

# Technology Fusion with Bright Prospects

**Process Integration.** The fusion of injection molding and reaction technologies permits one-step production of multicomponent parts with extended functions, optimized tactile properties at specific areas, and a first class surface.

At K2010, five technology partners show how it's done with the example of a specially developed part.

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Consumers are choosy – and difficult: they want products with as many functions as possible, a superior appearance, but at the same time they should not be expensive. That puts suppliers in almost all industries in a bind. The more complex a part, the more difficult and costly it is to produce. That applies to a high degree for high-gloss painted multicomponent composite parts, which are currently fashionable. Painting represents a particularly large obstacle. However, the economic production of such parts is continually increasing in importance in the automotive industry, but also the electronic sector, consumer goods and packaging applications.

KraussMaffei Technologies GmbH, Munich, Germany, – together with several system partners (see Table on p.??) – now presents a program that offers users a rapid entry into the next generation of multicomponent parts. The ColorForm process combines injection molding with reaction technology. It is thereby an example of the successful fusion of two different processing technologies. The project's success was at least partly due to the fact that KraussMaffei has in-

house engineering know-how for both processes.

The development aim was to realize first class surfaces in the closed mold. We can see why this is the case if we look at the work involved in painting: the parts must almost always be cleaned, in some cases primed, and also partly masked. The process is therefore less strict from a logistics point of view – not to mention the greater energy consumption that this entails. There is no secret about the fact that separate painting of parts makes a manufacturing process more expensive as a whole, and involves a greater proportion of rejects – as high as a double digit percentage.

The integration of painting into the injection mold – preferably with solvent-free paint – defuses these criticisms, and makes the production more reliable and economic. A decisive factor in this is the

symbiosis of suitable materials, high-precision mold making and reliable process engineering. To provide the proof, the partners decided to construct a suitable mold – and to combine two mutually independent established process engineering approaches. But first a suitable part had to be found.

## The Design Model

The plastic-oriented, extremely attractive form of the design model produced and presented at K was the work of the id-entily design agency of Raubling, Germany. The aim was to conceive a technically challenging plastic part with a high-quality appearance while also meeting tactile requirements. The part was to meet the requirements and aspirations of potential users from various industries. Not least, it should also be a



The design study, besides three different surfaces, also shows additional functional elements (photos: KraussMaffei)

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practical article that is suitable as a publicity gift.

The result – a high-quality sample case (**Title photo**) – consists of two mirror-symmetrical half shells, with base moldings of an ABS (manufacturer: A. Schulman GmbH, Kerpen, Germany). The upper and lower quarters of the case element is overmolded with a grain-structured TPU (manufacturer: API S.p.A., Mussolente, Italy, in cooperation with Schulman). To accentuate the design, the TPU surfaces are not grained in the area of the handles. The two case clasps, designed as film hinges, are also overmolded with TPU. The permits a special trick: during assembly – i. e. the first closing of the case – the base material breaks at a predetermined rupture point and takes on the function of a closure. On the base of the two half shells, two hinge bearings are molded, which, for their part, are connected together with a metal pin each.

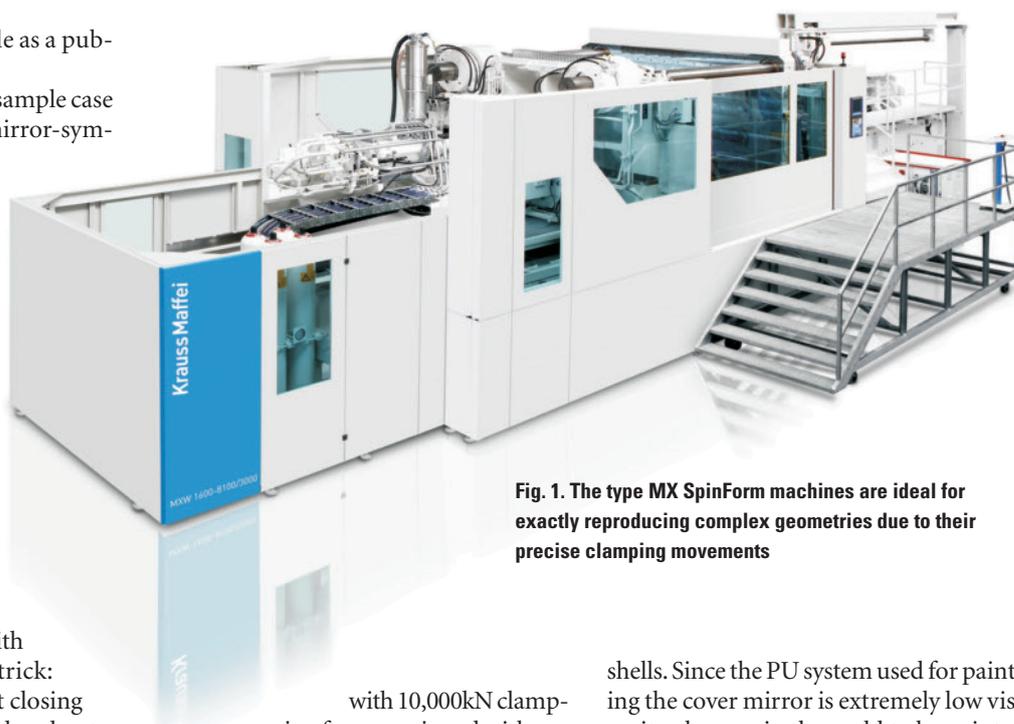
### Surface and Mold

The central area of the case half shell is designed as a cover mirror. The surface is decorated with a solvent-free high-gloss polyurea protective lacquer (manufacturer: Panadur GmbH, Halberstadt, Germany). For ColorForm, solvent-free means the elimination of process steps that would otherwise be necessary, and a significantly higher material efficiency compared to conventional wet lacquering. Moreover, the polyurea system is especially characterized by its resistance to weathering and environmental effects, such as UV radiation, and by its high chemical resistance.

Because of the complexity of the design model and in order to work out design features, the mold maker, Hofmann Innovation Group, Lichtenfels, Germany, first produced a 1:1 prototype from PA by stereolithography. The prototype was used to optimize the part and mold functions before the production mold was constructed from steel.

### The System and Its Environment

The centerpiece of the manufacturing cell is an MX 1000-8100/3000 SpinForm 2-component injection molding machine



**Fig. 1. The type MX SpinForm machines are ideal for exactly reproducing complex geometries due to their precise clamping movements**

with 10,000kN clamping force, equipped with energy-efficient servo drives from the BluePower modular toolbox (**Fig. 1**). Combined with SpinForm spin-platen technology, the large machines of the MX series are ideally suited for processes such as ColorForm due to their robust mechanical construction and precision. The optimized geometry of the twin-platen clamping unit plays a particular role, since it ensures a precise, parallel mold closure even for heavy multicomponent molds. This precision not only minimizes mold wear, it is an important boundary condition for the manufacture of the case half

shells. Since the PU system used for painting the cover mirror is extremely low viscosity, the area in the mold to be painted must be reliably leaktight. This is achieved not only by means of suitable contours at the mold side, but also through the plane-parallelism of the clamping unit.

The paint system is successfully applied with a RimStar Nano 4/4 metering system (**Fig. 2**) and a self-cleaning type MK 5/8 ULP-2-KVV mixing head (**Fig. 3**), which is fixed on the mold. RimStar Nano type systems are specially designed for metering very small quantities. Their capacity and their capability measured as a proportion of the cycle time are sufficient to serve even multiple injection molding

The five development partners were not alone		
KraussMaffei Technologies GmbH, Munich, Germany	www.kraussmaffei.com	Injection molding, reaction technology, as well as automation and trimming technologie
Hofmann Innovation Group AG, Lichtenfels, Germany	www.hofmann-innovation.com	Prototype and mold construction
Panadur GmbH, Halberstadt, Germany	www.panadur.de	Polyurea protective lacquer system
A. Schulman GmbH, Kerpen, Germany	www.aschulman.com	ABS material
Designagentur id-entity, Raubling, Germany	www.id-entity.de	Plastics-oriented design of the model
... and express their thanks to five other participants		
API S.p.A., Mussolente, Vicenza, Italy	www.apiplastic.com	TPU material
hotec GmbH, Herford, Germany	www.hotec-gmbh.de	Mold high-gloss polishing
Eschmann Textures International GmbH, Neuenstadt a.K., Germany	www.eschmanntextures.de	Mold surface structuring
Meusburger Georg GmbH & Co KG, Wolfurt, Austria	www.meusburger.com	Standard molds
Günther Heißkanaltechnik GmbH, Frankenberg, Germany	www.guenther-hotrunner.com	Hot runner system



**Fig. 2. The RimStar Nano metering system used for the ColorForm process is specially designed for metering extremely small quantities**

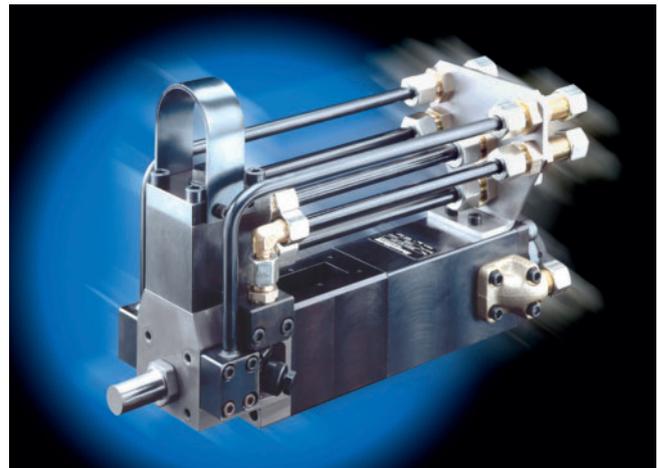
soon as the mold is closed, the lacquer and TPU are injected – the latter cascade controlled. The six-axis robot removes the parts and transfers them to the punching station, where a film sprue and lacquer ventilation area are removed. Then the half shells are transferred to the assembly station. Here, the two parts are fitted together in the region of the hinges and completed with steel pins to produce a finished case from two halves.

machines in regular production – an option that is attractive not least for cost reasons. To allow all the process steps to be executed fully automatically, the system is complemented with a six-axis robot and a downstream punching and assembly station (Fig. 4).

**Advantages of the Process**

The production workflow is comparatively easy to understand. First the basic body is injection molded from ABS. After a 180° rotation of the mold, there are a total of three cavities in the second mold half: two for the TPU and one for the lacquer. As

**Fig. 3. On the system demonstrated at K, the type MK 5/8 ULP-2-KVV self-cleaning mixing head is fixed on the mold**



**Fig. 4. The fusion of injection molding and reaction technologies permits one-step production of multi-component parts with first class surfaces**

The ColorForm process is suitable for both small and large parts, irrespective of their geometry. Any colors, from transparent to deep-black high-gloss lacquer can be processed. Compared to conventional lacquering, the process does not need preparation for coating. The complex separate process steps, such as cleaning, masking, priming, ventilation and drying are eliminated. Users profit from the fact that the paint system is solvent free, and cures rapidly due to the ideal mold and part temperatures. In addition, the ColorForm process reduces the overspray that is typical of external painting.

**Summary**

ColorForm is a process for producing complex multicomponent parts with high-quality surfaces in a closed mold and in a single economic process step. And it is not just limited to injection moldings. For example, it can be used to coat RTM (resin

transfer molding) or RRIM (reinforced reaction injection molding) in the mold.

In developing the process for mass production, it was a crucial advantage that KraussMaffei, with its industry-wide network, can turn to competent partners. Solutions such as ColorForm can only be made ready for the market through interdisciplinary inter-company and inter-process cooperation. ■

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