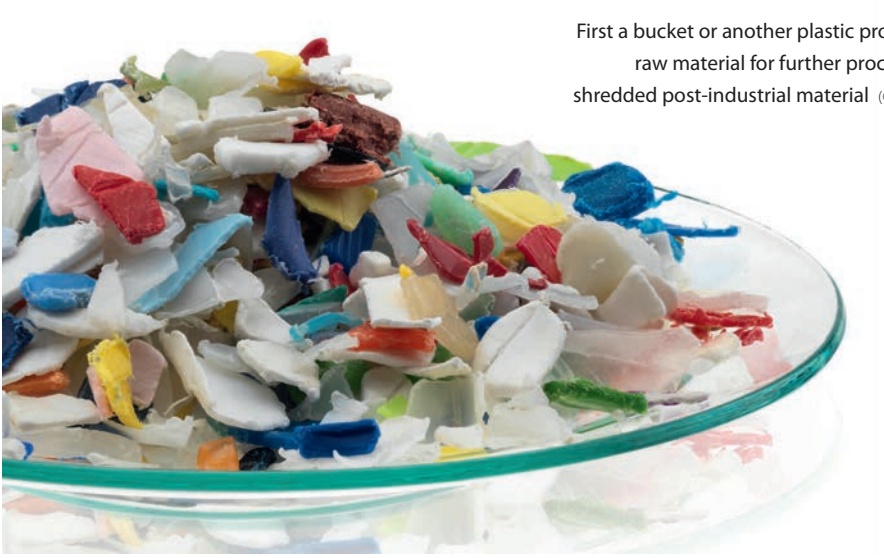
Today Packaging, Tomorrow Raw Material

At the K, KraussMaffei Will Be Showing the Cycle from Product to Upcycling to a New Product

Paint bucket or A-pillar finisher? In our thoughts and attribution of value, packaging items and high-tech components often represent opposites. Yet the two can complement one another – when you look at used packaging as a valuable raw material. At the fair, KraussMaffei will be showing the concept for a closed material cycle and is making plastics processing sustainable through this. The machine manufacturer will have three business units working hand-in-hand there: Injection Molding Machinery, Extrusion Technology and Digital & Service Solutions.



First a bucket or another plastic product, then raw material for further processing: the shredded post-industrial material (© KraussMaffei)

Packaging products fulfill their duty quickly. So, why not use them as raw material for new high-tech articles – in the automotive industry, for example? It has been rather uncommon to date, but Volvo, for example, wants to use 25% recycled plastics in its cars by 2025 – other automakers will follow suit. At K2019, KraussMaffei will be dovetailing its IMM (injection molding), EXT (extrusion) and DSS (Digital Service Solutions) business units and showing how a bucket decorated in the IML (in-mold labeling) process can be converted into an A-pillar with fabric surface (**Fig. 1**) with "Circular Economy" as the slogan. What is special about this scenario? The entire cycle of the material is recorded in detail. This is particularly important in view of the stringent requirements in the automotive industry, especially for safety-related technical components.

Requirements for this circular application are efficient production, the lowest possible consumption of plastic and the grade purity of the material. The GX 1100 injection molding machine with a clamping force of 11,000 kN (**Fig. 2**), presented for the first time at the K, uses a two-cavity mold to produce buckets made of polypropylene with decoration in the IML process (in-mold labeling). The containers are executed using thin-wall technology and the IML label also consists of a PP base to simplify the subsequent recycling. The GX is equipped with a speed option. This provides for particularly high injection speeds (up to 700 mm/s, depending on the injection unit) and fast mold movements, which is advantageous above all for large opening strokes. The cycle time is 14 s for a shot weight of 1500 g.

Thanks to the large L/D ratio (length/diameter) of 26, the HPS barrier screw (high-performance screw) that is used for polyolefins allows for a higher material throughput and is therefore suitable for manufacturing products with high shot weights – with a shorter residence time. Some of the finished buckets go to the booth of the Italian partner Moving, where visitors can see how an automated unit installs the handle. The majority of the buckets – after being shredded externally – is fed back into the material cycle as regrind.

Upcycling Provides for Premium-Quality Recompounds

KraussMaffei is the only manufacturer on the market providing turnkey systems for various types of plastics processing, so it sees itself as a solution provider for the circular economy. The extrusion division is demonstrating its ability to upcycle plastics. Under the "Edelweiss Compounding" brand, the ZE 28 BluePower twin-screw extruder (**Fig. 3**) turns secondary raw material into new and technically refined granulate. For this purpose, pigments and a 20-percent proportion of talc are added to the polypropylene flakes to improve the visual and mechanical properties. Unlike the single-screw extruders frequently seen in the re- »

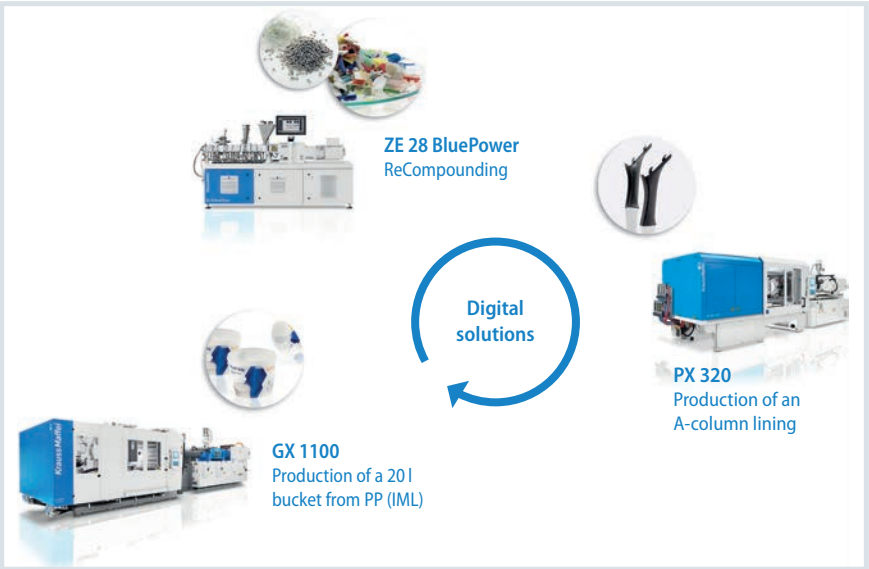


Fig. 1. A bucket becomes an A-pillar: at K 2019, KraussMaffei is demonstrating a closed material and manufacturing cycle composed of extrusion and injection molding technology in combination with digital solutions (© KraussMaffei)

cycling market, models with two screws achieve a more uniform distribution of additives and fillers as well as much more effective degassing of residual materials – so it is ideal for premium-quality recompounds that have to satisfy the requirements of the automotive industry.

Extruders take the material and first manufacture granulate, so that it can be used again as a raw material or as a compound in the injection molding process. The material throughput during extruding is the result of the ratio between available volume and torque. Both values are substantially determined by the ratio between the outer and inner diameters of the screw (Do/Di). For the BluePower series, Do/Di is defined as 1.65 and enables both a large available volume and a high torque density of 16 Nm/cm^3. The ZE BluePower twin-screw extruder is available with screw diameters ranging from 28 to 166 mm and in barrel lengths that equal either four or six times the diameter (4D/6D). For example, the extruder at the trade show has a total accumulated length of 44D.

While clean post-industrial material will be processed at the trade show booth, in everyday operations the material frequently consists of contaminated post-consumer articles from collected recyclables. For these, it is good to operate two twin-screw extruders in series. In the first, the washed flakes are dehumidified and foreign substances, such as aluminum or paper, are removed. What are called stripping agents are also used to largely eliminate offensive odors. In the case of material that is very soft and difficult to draw in, which happens when films are shredded, a cutter compactor can be used upstream, which KraussMaffei also offers.

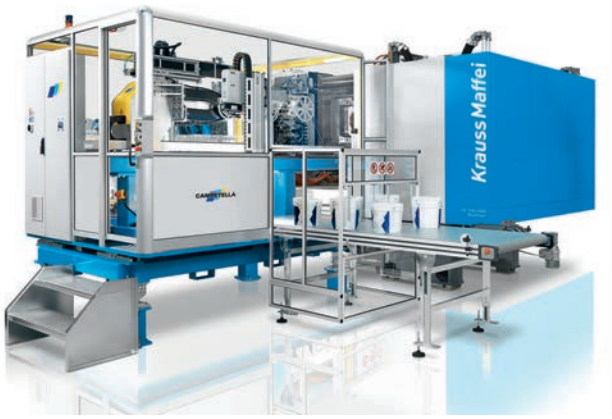


Fig. 2. The speed option of the new GX 1100 ensures high speeds during injection and fast mold movements (© KraussMaffei)

The first extruder is followed by filter units and a melt pump that continuously feeds the material to the second extruder, where it is refined and pelletized. This technique is intended to make on-site compounding more attractive to recycling companies and plastics manufacturers. Visitors at the K trade show booth can see live how the refined recompound gets fed back into the injection molding process after the underwater pelletizing and drying.

A-Pillar Paneling: No Wrinkles and No Visible Edges

The material supply unit feeds the recompound into an all-electric PX 320 injection molding machine, which uses it to make the A-pillar finisher with textile surface (**Fig. 4**). For this purpose, a linear robot of type LRX 150 uses needle grippers specially developed by KraussMaffei (**Fig. 5**) to remove a material label from an expandable textile magazine. In accordance with the "produce-to-order" manufacturing principle, in which production does not begin until after the order process, an optical inline inspection ensures that the correct decoration is selected for the component to be produced.

Then the textile is passed to the mold and inserted in the correct position. To prevent the possibility of any wrinkles forming, the textile has to be strongly clamped in several areas and undergo controlled compression in other areas. The handling solution uses ten parallel needle grippers and eleven separate strokes to ensure that the decoration is precisely inserted and clamped. In addition, all ten needles can be individually adapted to the various textile thicknesses. That way not only thicker leather decorations but also functional textiles such as airbag nets can be gripped reliably. The Alcantara surface is back-injected using the FlexFlow needle shut-off servo cascade control from the hot runner specialist HRSflow, which is integrated into the MC6 machine control system.

Another plus of this method: a slide mechanism in the mold punches the material to form the contour. Then it is bent 180° and bonded to the plastic on the back of the article. This produces back-injected decorative components without visible edges in one step. Otherwise these processes usually take place down-

stream, but here it was possible to integrate them into the cycle.

Seamless Traceability of Each Component's Path through the Process

The last step in the process for manufacturing the A-pillar finisher is to affix a QR code. The digital products of KraussMaffei's DSS business unit are behind this. When you scan the QR code, you are taken to an HTML page that shows not only the relevant component information, but also the complete path of the component – starting from the manufacturing of the IML-decorated bucket. A wide variety of process parameters and, very importantly, the dwell time of the material in the plasticizing unit demonstrate that the polypropylene has been gently processed instead of being degraded at this early stage by thermal or mechanical harm. After all, the material quality is a central quality attribute of each component.

The subsequent recompounding and the second injection molding process are also recorded. The data for this is supplied by the DataXplorer from KraussMaffei, which enables a detailed look into the process depth because it can save up to 500 signals every 5 ms as continuous curves. Unlike conventional sensors, therefore, the DataXplorer does not return a single value for a specific point in time in the cycle, but continuously returns signals over the entire process step. These can be standard machine signals such as temperature, pressure and screw torque, but also special signals such as mold cavity pressures. Thus the DataXplorer reveals what has taken place in the respective cycle or during the continuous extrusion.

Manufacturing of thin-walled buckets on a GX 1100	
Calframax Technologies Inc., Oldcastle, Ontario, Canada	Mold construction
Campetella Robotic Center Srl, Montecassiano, Italy	Automation
Creaprint S.L., Ibi, Spain	Label (IML)
ef cooling Ernst H. Furrer AG, Dällikon, Switzerland	Cooling technology
ExxonMobil Chemical Europe Inc., Machelen, Belgium	Material
gwk Gesellschaft Wärme Kältetechnik mbH, Meinerzhagen, Germany	Cooling technology
iba AG, Fürth, Germany	Data collection
mevisco Gesellschaft für Bildverarbeitung und Visualisierung mbh & Co. KG, Bremen, Germany	Quality check (visual)
motan colortronic GmbH, Isny, Germany	Material conveying and color dosage
Moving Srl., Milan, Italy	Handle installation (partner booth)
Uniform Color Company, Holland, MI/USA	Color batch
Manufacturing an A-pillar finisher on a PX 320	
cab Produkttechnik GmbH & Co KG, Karlsruhe, Germany	Label printer
Georg Kaufmann Formenbau AG, Busslingen, Switzerland	Mold construction
HB-Therm GmbH, Siegburg, Germany	Heating and cooling technology
HRSflow, San Polo di Piave, Italy	Needle shut-off control, hot runner system
iba AG, Fürth, Germany	Data collection
motan colortronic GmbH, Isny, Germany	Material conveying
SensoPart Industriesensorik GmbH, Wieden, Germany	Camera system
Trexel Inc., Wilmington, MA/USA	MuCell technology

Table 1. The partner network for the cycle from bucket to A-pillar finisher (source: KraussMaffei)

New Multi-Interface

This information plus much more from the peripherals, for example, from tempering units and robots, flows into a new data pool system from KraussMaffei. By doing this, the machine manufacturer has for the first time created a multi-interface concept to centrally save all important information across all systems and protocols throughout the production process and make it available to the customer in collected form. In addition to quality »

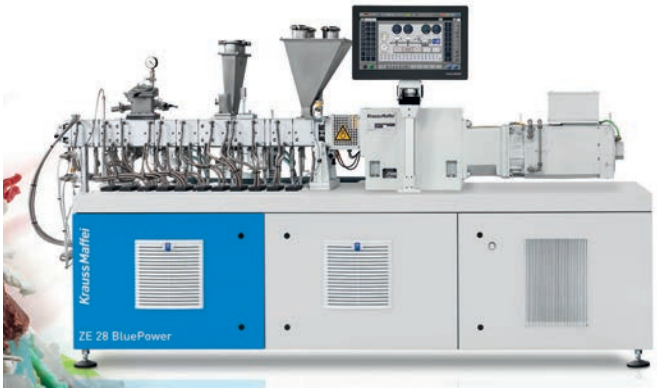


Fig. 3. The ZE 28 BluePower twin-screw extruder turns secondary raw material into new and technically refined granulate (© KraussMaffei)

assurance for the individual part, this also provides for monitoring the status of the production systems and documenting their efficiency.

Another digital actor is at work for quality assurance during injection molding. The APC plus (Adaptive Process Control) machine function provides for components that are always identically filled at both injection molding machines of the circular application by continuously readjusting the changeover point from pressure to holding pressure during the current cycle. This compensates for interference factors such as climate and batch fluctuations or changing amounts of recycled material. Those are manageable in the trade show scenario, but can play a big role in everyday manufacturing. During extrusion, color measurements and values such as melt pressure and melt temperature as well as the throughput and screw speed reference points indicate whether the process is running soundly.

Sustainability Becomes Measurable

For all processes, from the bucket to the A-pillar finisher, the necessary energy input is also noted. OEE key figures for operating materials and production systems allow you to compare what the use of recycled material has brought compared to new material. For the condition-based monitoring of systems, for example, the data from torque measurement enables you to draw conclusions about the screw. Irregularities in the vibration measurements during extrusion indicate wear on the gearbox. This data provides a uniform basis for traceability of the sustainability and thus reliable parameters for predictable maintenance.

The goal of a circular economy is to decrease the influence of plastics processing on the environment. For this purpose, recycling (less new material), quality assurance (less scrap) and energy efficiency (less consumption) must work together. KraussMaffei has been developing solutions in this area for over three decades – currently these solutions also include Polymore, a new B2B online marketplace for purchasing and selling compounds, masterbatches, recycled materials and post-industrial recyclables in Europe. Polymore connects compounders and plastics processors so that products can be traded and the requirements for sustainable value creation can be fulfilled as simply and securely as possible and without language barriers.

The topics of environmental protection and responsibility of industry are more present in society than ever before. KraussMaffei is taking up these challenges and advancing the building of a closed-loop economy in the plastics industry. ■

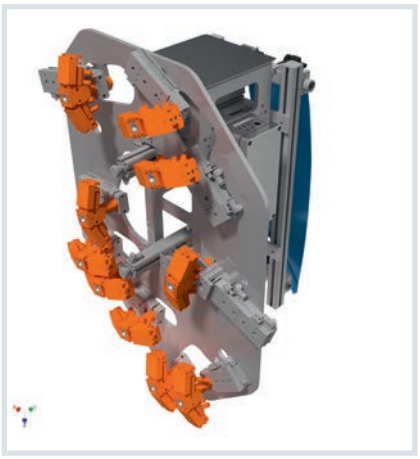


Fig. 5. Wrinkle-free production: the ten separate, individually movable needle grippers (orange) and eleven strokes allow for safe insertion and clamping of the decoration of the A-pillar finisher (© KraussMaffei)

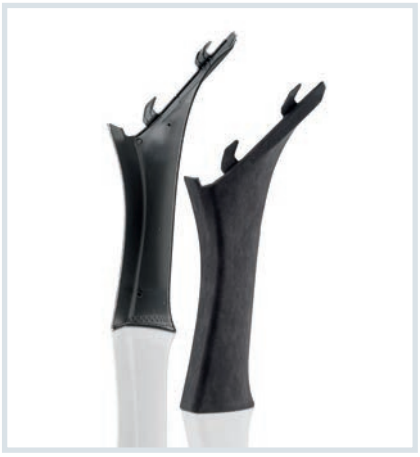


Fig. 4. The A-pillar finisher with textile surface is manufactured on an all-electric PX 320 injection molding machine (© KraussMaffei)

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Trade Show Information

KraussMaffei is jointly presenting the project at its trade show booth with partners (Table 1) during the K 2019:

- Hall 15, booth C24 – C27

Service

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