

272 metres of large profile in 48 hours High-speed rehabilitation of walkable oval profile sewers using GFRP pipe liners

It is common knowledge that trenchless [sewer rehabilitation](#) offers significant advantages in speed over open-pit methods. However, the rehabilitation of 272 metres of a walkable oval profile sewer within 48 hours remains an astonishing feat. Yet this is what happened in Kaiserslautern, Germany, where experts from Leipzig-based tubus GmbH used a BB^{2.5} light-curing [GFRP](#) pipe liner by Brandenburger to rehabilitate a 125-year-old collection drain in late summer, 2014.

The history of wastewater sewers in Kaiserslautern goes back well into the 19th century. The first sewers were built around 1890 and include, among others, two mixed water collection drains under Pariser Straße, as well as 7 conduits under Trippstadter Straße. The two concrete oval profiles, 800/1200 and 900/1350, respectively, are partially fitted with an integrated earthenware gutter. However, this has not prevented mechanical wear and the loss of wall sections to the left and right of the pipe's base. This type of damage necessitated a timely rehabilitation simply for reasons of operational reliability. Open-pit rehabilitation was impossible in both cases due to time constraints imposed by higher-level construction projects. The collection drain in Pariser Straße is at 9 metres depth. In the densely built-up Trippstadter Straße, the collection drain runs parallel to a railway. In consideration of the sewer's poor structural condition as well as the important function of both collection drains in the sewer network, a short downtime was highly desirable.

Following an evaluation of various rehabilitation methods, a call for tenders for an inliner procedure using UV light-curing [GFRP](#) was issued. Even at relatively low wall thicknesses, [GFRP](#) liners offer excellent structural properties. Moreover, the light curing procedure is currently the fastest method available, a very important point when considering the lengths of 272 metres (Pariser Straße) and 502 metres (Trippstadter Straße), to be installed in a total of six separate segments. It goes without saying that a short downtime is essential for collection drains of such importance. In the tendering process, the Leipzig-based tubus GmbH emerged as the winner, with a concept using BB^{2.5} [GFRP](#) liners by Brandenburger Liner GmbH (Landau), in a pure UV version without peroxide support. This removed the need for maintaining a cooling chain during the transport and installation of the liners. The light-curing liners tolerate storage, which enabled interruptions in the sensitive project, e.g. due to weather.

A prerequisite for the [liner installation](#) was, after re-routing the wastewater above ground, to restore the damaged base and walls of the oval profile. This was done manually by filling with a quickly hardening mineral mortar. After the profile had been restored and groundwater leaks sealed, the sewer was ready for the [liner installation](#).

The new BB^{2.5} [GFRP](#) liner system by Brandenburger offers significant benefits, especially for large diameter sewers. One advantage is good transparency, which enables curing using only UV light for wall thicknesses up to 15 millimetres. The BB^{2.5}'s long-term [modulus of elasticity](#) of 11,180 N/mm² provides good structural strength even at relatively low wall thicknesses. This allows installers to limit the unavoidable loss in cross section to an absolute minimum. An additional fibre-reinforced external foil provides protection against groundwater seepage and saponification and ensures a damage-free installation process. The added external foil allows the liner to be installed without a preliner or a slide foil, which reduces cost and accelerates the installation process even more. Furthermore, the BB^{2.5} liner system's high flexibility and compact design make it easy to fold before installation in the sewer.

Depending on their length, a liner segment together with its lightproof and mechanically resistant external protection foil may weigh several tons. These segments were pulled into the sewer by means of dedicated installation devices lowered into the manholes. Then the segments were inflated to fit the form of the oval profile. The Brandenburger conveyor belt with an integrated folding device was a key asset for handling the

heavy liners. It made it easy to insert the segments without undue strain on the technicians or the material. Everything else was just standard procedure for **GFRP**liner systems:

- Installing the UV lamps in the temporarily opened liner
- Resealing and pressurising to the pneumatic installation pressure
- Lighting the UV lamps
- Moving the UV unit through the sewer at a defined speed, depending on the diameter

For liners of this size, a UV unit of 8 x 1000 W is used. At the speed specified for this diameter, even the longest liner segment (176 metres) was cured and ready for operation within 8 hours. In the Pariser Straße, two 136 metre segments with a 900/1350 profile were inserted, inflated and cured within a mere 48 hours. It's hard to conceive of a liner rehabilitation job of this scale being done any faster at this time. And the same is true for doing it better, as lab tests demonstrate that were performed on samples taken from the liner by the IKT Institute for Subterranean Infrastructure as part of the mandatory external monitoring [table 1]: All of the installed and inspected liners were within tolerances for every single parameter. In summary, it was a great success for the tubus GmbH, together with project manager Wendelin Böhne (Dipl. Ing.), who represented Brandenburger Liner GmbH during the project. For the municipal water works of Kaiserslautern, a somewhat unusual liner rehabilitation of a large-diameter oval profile was performed to their utmost satisfaction.