Making our world more productive

PLASTINUM®

Innovative gas solutions for the plastics industry.

Pressure in plastics.

Optimisation potential in focus

Demand for plastics continues to expand across a hugely diverse range of markets from packaging and construction through automotive and electronics to white goods and healthcare. As the plastics market expands and diversifies, it faces a growing number of challenges. Climate mitigation, for instance, is pushing manufacturers to reduce or – even better – eliminate the use of HFCs, HCFCs and hazardous chemicals.

At the same time, competitive pressures and globalisation are calling for faster cycle times, lower energy consumption, more economical use of raw materials and reduced scrap rates. Customer expectations around material strength and surface quality are also rising. In many applications, new lightweight materials and high-tech composites are replacing metals – especially in industries such as aerospace and automotive. In this challenging environment, manufacturers are keen to explore optimisation potential across the entire process flow.

Versatile and essential role of gases

Industrial gases play an indispensable role in a number of process steps in plastics manufacturing. They are used, for instance, as a blowing agent for extrusion and polyurethane foaming, as a pressure medium for gas injection moulding (GIM) and as a cooling agent for hotspots. Other typical applications include the cleaning of moulds and plastic parts, inerting, tank blanketing, EB & UV curing and tyre curing. Gases can also be found in downstream applications such as deflashing, emissions control or cryogenic grinding of plastics. Specialty gases are used to calibrate lab instruments for tests and analytics.

Particularly in the case of advanced processes such as GIM, foaming, spot cooling and cleaning, gas-enabled technologies can improve productivity and quality while reducing scrap rates, and thus contribute to your bottom line. Temperature control and cleaning applications can help meet rising demand for material strength and surface quality, while foaming processes are paving the way for the next generation of lightweight materials. In addition, ozone-friendly gases with low GWP help demonstrate an active sense of corporate social responsibility by replacing harmful chemicals and contributing to climate mitigation.

"As a comparatively small company, innovation is key in such a competitive environment. This joint research and development alliance with Linde gives us an early-adopter advantage that puts us at least one year ahead of the field."

Dietmar Engel, MD at Engel Formenbau und Spritzguss GmbH, German plastics specialist in conventional injection moulding and GIM pioneer.

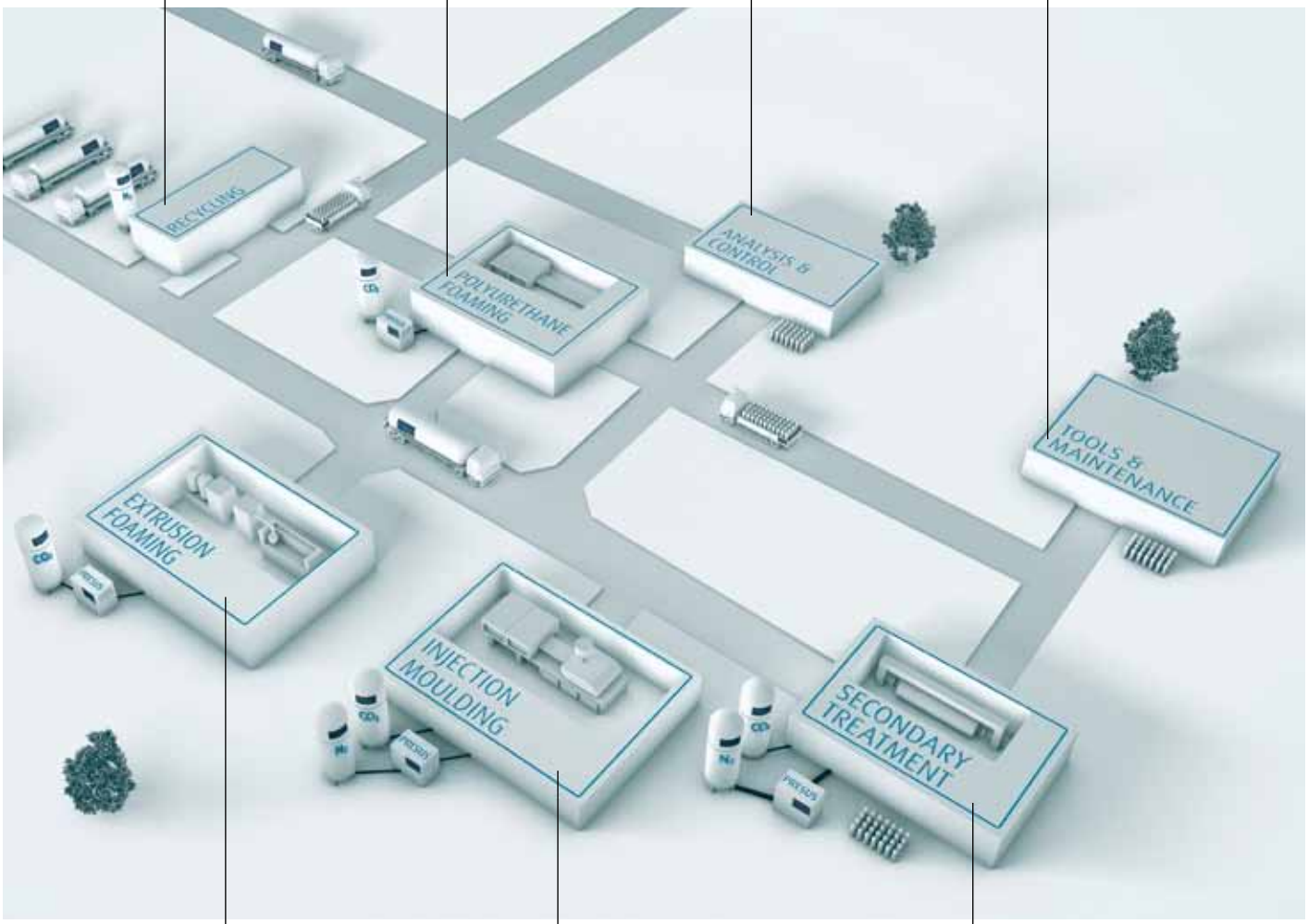
The role of gases in the plastics industry.

Recycling
→ Cryogenic grinding (N_2)

Polyurethane foaming
→ PLASTINUM® Foam P (CO_2)

Analysis and control
→ HiQ® specialty gases

Tools and maintenance
→ CRYOCLEAN® dry ice cleaning (CO_2)
→ Welding gases, e.g. CORGON®



Extrusion foaming
→ PLASTINUM Foam E (CO_2)

Injection moulding
→ PLASTINUM GIM (N_2/CO_2)
→ PLASTINUM Temp for mould tempering (CO_2)
→ Inerting of mould cavities and hoppers (N_2)

Secondary treatment
→ HiQ specialty gases for PVD/CVD
→ Inerting for UV/EB curing (N_2)
→ Fluorination
→ CRYOCLEAN snow (CO_2)
→ Deflashing (N_2/CO_2)

The environmentally friendly option
Carbon dioxide (CO_2) is used across a broad spectrum of industrial applications, plastics included. Like all gases, it must be stored and used correctly and safely – and this calls for specialist knowledge. We have developed a package of dedicated product stewardship services, which includes education and consulting, to support you in the safe handling and use of this gas. Committed to mitigating the effects of climate change, we seek to minimise our carbon footprint by recycling CO_2 instead of generating new streams of this gas. Consequently, around 80% of the CO_2 that we supply comes from chemical processes where the CO_2 occurs as a by-product – such as ammonia synthesis or ethylene oxide production. And the remaining 20% of the CO_2 we deliver originates from natural sources.

Infrared picture shows the temperature of a refrigerator handle 16 seconds after opening the mould. With carbon dioxide (right), the part cools down faster than with nitrogen (left).

Car headlight housing produced using PLASTINUM Temp S technology

PLASTINUM® highlights.

Our innovative PLASTINUM® portfolio is designed for reliability, bringing you productivity, speed and environmental gains. Not only does it accelerate cycle times, it also enhances product quality and lowers scrap rates. The following gives you an overview of just some of the highlights of our PLASTINUM family.

PLASTINUM GIM C

GIM often relies on high-pressure nitrogen gas to shape a hollow or channel in a moulded plastic part. Our PLASTINUM GIM C portfolio takes efficiency to the next level by replacing nitrogen (N_2) with carbon dioxide (CO_2). While matching the heat removal capacity and cycle times of water injection moulding, carbon dioxide does not leave any moisture on the products or mould, thus eliminating an additional drying step in the fluid injection cycle. In addition, it has a higher density and specific thermal capacity than nitrogen, which means it accelerates cycle times by as much as 30 percent.

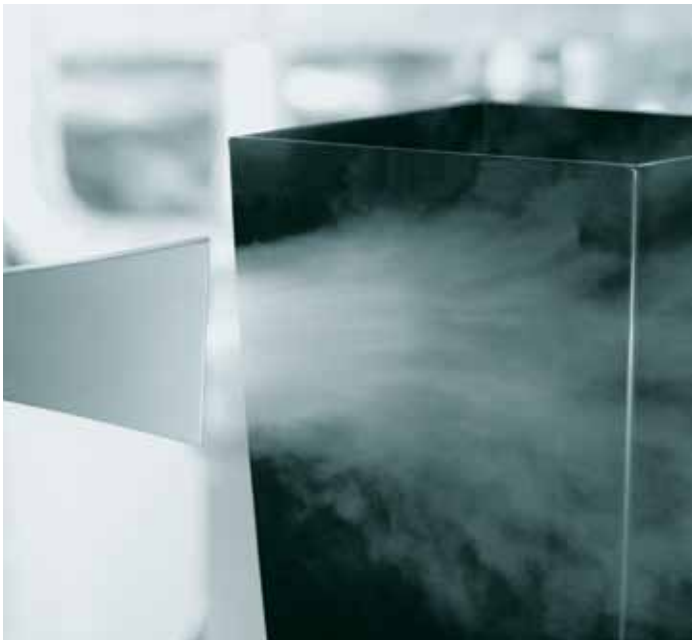
PLASTINUM Temp

This solution gives you advanced temperature control in plastics processing using liquid CO_2. It is ideal for areas of injection-moulded products that cannot be accessed with standard water cooling channels. Our sophisticated PLASTINUM Temp S temperature control solutions can access these “hotspots” and ensure uniform cooling with up to 50% faster cycle times. And our PLASTINUM Temp D variothermic temperature control technology is an effective way of enhancing surface quality with accurate reproduction of the mould surface.

PLASTINUM Foam E

In many plastic foaming applications, carbon dioxide is an attractive alternative to conventional blowing agents, especially if low densities and a high level of homogeneity are required. However, accurate metering of liquid carbon dioxide is a challenge. Our PLASTINUM Foam E portfolio was designed specifically to resolve this metering challenge. Our proven high-pressure gas supply and metering systems respond extremely quickly to changing counter-pressures to keep the mass flow of carbon dioxide constant for uniform, predictable foaming results.

Extruded polystyrene boards produced using PLASTINUM Foam E technology



Cleaning treatment of LECHUZA® garden planters with CRYOCLEAN snow prior to painting

CRYOCLEAN snow

CRYOCLEAN® snow is our environmentally friendly process for cleaning plastic parts prior to painting. It is based on liquid carbon dioxide and compressed air. Unlike conventional cleaning methods such as power washing or cleaning with volatile organic compounds, CRYOCLEAN snow does not release any chemical solvents and it does not leave any residue. Similarly, CRYOCLEAN snow eliminates water drying and limescale problems, thus accelerating cycle times considerably.

End-to-end high-pressure gas solutions

We have many years of experience in the development and delivery of innovative gas-enabled solutions tailored to the needs of the plastics industry to ensure the best possible results. We jointly developed our PLASTINUM high-pressure gas equipment, for instance, with Maximator, a leading supplier of high-pressure testing, hydraulic and pneumatic systems.

Reflecting state-of-the-art German engineering, our PLASTINUM technology package is built around our family of cost-effective, high-pressure gas supply and process solutions for both nitrogen and carbon dioxide including:

- Pressure boosters (PRESUS) – supply high-mass-flow liquid CO_2 or N_2 at constant high pressures
- DSD 400/500 inert gas metering devices – ensure accurate mass flow for extrusion and PU foaming and foam injection moulding
- Pressure control units – set and maintain the required pressure of gas during GIM processes

Our end-to-end offering includes tailored gas supply solutions based on the mode best suited to your volume needs, a large pool of test equipment for customer trials plus global service delivery capabilities.

State-of-the-art gas supply and process equipment. The right gas flow at the right pressure.

PRESUS N/C high-pressure boosters

Benefits
- → Fast commissioning
- → Easy installation
- → Low energy consumption
- → High reliability due to redundancy design

DSD metering devices for CO_2 foaming

Benefits
- → Accurate and stable mass flow even under extreme climate conditions
- → Automated and prompt reaction to process fluctuations

Pressure control units for GIM

Benefits
- → Precise pressure control for stable GIM process and high-quality results
- → Easy and flexible adaptation of production parameters

Partner of choice.

Linde is the partner of choice for plastics producers looking to exploit the full optimisation potential of gas-based technologies in plastics manufacturing. Using our Value Tool, we will advise you on the customised technology package that works best for your processes. This will include everything from the optimum gas and delivery mode through supply and process equipment to training and servicing. Our experts will explain how gas-enabled innovations can be implemented in your current process flow to ensure the highest possible efficiency and quality improvements.

For more information, please visit www.linde-gas.com/plastinum or send an email to plastics.rubber.team@linde.com

Quality control of refrigerator handles confirms the high process reliability of PLASTINUM GIM C.

"To align with the Montreal Protocol and following extensive evaluations, we selected Linde to supply our high-pressure gas solution. Linde helps us meet our corporate responsibility goals and also outperformed the competition in terms of stability and accuracy, aftersales service and general running costs."

Liu Ming, General Manager at Wuzhou Beijing Foam Plastics Co., Ltd., a leading manufacturer of EPS and XPS in China. Its vision is to actively contribute to energy savings and a green China.

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