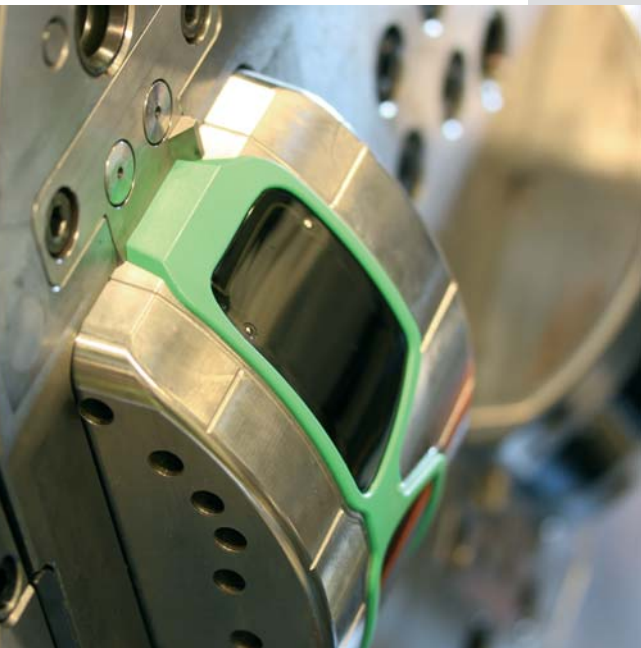




Hybrid Production – Bringing Power to Plastics

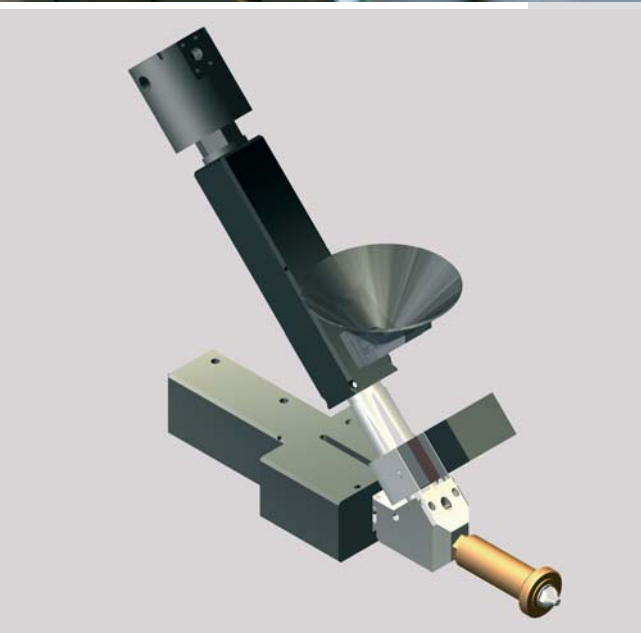
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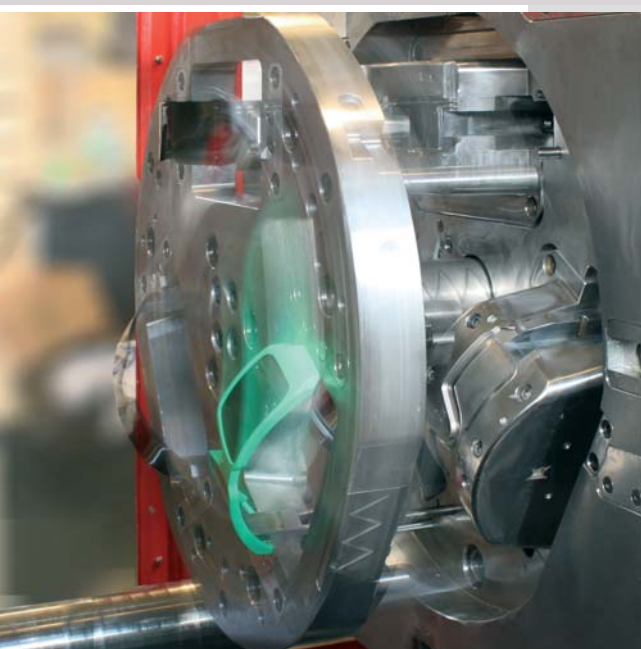
Hybrid multi-component technology combines advantages of injection moulding and die casting of metals in a new single-step process

Combining different processes to create a single-step process makes it possible to combine different materials and thus different functionalities in one moulded part. IKV has developed a new hybrid multi-component injection moulding process as part of the "Integrative production technology for high-wage countries" Cluster of Excellence at RWTH Aachen University. This process allows the production of complex plastics parts with integrated metal conductor tracks for electronic applications in a previously unattained short process chain. The new process combines aspects such as efficient processing and high current-carrying capacity with high geometric complexity and simple contactability. The key aspect of this project is the combination of the injection moulding of plastics with the die casting of metals to create a hybrid multi-component injection moulding process.



Newly designed die casting unit permits precise processing of ultra-small quantities of low-melting metal alloys

To be able to produce the conductor track structures on an injection moulding machine, an add-on device based on a Babyplast unit from Christmann Kunststofftechnik was developed to process the low-melting tin/zinc alloy. The unit has a separate metering and injection piston. The metal alloy, which is feeded via a hopper, is melted in the area of the metering piston through heat induction, and then conveyed shot by shot into the injection piston. To allow reproducible injection of the low-viscosity metal alloy, an innovative sealing concept was developed for the injection piston that allows adjustment of the fit between the cylinder and the piston at processing temperature. The shut-off system integrated between the plasticising cylinder and the injection cylinder ensures that there is no backflow of material in the direction of the metering piston during the injection phase.



3-station index plate mould allows production of complex electronic parts in short process times

Fully automatic production of the heatable sports glasses can be ensured with the aid of a 3-station index plate mould from IKV partner Krallmann. In the first station, the lens is produced in optical quality and the inserts are encapsulated with plastic. In the second station, the low-melting alloy is injected directly on to the lens via a hot runner nozzle with a needle valve. Because the flow properties are improved through the mould temperature, a complex conductor track profile with varying cross-sections and different conductor track lengths can be produced. At the end of the conductor track, the metal inserts are directly connected through encapsulation with the liquid alloy. At the final third station, the plastic frame is injected and the finished part removed.

Dynamic mould temperature control provides the basis for intricate conductor track structures

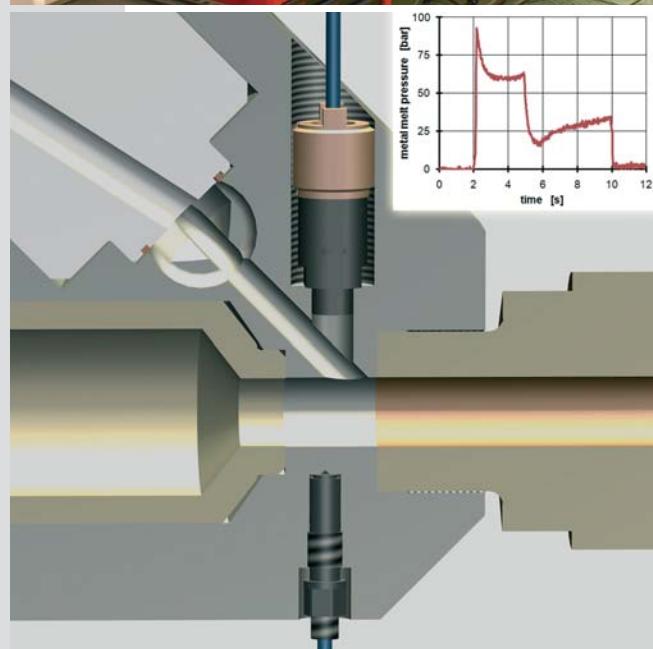
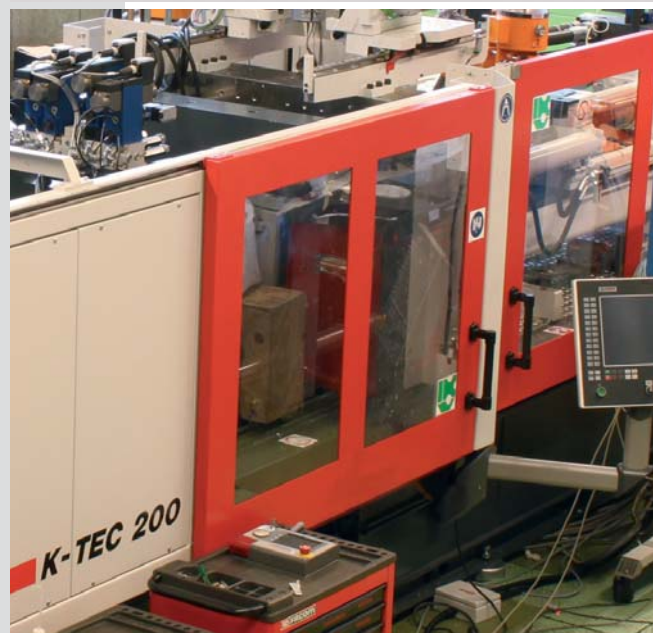
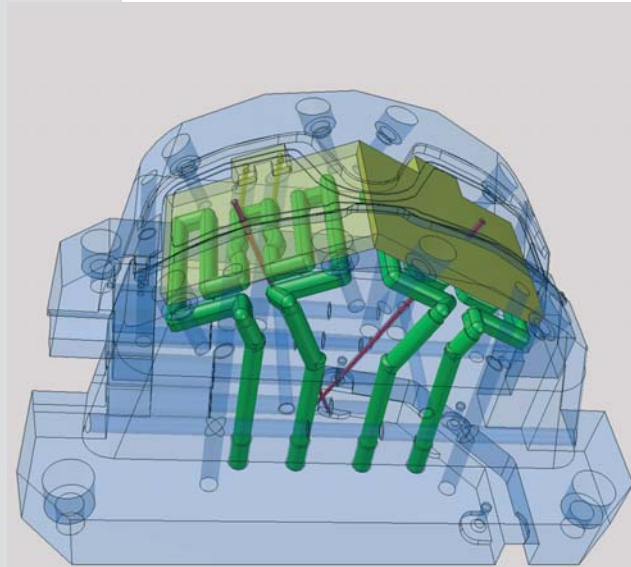
To produce parts with consistent dimensional stability and ensure reproducible application of the conductor tracks, temperature control of the mould is of major importance. The temperature of the cavity inserts in the individual stations is water-controlled via separate circuits using the „integrat evolution“ system from IKV project partner gwk Gesellschaft Wärme Kältetechnik. The index plate mould is equipped in the second station with a highly dynamic variothermal temperature control system. With this technology, a high flow path/wall thickness ratio of the extremely rapidly solidifying, low-melting metal alloy is achieved in the area of the conductor track. The variothermal temperature control allows not only rapid heating of the cavity wall to the melting temperature of the metal alloy during the injection phase, but also rapid cooling after application of the conductor track.

Injection moulding machine at the heart of the hybrid production cell

The 3K glasses are manufactured on an injection moulding machine from Ferromatik Milacron GmbH with a clamping force of 2,000 kN (Type: K-Tec 200 S/2F). The IKV research team added a unit for processing the low-melting metal alloy. Directly integrated into the process is a six-axis robot from Kuka Roboter GmbH, Type KR5 arc. The robot, in conjunction with a gripper from ASS Maschinenbau GmbH specially designed for this application, guarantees not only reproducible removal of the part but also reliable insertion and positioning of the metal contact pins. The KKT 55 drying and conveying system from project partner Werner Koch Maschinenteknik is optimally geared to the processing of optical polyamides. The conveyor systems transport the thermoplastics and the low-melting metal alloy in granule form to the plasticising units.

Monitoring of process and functionality ensures consistent shot-to-shot quality

For the production of the 3K sports glasses, the project partners have adopted different approaches to monitor quality. Sensor technology from Kistler Instrumente AG, Winterthur, Switzerland, is used for online monitoring of the processes in the mould and in the unit for the low-melting metal alloy. In the area of the metal processing unit, the melt pressure is measured with a sensor placed behind the flow channel. This sensor determines the melt pressure from the pressure-induced deformation of the metal part. Another quality criterion is the resistance of the electric conductor track, which is monitored and plotted for every component inline within the production cell. The profile of this measurement over several cycles allows direct conclusions to be drawn regarding process consistency of the hybrid multi-component injection moulding process and the electrical properties of the part.



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measure. analyze. innovate.



Robot gripper

ASS Maschinenbau GmbH, Overath, www.roboterhand-und-mehr.de

Babypplast add-on injection moulding unit

Christmann Kunststofftechnik GmbH, Kierspe, www.babypplast.de

Polyamide Type CX 7323 and CX 9704

Evonik Industries AG, Essen, www.evonik.com

Injection moulding machine K-Tec 200 S/2F

Ferromatik Milacron GmbH, Malterdingen, www.ferromatik.com

Variothermal temperature control system in the second mould station

gwK Gesellschaft Wärme Kältetechnik mbH, Kierspe, www.gwk.com

Standard mould units and glass side mould

Hasco Hasenclever GmbH & Co. KG, Lüdenscheid, www.hasco.com

Pressure and temperature sensors for metal and plastics processing

Kistler Instrumente AG, Winterthur, Schweiz, www.kistler.com

Drying and conveying system KKT 55

Werner Koch Maschinentechnik GmbH, Ispringen, www.koch-technik.com

Design and construction of the index plate mould

Krallmann Holding u. Verwaltungs GmbH, Hiddenhausen, www.krallmann.de

Six-axis robot Type KR5 arc

Kuka Roboter GmbH, Augsburg, www.kuka-robotics.com

The project is part of the Cluster of Excellence "Integrative production technology for high-wage countries", at RWTH Aachen University, www.production-research.de

