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INDUSTRY 4.0

Inline Quality Monitoring and Data-Based Quality Prediction

page 17

SPECIAL

Color and Design Trends in Plastics

from page 7

INJECTION MOLDING

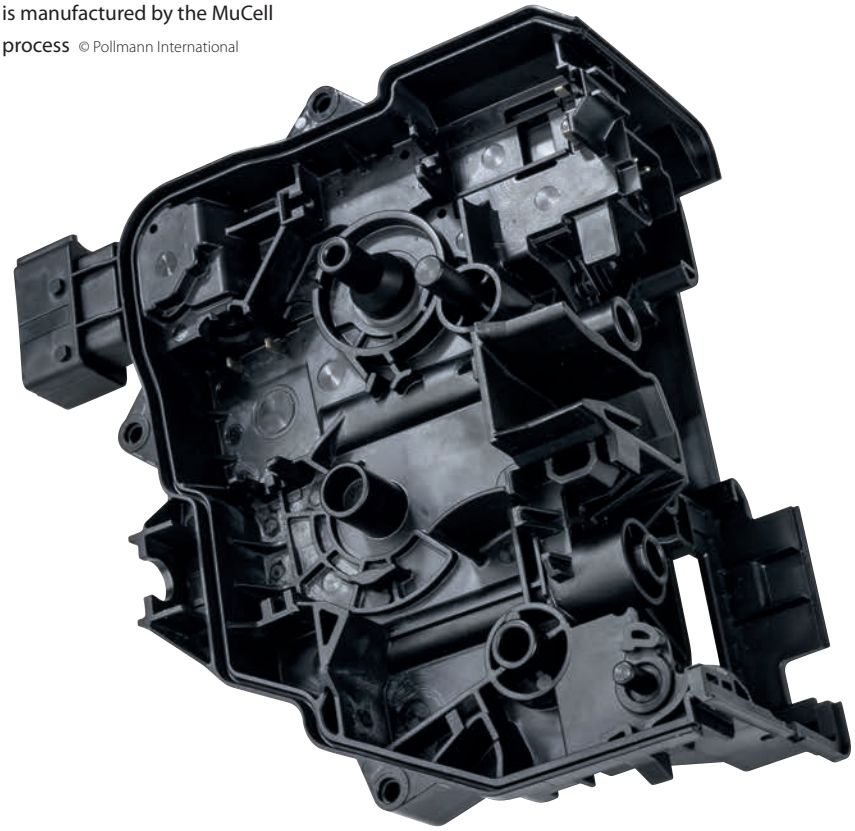
Physical Foaming Makes Plastic Parts Lighter and more Stable

page 36

Nitrogen on Tap – Not from the Bottle

Physical Foaming Makes Plastic Parts Lighter and more Stable

Automotive supplier Pollmann uses an injection molding process to physically foam glass fiber-reinforced thermoplastics used in the production of electromechanical components that are installed in motor vehicles. The use of nitrogen as blowing agent makes the process more efficient and confers special properties on the components. An Inmatec generator in the Pollmann plant supplies nitrogen on demand and in the required amount.



The housing for a doorlock system is manufactured by the MuCell process © Pollmann International

Pollmann International GmbH, headquartered in Karlstein, Austria, is a globally active subcontractor that combines metal, plastic and electronics to create complex mechatronic components for the automotive industry. This family-owned company has proven expertise in the field of injection molding and is ahead of the curve when it comes to the production of housings for doorlock systems found, for example, in BMWs, Mercedes, and other marques. The production setup also features MuCell technology (supplier: Trexel GmbH): the lower shells of the doorlock housings (**Title figure**) are made on three 5000 kN injection molding machines (manufacturer: Arburg GmbH + Co KG, Lossburg, Germany) from polybutylene terephthalate (PBT) with a 20 % glass fiber content.

The characteristic feature of the MuCell process is that nitrogen is injected into the melt during the plasticizing stage. The screw contains a special mixing zone which ensures that the blowing agent diffuses homogeneously into the melt. The resulting nitrogen-polymer mixture is called "supercritical" because a drop in pressure would cause the dissolved nitrogen (an SCF or supercritical fluid) to be suddenly released from the melt.

Once the nozzle has opened during the injection process, the screw moves forward axially and injects the nitrogenladen melt into the four cavities of the mold at a pressure of about 1500 bar (**Fig. 1**). This means that all four doorlock housings of an entire car – right and left, front and rear – can be molded in a single step.

4000 Parts per Shift

The pressure drop that occurs during injection causes the SCF-plastic mixture to start foaming. Tiny gas bubbles form on the glass fiber rods, which now grow until the material has solidified. Finally, a robot removes the finished injection molded parts from the mold and the process begins anew. Each of the three production lines produces 4000 parts per shift. In a three-shift operation, therefore, up to 36,000 doorlock housings for a total of 9000 vehicles can be produced every day.

This special injection molding process has many advantages over conventional compact injection molding. The use of nitrogen as blowing agent low-

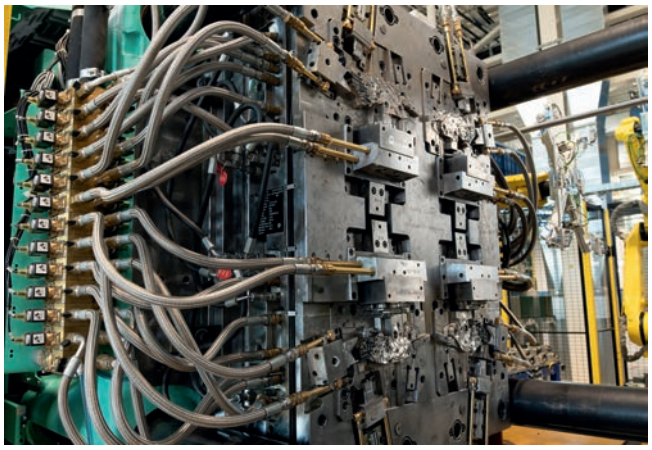


Fig. 1. The injection mold has four cavities, corresponding to a set of housings (two front and two rear doors) for each vehicle © Pollmann International

ers the viscosity of the melted plastic and so the melt exhibits improved flow behavior – to such an extent that molded parts having wall thicknesses of less than 1 mm can be produced. What is more, the components are up to 10 % lighter yet dimensionally more stable. The sink marks that are usually found on a component's surface are absent. In addition, cycle times during production can be significantly shortened and output increased accordingly.

Generator Plus Compressor System and Buffer Tank

The nitrogen for the MuCell process is produced on the Pollmann site by means of a nitrogen generator (type: PN 1450 OnTouch; manufacturer: Inmatec GaseTechnologie GmbH & Co. KG, Herrsching, Germany). Located on a platform along with a compressor system and a buffer storage tank (**Fig. 2**), the compressor utilizes pressure swing adsorption technology (PSA) to pass sterile compressed air through two adsorption vessels filled with a carbon molecular sieve.

Oxygen and carbon dioxide molecules from the ambient air are trapped on the sieve, while the free nitrogen molecules flow into the compressor. The latter compresses the gas, which ultimately flows into a buffer tank, to 25 bar. The tank can store enough nitrogen to cover two production shifts even when the generator is taken out of operation, e.g. for maintenance. The dry nitrogen generated by the system at a rate of up to 4.8 m^3 per hour has a purity of 99.99 % and can now be used in the injection molding machines.

Payback Period of about Two Years

In the past, the nitrogen at Pollmann was supplied from a bottle bundle comprising twelve bottles. However, this required constant supervision to monitor the levels and, as necessary, to order more; the newly delivered cylinders then had to be installed and connected up again. This changed in 2019 with the opening of the new production facility in Vitis, Austria. In keeping with the precepts of Industry 4.0, it was designed to boast state-of-the-art technology, efficient internal logistics, high energy efficiency and extensive automation. This meant that the company had to start looking for an alternative solution for its nitrogen supply in the early planning stages.

"We actively sought out solutions for the in-house production of nitrogen in order to optimize the processes in the new plant. Inmatec impressed us with its price-performance ratio – we expect the payback period of two to two-and-a-half years. Switching from bundles to in-house production has paid off," says Gerald Hauer, Head of Injection Molding at Pollmann's production plant in Vitis, before adding, "The Inmatec technology is highly reliable and failsafe. Furthermore, we are pleased to be able to lessen the burden on the environment and to reduce traffic volumes in this way." ■

Fig. 2. Inmatec nitrogen generator (far left). The tank on the platform to the right is the product tank (150 l), into which the generated nitrogen is first introduced under 6 bar. The second module on this platform is the compressor system. The large tank on the right is the buffer tank (500 l), which contains N_2 at 25 bar. From here, the pipeline leads to the injection molding machines © Pollmann International

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Service

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