



Witte Automotive reference report

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Gas-enabled technology innovates plastics processing at Witte Automotive

Meeting the strictest product quality and process efficiency standards

From streamlined door handles to complex mechatronic locking systems, Witte Automotive is a technology leader for secure, convenient vehicle latching and locking solutions. The company's success builds on its excellence in plastics processing. As a number of solutions developed in collaboration with Linde and deployed at the company's Czech plants in Ostrov and Nejdek demonstrate, the innovative use of nitrogen and carbon dioxide is playing a decisive role here.

Opened in 2016, Witte's Ostrov plant in the Northern Czech Republic complements its Nejdek plant 20 km away to form a specialist hub for the manufacture of door handle units with the associated technology modules. Ostrov focuses in particular on plastic injection moulding, coating and assembly.

When designing the Ostrov plant, Witte Automotive decided to capitalise on the opportunity to explore new plastics processing technologies for both the new and the Nejdek facility. Witte was convinced that the latest process innovations are the best way to maintain its strict quality standards while also improving process efficiency and thus minimising production costs.

Linde as technology partner for gases-enabled innovation

Drawing on their positive experience at their German production location in Bitburg, the decision-makers at Witte Automotive again turned to Linde as technology partner for the new project in the Czech Republic. The industrial gases and engineering company's extensive experience in plastics application technologies was another compelling factor in its favour. Under the overarching PLASTINUM® brand, Linde offers a broad portfolio of process technologies, plants and services for gases-enabled plastics processing – all offering sizeable efficiency quality gains. Supporting everything from gas injection moulding (GIM) to cooling, foaming and cleaning, industrial gases like nitrogen (N₂) and carbon dioxide (CO₂) have a wide range of applications in the plastics industry. Linde offers sophisticated solutions along with the complementary know-how to support every step in the processing chain. By sourcing its CO₂ as a by-product from chemical processes, Linde also helps to mitigate global warming by avoiding new emissions of CO₂.



The centrepiece of the PLASTINUM® Gas Injection Moulding technology in Ostrov: the PRESUS® N10 pressure booster, which is supplied with liquid nitrogen from a tank. (Source: Linde)

The specific objective in Ostrov was to optimise the production of exterior door handles. In Nejdek on the other hand, the focus was on solutions for foam injection-moulded bearing brackets. David Svoboda, head of injection moulding production at Witte Nejdek spol. s.r.o, explains what was required: “For us, the main objective of the new processes and plants was to fulfil the high quality requirements of our customers – both OEMs and Tier 1s – while at the same time guaranteeing a high level of efficiency to shorten cycle times and minimise reject rates.”

To date, Linde has implemented three systems for gas-based plastics processing at Witte Automotive: gas injection moulding with N₂ at Ostrov, CO₂ snow blasting at Ostrov, and mould core cooling with CO₂ in Nejdek. Also at the Nejdek plant, Linde supports MuCell foam injection moulding with N₂ cylinder bundles.

Spotlight on PLASTINUM® Gas Injection Moulding

Witte Automotive manufactures most of the handles in Ostrov as hollow parts with the use of gas injection moulding technology, or GIM. This method is particularly effective for thick-walled parts, complex contours and high-grade surface finishes. Gas is injected into the molten plastic at high pressure, displaces the melt from the core of the part and presses it against the mould wall. After solidification, the gas is vented from the component. Plastic parts with a hollow core offer a number of advantages over solid designs, including a significant reduction in raw materials and final product weight, greater stability and higher dimensional accuracy. Another benefit is the elimination of sink marks at spots where material accumulates.

N₂ is the standard gas injected into the plastic melt. Recent developments, however, indicate that CO₂ also shows great potential as the injection agent. It has a significantly better cooling effect than nitrogen, resulting in shorter cycle times. In addition, unlike water injection technology, there is no need to dry the parts or worry about leakage problems in the mould. Several Linde customers have already introduced gas injection moulding with CO₂ in series production. Witte

opted for the conventional N₂ technology, however, as the company in Germany had already been deploying this solution for several years.

Linde provided the Witte plant in Ostrov with an extremely energy-efficient, low-maintenance solution optimised to supply high-pressure nitrogen to the moulding machine. The concept is designed to supply high-purity nitrogen for a low reject rate and minimal cleaning effort for gas injectors, for instance.

The centrepiece of the PLASTINUM Gas Injection Moulding technology is the PRESUS® N10 high-pressure booster, which is fed with liquid nitrogen from a tank. The pressure booster compresses the liquid nitrogen prior to evaporation by means of a hydraulic slow-moving piston. This means that it consumes up to 90% less energy than conventional gas compressors. At the same time, the capacity is at least five times higher than standard compressors. And the fact that the components in contact with the media are free of oil eliminates the risk of gas contamination through contact with oil. The entire pressure boosting system including evaporator and buffer vessel is installed outside of the operation building near to the tank system.



One of the 5 million bearing brackets which Witte Automotive produces at its Nejdeč plant every year on one of its many injection moulding machines. (Source: Witte Automotive)

CO₂ snow blasting with CRYOCLEAN® Snow

Witte relies on Linde's CRYOCLEAN Snow solution to clean injection-moulded door handles before coating them. CRYOCLEAN Snow uses solid cryogenic CO₂, or dry ice, as a highly efficient cleaning agent. Special nozzles are used to expand liquid carbon dioxide to form the dry ice snow. Compressed air then accelerates the snow to sound velocity and blasts it onto the surface to be cleaned. These "microexplosions" gently wear away any contaminants as the CO₂ snow transitions from a solid to a gaseous state – known as sublimation. The very low temperature of the dry ice embrittles the dirt, enhanced by the fact that the base material and the dirt expand at different rates.

Unlike other, often aggressive, methods like power washing or rinsing with isopropanol, etc., the CO₂ evaporates after cleaning and leaves no residue. The fact that cleaning with CO₂ requires no chemical solvents or water makes it a particularly environmentally friendly solution. As well as preparing for the coating stage, the process is also suitable for the deburring of components and cleaning prior to injection moulding. A particular highlight of snow cleaning is that it eliminates the need to remove the moulds; they can be cleaned while they are still hot.

Linde's PRESUS C50 pressure booster ensures a steady supply of high-pressure carbon dioxide for the cleaning step. Redundant design and compressed air operation make these booster pumps extremely reliable. The PRESUS C50 is also highly flexible due to automatic adjustment of the mass flow rate in line with current needs. Finally, since it is supplied with a single pipe, installation costs are much lower than those of a ring pipe.



Witte relies on Linde's CRYOCLEAN Snow solution to clean injection-moulded door handles before coating them – the picture shows a typical handle before and after coating. (Source: Witte Automotive)

Focus on PLASTINUM® Mould Spot Cooling

In Nejde, bearing brackets are manufactured with the MuCell foam injection moulding process. Linde supplies the nitrogen for MuCell metering devices in cylinder bundles. Two parallel foam injection moulding machines supply the downstream assembly line. This set-up calls not only for consistently high product quality, but also very high throughput rates and thus short cooling times. A crucial factor here is even temperature distribution on the surface of the mould wall. The temperature of thermoplastic processing moulds is usually regulated with water fed through special channels. However, at the points where the space for cooling channels is limited, the conventional water-cooling method falls short. Long and thin cores as well as other hard-to-reach spots tend to be particularly problematic. In these areas, either no cooling channels or – at most – very thin ones can be implemented. As the latter are prone to clogging, high temperatures will occur at the mould wall. In addition to problems during removal from the mould, these hotspots can result in parts which are difficult to eject, with surface damage or deformation and may require longer cooling times.

These undesired effects can be counteracted with the PLASTINUM Mould Spot Cooling technology, which Linde developed in collaboration with

Kunststoff-Institut Lüdenscheid (KIMW). This patented process uses liquid CO₂ to cool thin mould cores. PLASTINUM Mould Spot Cooling generally reduces cooling and cycle times by up to 50% and even more in some cases.

At Witte's plant in Nejde, bearing brackets are manufactured in a 4-cavity mould with two thin movable cores per cavity for moulding screw bosses in the component. The challenge here was that the screw bosses ended up with pronounced deformations. In addition, the customer was looking to significantly accelerate the cycle time. By implementing PLASTINUM Mould Spot Cooling, narrow cooling channels were inserted into the mould cores to enable CO₂ cooling. This eliminated the deformations and reduced the cycle time by 14%.

The technology essentially consists of special capillary tubes which are inserted into the mould, a CO₂ control unit, CO₂ solenoid valves, a liquid CO₂ supply tank and a PRESUS C pressure booster.

Summary



Plastics project team at Witte Nejdek: Jaroslav Houska, Martin Vanek, David Svoboda, Kamil Husek and Karel Zuska. (Source: Witte Automotive)

The innovative use of nitrogen and carbon dioxide has helped Witte Automotive meet the highest product quality and process efficiency standards for the production of plastic parts at its Ostrov and Nejdek plants. Linde provided the enabling technologies with its broad portfolio of processes and systems for gas-based plastics processing.

After around three years of operation, the practical experience on site has remained extremely positive: "The machines are totally stable and are delivering the outcomes we expected," confirms David Svoboda from Witte Nejdek. "Our decision to go with Linde was based on the company's outstanding technical competence in plastics processing along with its bespoke and optimised gas supply concepts. We are completely satisfied that we made the right choice. Other positives that we experienced were excellent collaboration across borders, professional project management and constructive, open communication."

Getting ahead through innovation.

With its innovative concepts, Linde is playing a pioneering role in the global market. As a technology leader, it is our task to constantly raise the bar. Traditionally driven by entrepreneurship, we are working steadily on new high-quality products and innovative processes.

Linde offers more. We create added value, clearly discernible competitive advantages, and greater profitability. Each concept is tailored specifically to meet our customers' requirements – offering standardized as well as customized solutions. This applies to all industries and all companies regardless of their size.

If you want to keep pace with tomorrow's competition, you need a partner by your side for whom top quality, process optimization, and enhanced productivity are part of daily business. However, we define partnership not merely as being there for you but being with you. After all, joint activities form the core of commercial success.

Linde – ideas become solutions.

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