolled into one: at Fakuma, a complete ten-inch HMI display in dead front design, with integrated electronics and top coat for scratch resistance, takes shape on the PX 320 in one production step (© Leonhard Kurz)

use different film designs, combine single-image and continuous decors and manufacture an extremely wide range of articles.

In the single-image area, film widths between 200 and 800mm are common. For example, the basic device of the IMD SI Duo can hold two films, each with a width of 200 or 300mm, and can be equipped with further options such as a cleaning function or a special braking system. For special projects, it is also possible to build custom designs by combining different roll widths or creating cube mold variations.

In any case, the films are positioned by sensor blocks attached inside the mold, which identify printed-on fiducial markers. Servomotors control the feed. To ensure process reliability, it is crucial that the feeding device, mold and film system are harmonized with each other – and Kurz has the expertise to make this happen. The whole IMD package must then be integrated into a high-precision injection

molding machine (and its control system) that leaves enough space for the unwinding and winding units of the film feed above and below the mold. One example would be the all-electric PX 320 from KraussMaffei featured at Fakuma (**Fig. 1**). At this point, the machine manufacturer assumes responsibility for production and automation.

For the automation task at the trade show, the two companies take functional integration to the next level. In the rear right cavity, an HMI (human-machine interface) display measuring 100x240mm² is created in the popular dead-front design with a UV-hardened layer of paint for scratch resistance and a touch sensor inserted using IML. The sensor activates a light source when the surface is touched, revealing previously invisible operation icons (**Fig. 2**). At the same time, in the second cavity (front left), the same component is created with faux-concrete surface aesthetics that can be lit from behind (**Fig. 3**). »

Project Partners

Visitors at the Fakuma trade show can check out the exhibit at KraussMaffei's booth (hall A7, booth 7303). The partners involved in the joint venture:

- KraussMaffei (PX 320 injection molding machine, automation)
 - » www.kraussmaffei.com
- Leonard Kurz (IMD SI Duo film feed)
 - » www.plastic-decoration.com
- Evonik (PMMA backing material)
 - » corporate.evonik.com
- Max Petek (clean room technology)
 - » www.cleanroomtechnology.biz
- Datronik (laser cell)
 - » www.datronik.de

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Fig. 3. In the second cavity of the same mold, a display trim that can be lit from behind is shaped with faux-concrete surface aesthetics (© Leonhard Kurz)

Fully Automated Process – from Film Insertion to Component Trimming

The entire process is fully automated. A six-axis robot removes the IML labels made of capacitive touch film (PolyTC Metal Mesh Sensor from a subsidiary of Kurz called PolyIC) from a drawer storage system, pulls the protective film off – a procedure that previously had to be done by hand – and inserts the label into the mold on the nozzle side. The PMMA flow-

ing in fills the space in front of the label and accepts the IMD coating package on the other side, which is connected to the PET backing film through a release layer. The coating package itself consists of the primer (which melts and forms a molecular bond with the plastic), the design layer and a “dual cure top coat.” The total thickness is about 15 µm. The coat has already been thermally cured.

The parts are removed again by the six-axis robot, which, in contrast to the

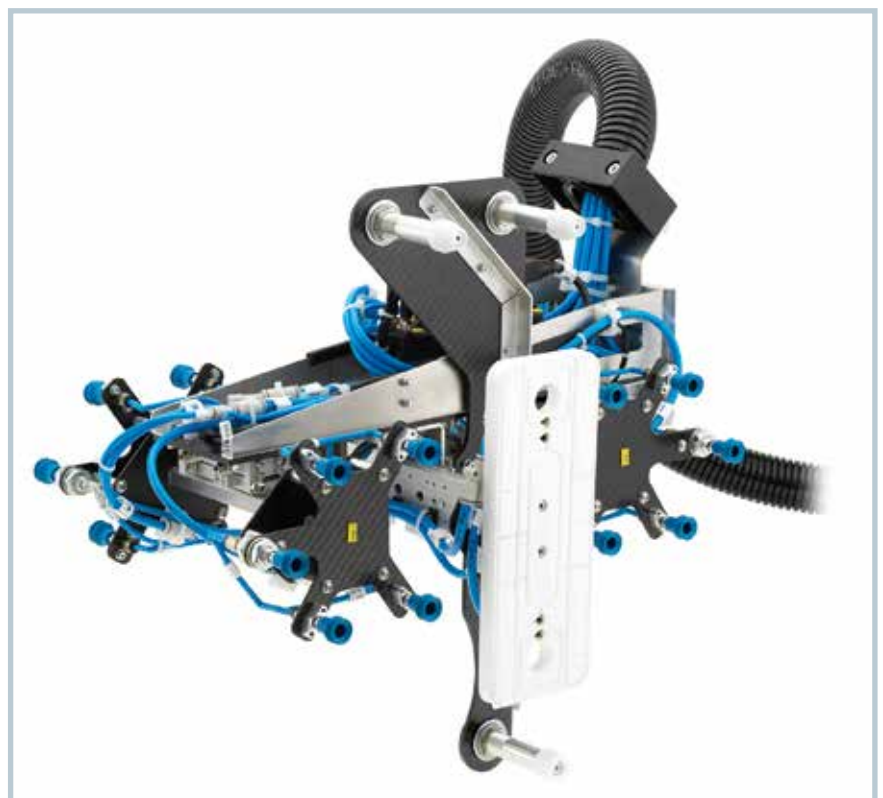


Fig. 4. Consistent lightweight design: the insertion and removal gripper developed by KraussMaffei is made of carbon and allows for the use of smaller base units (© KraussMaffei)



Fig. 5. Compact automation: a six-axis robot inserts the components into the laser trimming station. Visible in the background: the conveyor with UV tunnel and, behind it, the clamping unit with the film feed (© KraussMaffei)

version at the Competence Forum, has been equipped with a new insertion and removal gripper in a lightweight design. It was previously made of aluminum and weighed 7,700 g. Now it weighs only about half as much at 3,800 g. This means that it is possible to use an even smaller robot base tool for this project (Fig. 4). After demolding, the parts are first inserted into the laser cell, where protruding flakes of the top coat and the film gate on the side are removed (Fig. 5). A suction device collects the flakes in a container. The winding unit for the used IMD film is located behind the container.

This way, the roll can be replaced even during operation. After trimming, the robot picks up the parts with the suction cups on one side of its gripper, rotates and then immediately inserts untrimmed parts into the laser station again. Using the protruding "tail" of the touch film, the finished HMI display can now immediately be connected to a controller through a ZIF connector. Subsequently, the parts are deposited on the belt and cured by UV.

Space-Saving Design Paired with High Flexibility

Automation developed by KraussMaffei takes on an important role in achieving

this. The automation cell is standing on rollers and can be connected to another injection molding machine within only 15 minutes – even if the machine axes are different. Therefore, product changeovers can be carried out easily, with or without IMD. To complement this, the film feed has a memory function for recurring orders and is capable of storing the parameter sets of 50 projects. Thus, plastic processors obtain a high degree of flexibility and efficiency for their production. The compact manufacturing cell of the PX 320 is very economical in its use of space. For example, the space below the clamping unit provides enough room for routing two parallel strips (Title figure).

A system based on a two-platen machine allows precious production space to be used even more efficiently. Two-platen machines generally have a shorter design. Specifically for small and medium clamping forces, the CX machines from KraussMaffei feature cantilevered clamping units, making it possible to place the otherwise bulky film rewinding unit below this part of the machine. Another advantage of the two-platen machine is easy access to the film feed on the moving platen. The ejector area of the CX machine is freely accessible thanks to an additional door (including step ladder), which means that maintenance can be carried out on the film feed on its narrow side without any barriers. That way, film changeovers can be carried out fast, safely and ergonomically (Fig. 6).

Initial Use in Series Production

The IMD SI Duo has already passed its first test in a high-volume automation application on a KraussMaffei machine. The NBHX Trim Group, expert in innovative surfaces for vehicle interiors, uses it for manufacturing decor panels for the A and B classes of Mercedes at its location in Codlea, Romania. For this purpose, the device has been integrated into an injection molding machine of the GX 900 type.

Conclusion

The IMD and IML film processes are indispensable for premium-quality, functionally integrated decoration of plastic surfaces. In combination, they make it possible for the processor to manufac-



Fig. 6. The two-platen machines of the CX series make very efficient use of the installation area for the IMD process and ensure outstanding accessibility of all components thanks to their ejector space door (© KraussMaffei)

ture components with embedded electronics efficiently and flexibly. Thanks to the IMD SI Duo film feed from Kurz, now even multiple-cavity molds can be fed with single-image decors – something that used to be practically impossible until now. ■