

# Accelerated concrete curing using radiant heat

■ Mark Küppers, CPi worldwide, Germany

**Growth in metropolitan areas and their inhabitants' demand for rapid transportation present many of the world's major cities with extensive infrastructural challenges. Tunnels, constructed with tunnel boring machines and lining segments, offer a fast and safe solution for almost any dimension and type of ground conditions. With its many years of experience, Herrenknecht Formwork offers integrated, technical solutions for all dimensions and requirements when producing lining segments. From formwork, circulation systems and handling equipment to entire facilities including hall, cranes and mixing facility - Herrenknecht adapts to every situation and can design a solution that meets requirements. The company depends on the ThermalCure® system from Kraft Curing Systems for optimum curing with concrete lining segments.**

Herrenknecht Formwork, founded in 2007 as a wholly-owned subsidiary of Herrenknecht AG, shares 40 years of know-how and experience with a world market leader in mechanised tunnelling technology and is thus part of a professional group with a guaranteed future, global expertise and an excellent service network.

Customers appreciate the professionalism and commitment with which its employees approach and implement their projects: competent, cooperative support from the first contact to a project's completion.

Herrenknecht Formwork has produced over 8,000 precision formwork units to date and successfully completed over 300 projects worldwide. For the future, the company is focusing on further automation and sustainability. Its main emphasis will continue to be on working in partnership with customers.

## Stationary production - simple and efficient

With stationary production, all formwork is firmly fixed to the workshop floor. Specific vibration dampers and adjustable supports ensure optimum concreting results. The advantages are a fast, uncomplicated set-up in combination with

high production output. Existing production facilities can be adapted with little effort.

At the planning stage, Herrenknecht takes into account all relevant factors such as tunnel length, targeted tunnelling speed as well as individual space conditions and personnel situations. Sophisticated concrete logistics, including a crane system plus concrete transport and concreting buckets with a cleaning system, contribute to optimising cycle times. In addition, Herrenknecht's many accumulated years of proficiency in efficient stationary production work also includes customised heating systems, for which Kraft Curing Systems from Lindern, Germany, supplies the appropriate equipment and expertise.

## ThermalCure

The ThermalCure concrete curing system generates hot water at 80°C to 110°C in a low-temperature boiler, allowing a maximum concrete temperature of 40°C to 68°C to be achieved. The temperature is controlled fully automatically by temperature sensors and valves.

The system circulates hot water continuously through a finned hot water pipe system that delivers the radiant heat required for accelerated curing under the segment moulds. Its finned heat pipe radiators have been especially designed for the requirements of accelerated concrete curing using radiant heat. There is no interference with the actual production process since the radiators are located under the moulds.

The ThermalCure heating unit provides 93% efficient hot water generation and storage. The unit is available either on a carriage or as a container unit. The heat distribution system allows moulds to be heated independently of one another.

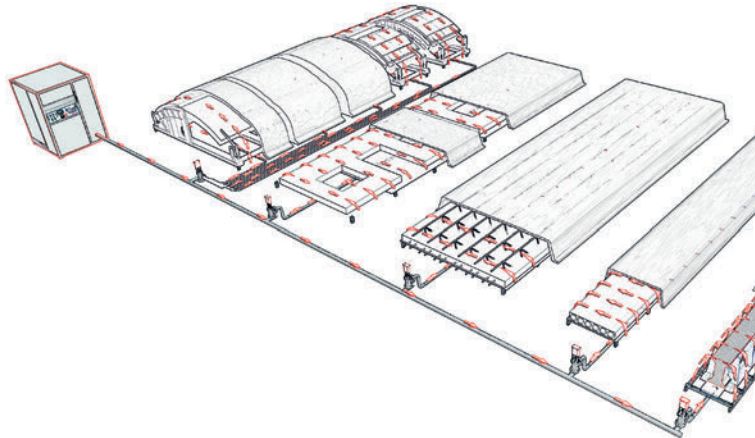
Production can be carried on without supervision thanks to the automatic AutoCure® control unit. This automated system can prevent heating up too slowly or too quickly. Harmful excess temperatures can also be prevented by the AutoCure

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*The ThermalCure heating unit continuously pumps hot water or steam through a high-performance finned pipe system*

system; the results remain constant. The moulds are filled with concrete, covered with a tarpaulin and then the heating process is started.

The system can be operated with diesel, natural gas or propane gas burners and also as a hot water or steam heat exchanger. Products attain high early strength due to the uniform heat.

## Example Project

An Austrian precast production facility manufactured a large number of segments for a tunnel project. In this case, Kraft's ThermalCure system was also employed using stationary production with Herrenknecht segment moulds to ensure very high, uniform product quality as a result of the optimised, controlled curing conditions.

The ThermalCure unit has a 700 kW burner and is permanently installed in a container outside the production building. The concrete curing area is divided into 24 zones, with a low-temperature boiler supplying hot water via inlet and return pipes to the moulds via 24 different valves. The 110°C hot water causes the steel moulds to be heated by the finned pipe sections located underneath the moulds. These high performance finned pipes especially built for Kraft offer bet-



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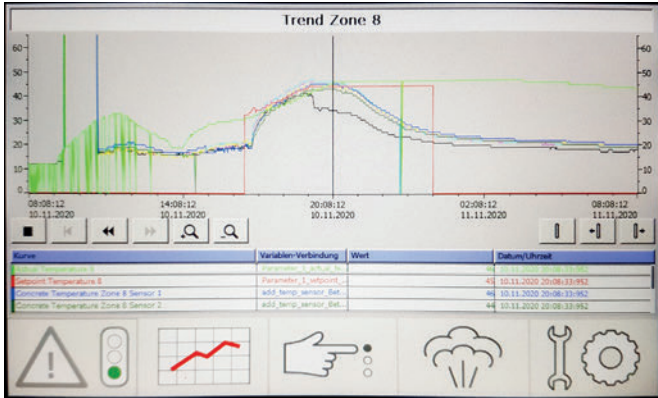
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ter efficiency than standard finned pipes due to the increased number of fins per linear metre, which reduces the amount of piping, as well as the space required and installation time and costs. The hot water is distributed in the ribbed pipes and the mould is heated by the radiant heat. Protection covers over the concrete moulds prevent heat from escaping unnecessarily. The ThermalCure system was additionally utilised to provide comfort heat in the hall.

The system makes it possible to keep curing times significantly shorter by heating the moulds to a maximum temperature of 60°C. Manual shut-off valves upstream and downstream of the automatic valves permit easy and quick maintenance without draining the system.

The automatic AutoCure control unit allows temperature and duration to be set via a large, high-quality display. The tem-



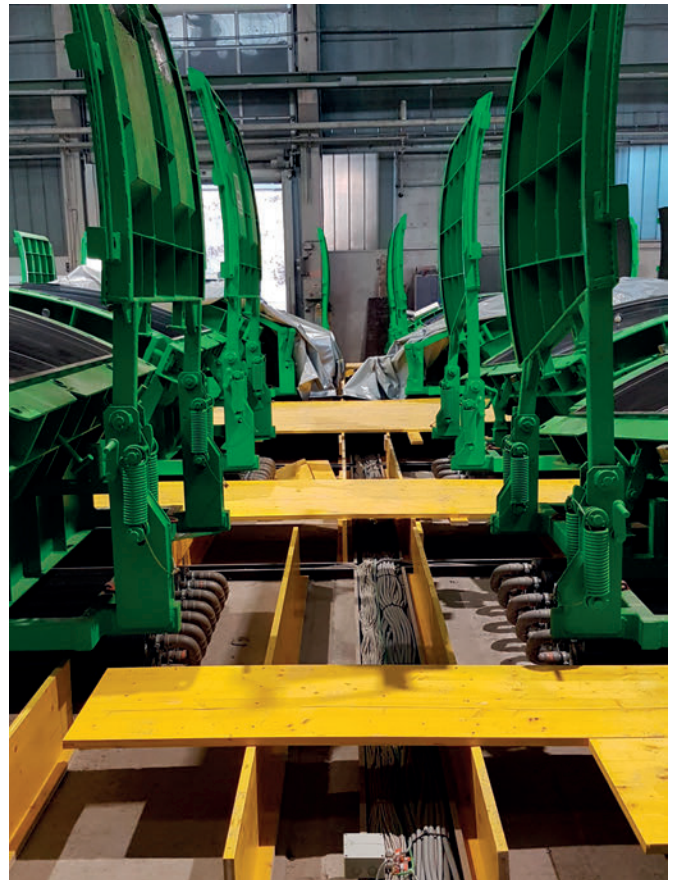
Screenshot from the AutoCure system showing the trend line in one of the 24 zones



ThermalCure system made by Kraft is also in operation producing lining segments in Austria



Heat distribution system designed by Kraft Curing



The production area in the Austrian factory is equipped with twenty-four segment moulds

peratures of the 24 moulds can be controlled fully automatically with AutoCure, and are read by temperature sensors and valves. A type K Thermocouple temperature sensor performs temperature measurements, so that values can be read per mould. A Type K sensor consists of two metal wires that are inserted into the fresh concrete element to perform a concrete core measurement, with the VaporWare® V2 software taking care of data recording. VaporWare measures, archives and prints, for example, the curing temperature and its duration and can define events, such as changes to set-point specifications or alarms and faults in a protocol. ■

FURTHER INFORMATION



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