

Kraft Curing Systems GmbH, 49699 Lindern, Germany

UK-Based Explore Manufacturing Modernise their Curing System on a High-Speed Carousel Line

■ Daniel Rafter, Kraft Curing Systems GmbH, Germany

Laing O'Rourke is the largest privately owned engineering and construction company in the UK, employing over 10,000 people across Europe, the Middle East, and Australia, with a diverse portfolio spanning multiple sectors. In 2009, the company set up Explore Manufacturing, a cutting-edge precast factory located in the East Midlands. Built on the site of a former brickworks and colliery, the factory was designed to enhance the company's offsite manufacturing capabilities, enabling the production of high-quality precast elements in a controlled environment. This innovation facilitates the rapid assembly of structures for construction projects across the UK.

Now celebrating 15 years of operations, Explore Manufacturing has become a well-established leader in the production of precast elements. Since its inception, the facility has produced nearly 300,000 components for over 300 buildings and infrastructure projects across the UK.

Project Overview

One of the three production lines at the Explore Manufacturing facility is the HSC or High-Speed Carousel, an automatic pallet circulation line with the capability to cast four to six pallets per hour containing a variety of precast wall elements. Each pallet has a typical concrete load of up to 13,500kg. The carousel line is equipped with an insulated curing chamber consisting of four pallet towers with a maximum of 18 pallets per tower. In 2009 Explore Manufacturing acquired a curing solution which was installed across the three production lines, including the larger HSC line. Each of the three curing systems was supplied with a gas-fired hot air generator to provide heating and air circulation.

In 2021 Explore Manufacturing approached Kraft Curing Systems to discuss if there were improvements that could be made to the current curing systems. New, slower reacting cements were being considered for future trials and the



Kraft provided a 22" touch panel with a clear and intuitive home page, enabling operators to easily monitor key system parameters such as temperature, humidity, and fault status at a glance. The main supply duct, visible in the background, was retained from the original installation and reconfigured to deliver hot air at floor level.

company wanted to increase throughput at the HSC and to improve the quality of the finished concrete elements. Following several on-site surveys and technical proposals, the solution was chosen and the customer moved forward with Kraft Curing Systems. The order included a replacement hot air generator, moisture addition system, moisture extraction system and a comprehensive control system. The order was realised in early 2023, with planned implementation at the end-of-year maintenance shut-down.

The Solution – Air Circulation

Considering the existing curing system was relatively modern, Kraft worked to retain as much of the old system as possible, reducing cost for the customer and overall installation time. Firstly, the supply ducting design was changed. The multilevel hot air outlet system inside the chamber was modified by blocking off the outlets, and removing the end section of the duct. Additional ducting and a 90-degree bend was added to the now open end, to channel the supply air flow along floor level to the front of the chamber. This meant that the hot air flow was now delivered laterally at floor level, along the full length of the production pallet. This allows the warm air to gently rise to the upper parts of the chamber for recirculation, without direct airflow across the product. The airflow, now over the full-chamber depth, drastically improves the consistency of the climate. Special adapter pieces were supplied to facilitate connection of the main ducts to the new Kraft Convect-Air® unit.

In conjunction with the ducting activities, some maintenance and improvement works were carried out on the curing chamber itself. The old breakthrough points for the ducting were patched with insulating material and sealed. All curing chamber flashings were removed to allow sealing of the sandwich panel connections with expanding foam. The aim was to remove thermal bridges from the chamber, reducing heat loss and preventing condensation. With the curing chamber now planned to operate at much higher relative humidity level than ever before, it was essential that any leakages to the insulating envelope were abated. Meticulous planning and coordination with the customer ensured that the complete mechanical and electrical installation was completed on schedule, and just before the Christmas break. Commissioning was planned for early 2024 following completion of the power and water supply work.

The Solution – Humidity Addition System

Curing concrete products within dry conditions can result in surface cracking, brittle edges and corners and other unwanted product defects. To minimise these potential issues Kraft supplied the AutoFog™ moisture addition system. The AutoFog is



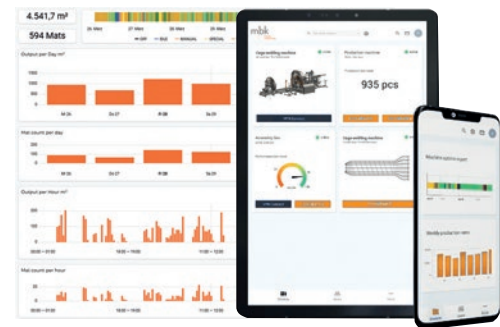
The 100kg/hour AutoFog moisture addition system introduces steam directly into the air circulation supply ducting, increasing the relative humidity in the curing chamber whenever required.



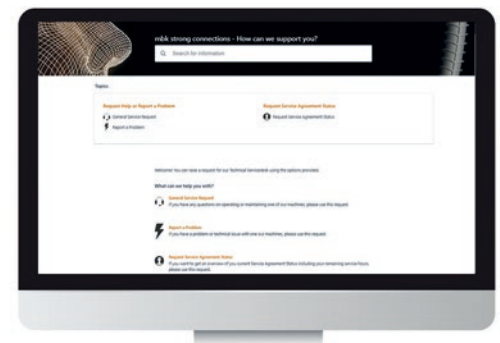
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a standalone electrical evaporator which operates at atmospheric pressure and is available in several outputs. The system can be easily retrofitted into virtually any existing curing system which utilises some form of air circulation system. This system increases the relative humidity within the chamber by introducing steam through eight large diffusers directly into the main warm air supply duct. Water-misting based humidity addition systems with micro nozzles are still very much commonplace in the market.

The AutoFog steam system offers a number of notable benefits over misting systems, including all equipment being centralized for ease of maintenance, steam is more readily dispersed into the environment, and the use of contaminant-sensitive micro nozzles is not required, making the unit more reliable and lower in maintenance. Delivering humidity in this manner, ensures that the airflow can carry the steam into the main chamber for further distribution into the curing environment. Very consistent humidity dispersion can be achieved in this way, preventing unwanted condensation in ducting and water pooling on the chamber floor. Because there are no nozzles in the chamber itself, and the nozzles installed within the duct are maintenance-free, all service work to the AutoFog can be carried out safely from outside of the curing chamber, and without disruption to production or heating and circulation within the chamber. This particular AutoFog has a large steaming capacity of 100kg per hour, ensuring a minimum relative humidity of 80% at 40 degrees

Celsius can be achieved. Various size units can be supplied depending on the project. A comprehensive reverse osmosis water treatment system was supplied by Kraft to prevent scale build up within the boiling vessel. An intelligent internal control system within the AutoFog provides regular and automatic cylinder flushing to not only remove sludge build-up but also eradicate any potential risk of exposure to Legionella if the AutoFog unit is out of use for an extended period.

The heart of the Kraft curing system is the Convect-Air, air-heating and circulation unit. The Convect-Air is specifically designed for this application, carousel curing chambers for the precast industry. Powerful inboard radial ventilators provide circulation within the curing chamber. The materials used in its manufacture allow for a long, reliable service life, even in high-humidity environments. In order to meet the relatively large hourly heat requirement, which includes four to six incoming steel pallets per hour along with a generous concrete load, a 500 kW heating system was calculated to be sufficient. To take advantage of a locally available, sustainably generated electricity source, Explore Manufacturing opted for an electrical resistance heating solution, including a multi-step heater control cabinet. Although this particular system is heated using an electrical resistance heating bank, the Convect-Air system is available with a number of potential heat sources including – multiple gas types, multiple oil types, hot water and even steam, depending on what is available to the customer and economical to use. There is also the pos-



*Left: KC 500 Convect-Air air heating and circulation unit connected to the original ducting.
Right: Electrical load cabinet which provides multi-step control of the 500 kW electrical resistance heater, designed to provide a minimum curing temperature of 40 degrees Celsius year-round.*



Above images - Due to the compact design, the equipment fits into a small area, where it does not interfere with plant operations

sibility to supply different performance combinations, with reduced heating capacity or increased air circulation for example, which can be selected based on the curing chamber size and the hourly heat load. Convect-Air working in combination with the carefully designed ducting provides Explore

Manufacturing with a consistent, elevated curing temperature to allow sustained production in cooler months and to future-proof the solution when using cements which are less reactive and require additional heat input to maintain manageable curing times.

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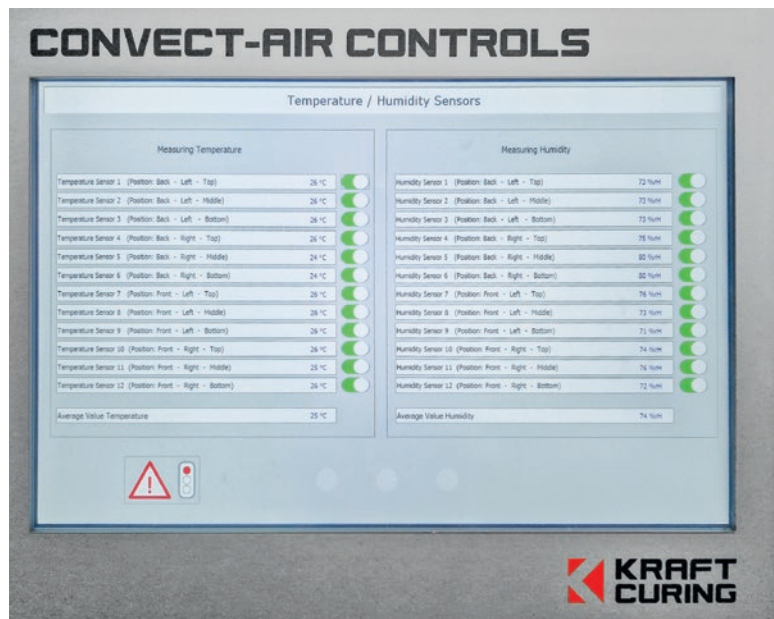
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Redirecting the hot air supply from the multi-level outlet system on the rear wall to a floor-level outlet system was crucial to the system's success. This adjustment enables the heating of pallet and concrete products through indirect air flow.

To coordinate the operation of the supplied equipment, Kraft utilises a fully automated curing control system known as AutoCure®. This PLC-based system is equipped with a 22" touch panel, providing a user-friendly interface for easy monitoring



A large array of twelve temperature and humidity sensors record the curing conditions across three levels inside the curing chamber

of the equipment status, curing functions and parameters. As per the customer's request, twelve combination temperature and humidity sensors are strategically placed across three levels to measure chamber conditions accurately. Additionally, the system includes a VaporWare® V2 industrial PC and software. Developed in-house by Kraft, this system records all curing parameters in 24-hour intervals. This feature enables the customer to archive curing reports for quality control purposes. The system generates two reports from each cycle: one, customisable for internal use, and another, tamper-proof report intended for presentation to the client where required. The latter ensures that the delivered product meets quality

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standards by linking production batch numbers to the actual curing conditions it underwent. The VaporWare V2 system is fully customisable to meet the specific needs of each customer. AutoCure also comes with a service router and an Access Anywhere license, enabling customers to connect to the touch panel from any device—whether desktop, laptop, or mobile phone—to view or make adjustments remotely. Additionally, Kraft can connect to the system to assist with program adjustments or troubleshooting.

To conclude, the system has now been in successful operation since 1st of February 2024. Following the commissioning of the system, the customer has noticed a significant decrease in the curing duration of the precast elements, with a reduction from 18 plus hours, down to a maximum of 8-10 hours. With the hot and humid curing conditions, offering improved hydration rates in the corners and edges of the slabs improving the durability in these normally vulnerable areas, preventing unwanted blemishes and damage during demoulding and handling.

As part of the order from Kraft, Explore Manufacturing specified a comprehensive spare parts package and have subsequently signed up with Kraft for a long-term, twice-yearly service and maintenance contract. These measures will ensure the efficient and reliable operation of the system for many years to come. ■



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