

Kraft Curing Systems GmbH, 49699 Lindern, Germany

# Accelerated Concrete Tunnel Segment Curing for the Albvorland Tunnel

■ Josef Hammerschmidt, Kraft Curing Systems GmbH, Germany

For the Stuttgart-Ulm railway project a new high-speed section is being built from Wendlingen (Neckar) to Ulm alongside the A8 motorway. The new section will offer a fast and convenient way to get over the Swabian Alb. Regional, national and international travel times will be significantly reduced. The Baden-Württemberg region will be permanently incorporated into the European high-speed network. The section includes the approximately 8 km-long Albvorland Tunnel between Wendlingen and Kirchheim unter Teck. The production of the precast concrete tunnel liner segments required for the construction of the tunnel, are cured with a system that is designed, supplied and serviced by Kraft Curing Systems.

Deutsche Bahn has awarded the contract for the section to Implema Construction GmbH. It will be built by specialists from the tunnel, special underground and civil engineering sectors. The Albvorland Tunnel consists of two tunnels, each approximately 8 km long with an external diameter of 11 m.

Herrenknecht AG from Schwanau was awarded the contract for the tunneling equipment. Two tunnel boring machines are in use, each is approximately 120 m long and weighs about 2,300 tonnes. The tunnel boring machines are 11 m in diameter. The drive power of the rotating cutting wheel is around 4,400 kW per machine.

The Herrenknecht subsidiary, Formwork, is supplying the equipment for the production of the precast concrete tunnel segments in Kirchheim unter Teck. The challenge in erecting the field factory is to erect a tubing production hall on an area of a limited size in which the available space is used optimally with regard to the correct balance between production and storage capacity. The planned tunneling speed and the daily tunnel segment requirement derived from it thereby play a decisive role. In order to guarantee that the moulds are used twice per day, it is necessary to heat both the moulds and the production building.

Implema Construction GmbH and Herrenknecht Formwork turned to Kraft Curing Systems from Lindern near Oldenburg, to overcome this challenge within the specified schedule.



Overview of the tunnel project



For the current project, the Albvorland Tunnel, Kraft is supplying the Thermalcure® concrete curing system, whose core (water heater) is installed in an insulated, ventilated and frost-protected container.



*Thanks to the specially designed water heater a high water temperature of up to 110 °C is reached without steam being produced.*

Kraft Curing Systems has already equipped several tubing production plants. These include two projects in Egypt, the Metropolitan Light Rail in Israel and the Vancouver BC Evergreen Line in Canada.

For the current project, the Albvorland Tunnel, Kraft Curing is supplying their Thermalcure® concrete curing system, whose equipment (water heater) is installed in a 20-ft. insulated,



*The hot water is circulated underneath the individual tunnel segment moulds via insulated supply and return pipes.*



## Production Engineering and Automation Systems for the Prefabricated Concrete Element Industry

- | Stationary line production
- | Tilting station
- | Pallet circulation plants
- | Transport and handling systems
- | Multi-Function-Shuttering-Robot (MFSR)
- | Concrete distribution systems for all purposes
- | Compacting systems
- | Finishing equipment
- | Shuttering systems
- | Shuttering for special purpose elements
- | Moulds for garages/moulds for rooms/special purpose elements
- | Shuttering for skeleton building systems
- | Moulds for columns/moulds for girders/moulds for TT-elements
- | Insulation-Process-Application-Robot (IPAR)
- | Shuttle-Processing-Plant (SPP)



ventilated and frost-protected container. The maximum output of the water heater is 1300 kW/h. The heating requirement was determined by Kraft Curing Systems and the system was designed in order to provide heating capacity for both the concrete production moulds and comfort heat for the production building. 36 high-performance circulation ventilators provide heat to the working areas in the production building.

Thanks to the water heater design, a flow temperature of up to 110 °C is reached without steam being produced. Hot water is circulated through high performance radiant heat pipes under the individual tunnel segment moulds - 77 in all - via insulated supply and return manifolds. The radiant heat pipes under the tunnel segment moulds are high-performance ribbed pipes, which generate up to 600 Watts of radiant heat per linear meter and thus heat the moulds up to 60 °C in a controlled manner as necessary.

The demanding requirements for the mould heating necessitate a sophisticated system. It is possible to heat every single



*High-performance ribbed pipe, located underneath the moulds, generating 600 Watts of heat per linear meter are capable of heating the concrete segments to 60 °C in a controlled manner as necessary.*

### Positive business development brings growth in all areas

Kraft Curing Systems GmbH has undergone rapid development in recent years. The company's curing systems are in demand worldwide as the need for the individual designed solutions has grown. This is proven most impressively by the figures from the past years; for example the order volume: whereas 26 systems were manufactured and delivered in 2013, that number had already grown to 75 in 2016.

Kraft Curing Systems has also grown continuously as a company in order to keep up with this very positive development. Whereas the workforce numbered 12 people in 2013, that figure had already doubled by 2016 and has grown significantly once again in 2017 so that the high order volume can be handled in the interests of increased customer satisfaction.

More design engineers and electrical technicians are now providing for considerably higher capacities in production and customer service and these were urgently needed, too, so that the orders can be handled within an acceptable time frame.

Of course, the additional production capacity requires additional space which was no longer adequate. For that reason, Kraft has recently built a new production building with a production area of 450 m<sup>2</sup> next to the existing offices and production building. Material fabrication such as the welding, grinding, cutting and other fabrication of steel components will be completed in the new production building, whilst the "final manufacture" can now be found in the existing production building. This is where the individual components are assembled into tested, ready-to-deliver systems.

At Kraft Curing a multilingual Customer Service team - which has also grown from 3 to 8 technicians - ensures that the customer gets help as quickly as possible: with enquiries for new systems, the handling of the order and service matters.



*Kraft Curing Systems GmbH headquarters in Lindern has been extended by a new 450 m<sup>2</sup> hall.*

one of the 77 moulds separately from one another with certain temperature and curing duration parameters. Kraft Curing's AutoCure® automatic concrete curing control system makes this possible through the use of predefined temperature or curing curves. AutoCure provides several concrete curing phases (Preset, Ramp, Soak, Cooldown) and uses the measured data from a temperature sensor, located on each steel mould, to control an automated valve that controls the flow of hot water. Each mould has a fully automated valve and a temperature sensor that supplies the accurate concrete temperature through direct contact with the concrete. The entire system is operated by four 9" color touch panels, which are assigned to four production zones in order to reduce walking distance for production personnel and to rule out any possible confusion of the many moulds. Each visualization is individually configured for each operating zone.

In drawing up the concept, it was important to consider that each tunnel segment must be cured with a defined temperature curve and that this process is controlled and recorded. This individual control ensures that the quality results are the "constantly consistent" in the hot summer and the cold winter. The system also allows of multiple casting of the segment moulds.

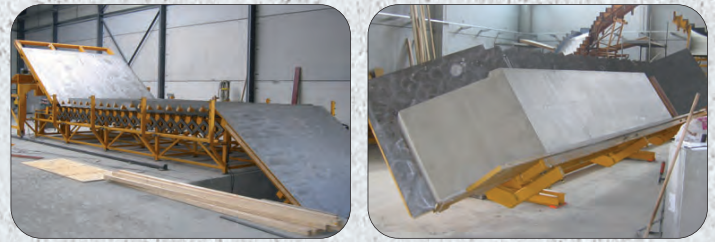
For 28 years, Kraft has been manufacturing controlled concrete curing systems for every kind of precast concrete element and has installed more than 1,000 systems during that time. Due to the high demand for its products, also caused by the continuously growing concrete quality requirements and shortened production schedules of large infrastructure projects (in order to reduce disruption), Kraft Curing Systems is able to verify that controlled and accelerated curing and consistent climatic conditions are becoming increasingly critical to producers of precast concrete elements. ■

FURTHER INFORMATION



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