Efficient Tempering and Economic Cooling

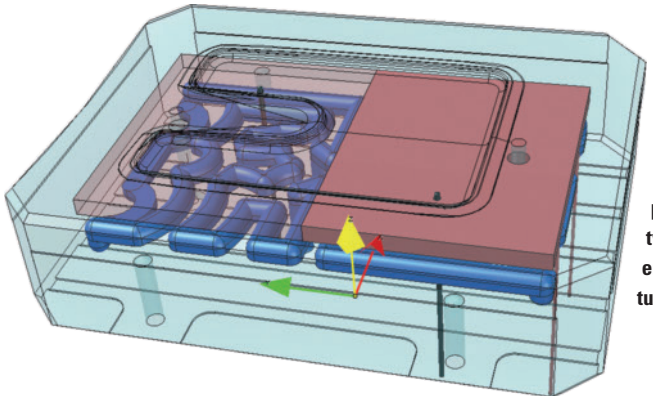
Energy Consumption. Energy saving has meanwhile become an issue that is considered also in regard to the peripherals of production machines. Increasingly, plastics processors call for holistic approaches that comprise the entire range of process technology and plant engineering.

New techniques of injection molding demand improved mold tempering. However, this does not only refer to the quality of the molded part. Today, energy consumption is at the focus of processors' attention too. An innovation introduced by gwk Wärme Kältetechnik mbH in Kierspe, Germany, features a tempering system that combines cooling to heating, both close to the cavity. Ceramic high-performance heating elements were integrated into the mold inserts themselves, thus enabling energy-efficient and dynamic cavity tempering. This helps the manufacturer meet the demands of efficiency while producing moldings with high-quality surfaces. As examples, gwk quotes high-gloss surfaces and moldings without weld lines, which are designed for the areas of automotive and consumer goods, and for telecommunication gadgets. Applying this technique, also thick-walled moldings for optical applications can be produced more efficiently than before.

Ten Times Faster than with Variotherm Tempering

The tempering device's heating unit sits right inside the mold here; just below the cavity surface, gwk placed a ceramic resistance heating unit, which – along with the cooling channels close to the cavity – enables temperatures to be switched in a fast and energy efficient way. A signal from the injection molding machine induces short-term heating of the surface to a temperature so high that the mold is entirely filled and the cavity wall is reproduced. Immediately after filling, the system switches to cooling, thus keeping cycle times short, which would not be the case with temperatures still high. According to gwk information, this technique can conduct the temperature changes necessary for the process ten times as fast as is possible with conventional variotherm tempering, while at the same time consuming only a tenth of the amount of energy usually required.

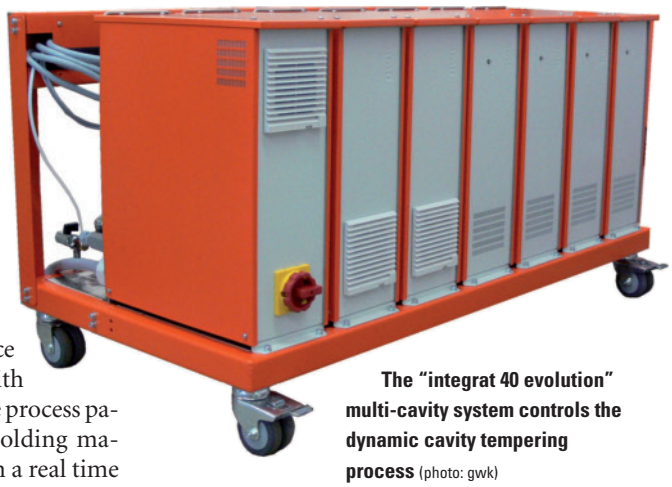
To enable processors to conduct this dynamic cavity tempering, gwk has a tempering device on offer, named "integrat evolution". It consists of several components. To place the mold's tempering channels close to the cavity, the well-proven "integrat 4D" method is applied. The "integrat direct" device assumes efficient online control of the water flowing in the individual cooling channels during cooling. The new "integrat process control" unit provides for communication between and control of the heating and cooling elements. Via the Varan interface newly developed together with KraussMaffei, it transmits the process parameters to the injection molding machine's online control unit, in a real time mode.



Cooling channels and ceramic resistance heating elements were placed close to the cavity, thus enabling fast and energy-efficient temperature changeover (figure: gwk)

Nanostructured Surfaces and Backmolded Metal Sheets

An example of comprehensive process integration was presented at the latest Fakuma trade show. It was a research project performed on the injection molding of nanostructured surfaces. An 800 kN injection molding machine (manufacturer: KraussMaffei Technologies GmbH) produced panes with antireflection coatings in a two-cavity mold (partners: Gebr. Krallmann GmbH and gwk). To show the nanostructure effect, a cavity from Fraun- →



The "integrat 40 evolution" multi-cavity system controls the dynamic cavity tempering process (photo: gwk)

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While backmolding metal sheets, the metal sheet, as the binding element, is activated by high-performance heating prior to injection (photo: IWK)

hofer Institute for Manufacturing Engineering and Automation was coated.

The "integrat evolution" multiple circuit system was in charge of heating and cooling control. There are several tempering circuits controlling, in segments, the basic temperature of the mold body. An electric module controls the ceramic heating elements corresponding to the cycle, while another module controls the cooling system during the subsequent cooling stage. The cooling system features proportional valves to perform volume-based cooling. All control modules sit in a horizontal line in one rack.

Ceramic heating elements serving for dynamic mold tempering were also used in another presentation that could be seen at the trade show. On an injection molding machine with a vertical clamping unit (manufacturer: Arburg GmbH + Co. KG), gwk, in cooperation with the Swiss Institut für Werkstofftechnik und Kunststoffverarbeitung (IWK), and Georg Kaufmann Formenbau AG, showed the backmolding of metal sheets. Applying this technique, the metal sheet, as the binding element, is activated by high-performance heating prior to material injection. This generates a homogeneous connection between metal and plastic with low stress and high dimensional stability. The project partners claim that the period of cooling is reduced by 40 %, if compared to conventional cooling methods. In this production unit, all control modules sit in a vertical line in one rack.

Interconnected Energy Saving Modules for Cooling Units

Increased cost of energy steps up cost pressure on processors so severely that more and more of them pose detailed requirements as to how much electric power may be consumed by production per weight unit of plastic material. Such boundary conditions can only be met if production units are interconnected, individually tailored to the actual production environment of the processor, and if they feature integrated modules for energy saving. Therefore, regarding cooling, there is a trend towards saving more operating costs in cold water generation and reusing more waste heat for heating processes.

To consume as little energy as possible while providing for the necessary temperatures and quantities of water means that tempering and cooling units need to be interconnected and tuned in the production process, in terms of energies. The system's efficiency is made reliable by water treatment tuned to process temperatures and to the materials used in those plant components that get into contact with water. Deposits that might be generated in the tempering channels, and which can reduce heat transmission, are prevented by a central water treatment unit; this safeguards short cycle times and keeps energy consumption low. The waste water from the hydraulic cooling unit passes through a floor heating and a heat exchanger and is thus re-used for heating purposes. As a result, the overall system has a high level of energy efficiency.

The gwk cooling equipment named hermeticool makes use of the differences in temperatures between day and night, and between the seasons, to generate cold water for production plants in a cost-efficient way. Sophisticated models of energy saving control the flows of refrigerants and the motor speeds, thus stepping up efficiencies, if compared to conventional systems. It is said that operating cost can be reduced by up to 75 %, in this way.

Energy Recycling of the Future

Recently, the "gwk-Energie-Recycling" project was presented to the public. It offers a glance of the future. The project aims at utilizing the different levels of energy flows from industrial processes and natural resources to gain, from the heat sources available, the energies required for heating and cooling without employing additional energy input. This might involve solar panels as well as a new type of refrigerating machine that generates, from hot water, the cold water needed to cool the mold. The weco gt (green technology) follows the adsorption principle. It needs no electrically driven compressor, emits very little noise and requires none of the usual cooling agents, which cause damage to the environment. According to company statements, this technique also has the potential to contribute significantly to energy saving and environmental protection.

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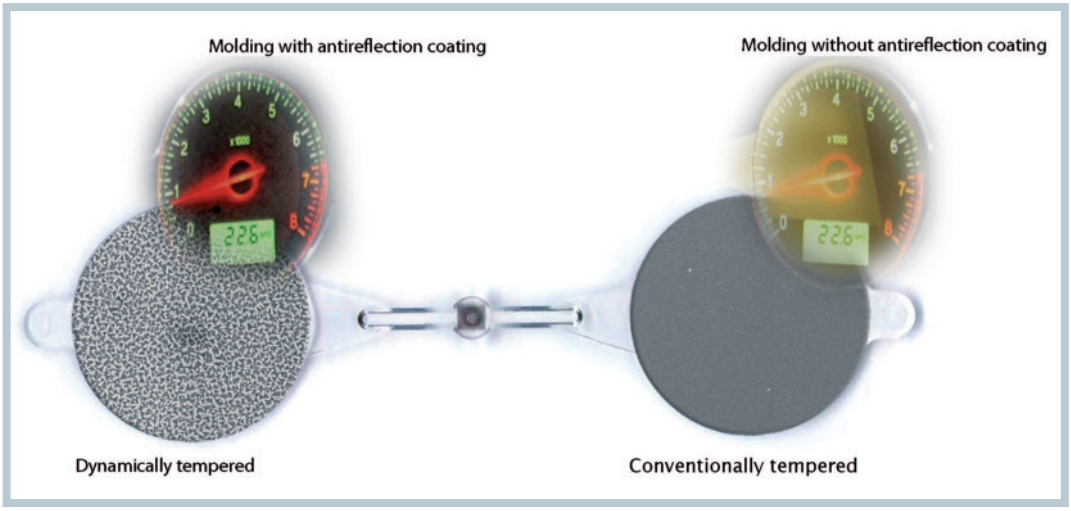

Nano structures in the mold enable the antireflection coating of optical components as early as during injection molding (figure: gwk)

