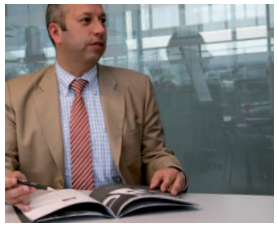


At the bottom from left: *Franz Füreder | Georg Steinbichler | Michael Fischer | Karl-Heinz Knab*

Superior product quality at a **lower** cost

The trend towards combination of various production stages into an integral process is advancing. ENGEL joinmelt enables components to be joined for the first time directly in the injection mould. Besides a reduction in investments and the cost of component parts, the principal incitement for process developers is an increase in component quality.

The new process, its potential and opportunities were discussed by Georg Steinbichler, Head of Research and Development Technologies at ENGEL AUSTRIA, Franz Füreder, Head of ENGEL Business Unit Automotive, Michæl Fischer, ENGEL Sales Manager Technologies, and Karl-Heinz Knab, Sales at Hummel-Formen.

ENGEL joinmelt takes process integration to new heights. How does the process work?
Steinbichler: In the ENGEL joinmelt process the upper and lower parts of a component are injected simultaneously into a common mould. When the mould is opened, one part remains in the left and the other part in the right mould half. Now the movable half of the mould is shifted until the upper and lower parts are aligned for joining. A heating element is then positioned between them. The edges of the component halves are heated and joined together by closing the mould.

Doesn't that prolong the process?
Füreder: We produced prototype parts with the ENGEL joinmelt and determined that we achieve approximately the same cycle time as for the injection moulding process without integral joining. That is possible because we save the time for welding during

cooling. When the mould opens for the welding process, the two component halves still have a temperature of about 100°C.

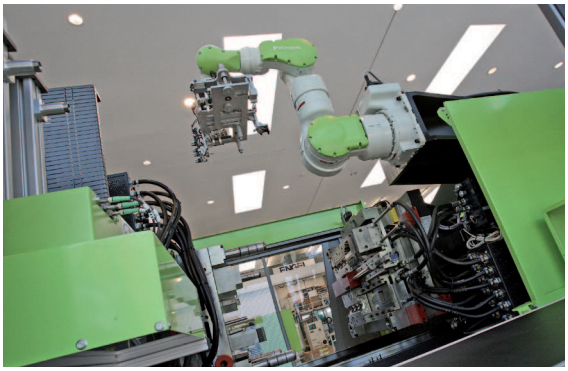
Fischer: Whether or not the cycle time is prolonged by integration of the welding process depends on the respective component geometry and size, as well as the wall thickness and materials used.

Steinbichler: The total component manufacturing time is much more important than the cycle time alone. In the conventional process the parts are injection moulded, then stockpiled until they can be welded together on another machine. The ENGEL joinmelt completely eliminates this temporary stockpiling, handling of semi-finished products and a second work stage, thus accelerating the manufacturing process. Furthermore, the integral machine saves investment costs compared to two separate machines and requires hardly more space than the injection moulding machine without welding function.

ENGEL joinmelt also produces superior component quality. How can this be explained?

Knab: If the two component halves are first injection moulded and subsequently joined together in the conventional manner, this usually requires compromises. The conventional vibration welding results in burrs along the welding seam, where minute particles, so-called flashes, form. When these are removed, the functional parts – for example the valve tappets in the combustion engine – may be damaged. Although hot gas welding creates clean and homogeneous weldseams, this process requires absolutely coplanar joining surfaces which injection-moulded components rarely have. Usually the components warp while cooling and taking-off. This dilemma finally led to the idea of welding the hot component parts together while they are still in the mould. For as long as the moulded parts are hot, no tension can occur and there will be no warping. Furthermore, no humidity is absorbed in the short time. This guarantees absolutely coplanar surfaces which can be cleanly joined. It is also important that the injection moulding machine can be controlled with a high degree of precision in order to achieve even surface pressure.

Füreder: Incidentally, the high quality of the weldseam results in a further savings effect. With our prototype parts we were able to reduce material consumption, because the weldseam was much thinner than normal. Furthermore, hot gas welding ensures a high degree of process stability and reproducibility, ensuring shorter production start-up times and optimisation, and reducing the amount of rejects in running production operations.



To which components is the ENGEL joinmelt best suited?

Knab: The process is predestined for complex, three-dimensional structures such as suction pipes, exhaust gas manifolds or oil reservoirs which were conventionally manufactured in a multi-stage process. This opens up a broad new range of possibilities for designers and product engineers. For example, internal ribs for reinforcing a component can be welded on simultaneously, reducing tensile and shearing forces and increasing their strength, e.g. pressure vessels.

Fischer: Because ENGEL joinmelt creates an extremely homogeneous, clean weldseam, the resulting joins have a high strength. Generally speaking, the freedom from particles on the inside of hollow plastic bodies gains in significance with increasing complexity of the component geometry. The best results are obtained in the welding process with filled polyamides and other high-tech materials, even with materials considered difficult to weld, such as PBT, POM, PPO and PPS.

Füreder: The welding process is also suitable for light-coloured visible parts in which discolouring is to be avoided, and generally for products which must satisfy high cleanliness criteria. Because with hot gas welding the plastification energy is introduced contactless via an inert gas – usually nitrogen – the melt cannot oxidise.

ENGEL joinmelt is a joint development of **ENGEL AUSTRIA**, **Hummel-Formen** and **KVT Bielefeld**. Hummel-Formen in Lenningen/Germany was the initiator of the project and has applied for a patent for hot gas welding in the injection mould (www.hummel-formen.de). Within the cooperation KVT Bielefeld, Germany, is responsible for welding technology and holds a patent for hot gas welding in a protective atmosphere to ensure a particle-free and highly stable weld (www.kvt-bielefeld.de). ENGEL participates as an injection moulding machine manufacturer and automation expert. It also developed the software for controlling the integrated process flow.