

## PLASTINUM™ Temp D. Dynamic mould temperature control with carbon dioxide (CO<sub>2</sub>).



Temperature control unit for CO<sub>2</sub>

**Introduction** We have many decades of experience in the development and delivery of innovative gas-enabled solutions tailored to the needs of the plastics industry. Addressing the process challenges of both injection moulding and foaming applications, our end-to-end offering extends from high-pressure supply and metering systems through cooling technologies to total gas supply solutions and supporting services. By innovating our customers' plastics processes, we help to increase capacity, improve quality and boost profitability.

**Challenge** Demand for injection-moulded plastic parts is rising. However, injection moulding faces a number of challenges, many of which are related to the surface quality. These include the need for a seamless surface and accurate reproduction of the mould surface for enhanced surface quality. Our PLASTINUM™ Temp D technology is an effective way of meeting these challenges. It involves controlling the mould temperature according to a defined temperature profile during a given injection cycle – rather than holding it at a constant level. With dynamic injection moulding, the mould surface is actively heated and cooled.

**Solution** We partnered with gwk GmbH and ISK GmbH to resolve the dynamic challenges, jointly developing an innovative and efficient heating and cooling solution using carbon dioxide (CO<sub>2</sub>). This all-in-one solution relies on one medium to both heat and cool, using the same close-to-surface channel system integrated in the mould inserts for both processes. This eliminates the need for separate heating and cooling systems.

Temperature control with CO<sub>2</sub> opens up a whole new range of possibilities. It accelerates cycle times, enabling complex geometries and narrow mould areas to be cooled and heated very quickly and homogeneously. By replacing water, it avoids problems associated with fouling of tempering channels. Channels for CO<sub>2</sub> are very thin and thus give manufacturers high design flexibility. This technology also supports seamless finishes by eliminating joint lines. In addition, heating/cooling with CO<sub>2</sub> is an environmentally friendly choice. This technology is ideal for parts requiring high surface quality (e.g. optical, medical, high-gloss components), parts with complex or thin geometries and foamed parts requiring good optical surface quality.

**In detail**

Before injecting the plastic melt, hot gaseous CO<sub>2</sub> flows through the tiny channels. At temperatures of 300°C or higher and at defined pressures, CO<sub>2</sub> offers excellent heat transfer properties. The mould area is thus heated extremely efficiently. The CO<sub>2</sub> circulates in a closed system with a heater based on high-performance heating ceramics. An open system would also be feasible with gaseous CO<sub>2</sub>.

When the plastic melt is injected into the cavity, liquid CO<sub>2</sub> is injected into the channels in order to quickly cool the part. The expansion to atmospheric pressure generates a mixture of CO<sub>2</sub> snow and gas at a temperature of -79°C. This results in highly effective cooling action, with the CO<sub>2</sub> removing heat from the mould and releasing it to the atmosphere.

**Benefits**

- High cooling and heating rates
- Heating/cooling of narrow mould sections with complex geometries
- Same medium for cooling and heating
- Same tempering channels for heating and cooling
- Only one heating/cooling system to be incorporated into the mould
- Minimised amount of mould steel involved in heating/cooling
- No deposits or clogging in tempering ducts
- Completely dry process – no humidity in the system
- Flexibility – technology can be applied to the whole mould or to particular surfaces/areas of the mould

**Equipment**

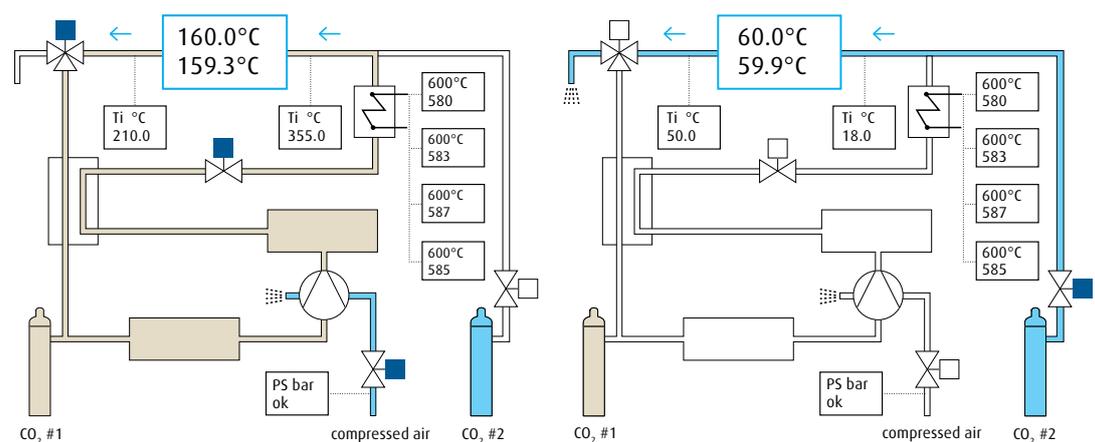
Dynamic mould heating/cooling with CO<sub>2</sub> uses a compact temperature control system jointly developed by Linde and gwk. The system is manufactured by gwk. A custom-designed turbo heater and heat exchanger minimise energy consumption. Our partner gwk also delivers the requisite customised mould inserts, building on our long-standing expertise in CO<sub>2</sub> cooling. These inserts allow manufacturers to maximise the potential of CO<sub>2</sub> and ensure the temperature is homogeneously distributed across even larger surface areas.

The right CO<sub>2</sub> supply concept is essential to ensure stable, predictable cooling results. Depending on individual needs, we offer various CO<sub>2</sub> supply solutions, usually consisting of a CO<sub>2</sub> tank in combination with dedicated pressure boosting equipment or cylinders/bundles with dip tubes.

**Supporting services**

Together with our cooperation partners gwk and ISK, we ensure you maximise the return on your investment in PLASTINUM Temp D with a broad portfolio of supporting services:

- Feasibility study of CO<sub>2</sub> temperature control for each product
- Installation of a suitable CO<sub>2</sub> supply system based on your needs and production environment
- Start-up assistance



Heating process

Cooling process

**Linde AG**

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