KEMROC KSI injection attachment

EFFECTIVE DIAPHRAGM WALL FOR A RETENTION BASIN

Cost effective solution using a standard excavator

Possibly the largest retention basin in Austria is currently being built in Triestingtal (Lower Austria). Engineers at PORR were given the task of installing a diaphragm wall along the centre line of the dam during the construction phase. For this project it was decided to try a KSI injection attachment from the German manufacturer KEMROC. This modified excavator trenching tool digs into the ground, mixes the soil and injects a cement suspension into it. After hardening, what is left is a pressure resistant, impermeable soil cement structure closely connected to the adjacent rock.

In the future, when the Triesting, a river flowing through south-eastern Wienerwald in Lower Austria, floods again after heavy rains, as has so often happened in the past, people living around Fahrafeld in the district of Pottenstein should find themselves better protected from the flood waters. A massive water retention basin is being built there for this purpose. With a capacity of 725,000 m³, the basin is intended to protect the community and the infrastructure from those once in a 100-year flood event. The construction company PORR is currently building a dam, approximately ten meters high, to hold the flood water. The dam consists of two side sections about 1,300 m long with the basin located between the riverbed and railway lines. The sides are connected to one another with a transvers dam about 150 m long. The main structural element of the dam is a diaphragm wall made of a soil cement mixture which is firmly anchored into the solid rock below the dam.

Under the topsoil, the local geology consists of various layers of loose rock lying on a bed of compact limestone. To create a sturdy diaphragm wall in this material, the specialists at PORR decided to use equipment they had not tried before. They chose to use a KSI injection excavator attachment designed and manufactured by the German company KEMROC. The attachment has a long sword with a cutting chain that can grind its way down through the earth and rock. It can then mix the broken material with a cement suspension pumped via hoses from a semi-mobile mixing plant. When hardened, the soil cement mixture produces a dense, structurally sound, impermeable structure.

Mixing and stabilising soil by the addition of a cement suspension in a binding agent – using the KSI injection attachment from KEMROC, stable soil cement structures can be created in-situ. Engineers at PORR used the attachment when constructing a retention basin in Pottenstein (Lower Austria).

Before cutting into the ground, the full length of the sword is visible. For the first phase of the installation of a diaphragm wall at the retention basin a KSI 5000 attachment with 5 m long sword is used mounted on a 50-t excavator.

Different Sizes and Sword Lengths

The KSI stabilising attachments from KEMROC are at the core of a recently developed method for producing in-situ earth cement structures. They are available in a range of various sizes and sword lengths. The KSI 5000 drive unit (nominal output power 130 kW) can be equipped with swords for 3, 4 or 5 m mixing depth and can be used on excavators with operating weights from 30 to 50 tons. The larger KSI 10000 model (nominal output power 220 kW) can be equipped with swords for 6, 8 or 10 m mixing depths and was designed for use on excavators with operating weights from 45 to 70 tons. As accessories for both models, there is a mixing chain extension (1 m) available as well as the KRM 80 rotation unit and spare cutter teeth. On request, KEMROC can offer a complete package consisting of the KSI mixing attachment, a mobile mixing plant for the cement suspension complete with measurement and control equipment to specialist contracting companies.

Site Manager for the PORR project on the river Triesting, Dipl. Eng. Martin Pühringer said, “At Fahrafeld we used a KSI 5000 attachment mounted on one of our 50-t standard excavators together with a control system that we developed ourselves to set the operating parameters and keep a record of the results. We record data on a continuous basis so we can create a report.”

Positive Interim Results at Fahrafeld

Early October 2020, the civil engineering company PORR were halfway through the first phase of construction of the Fahrafeld retention basin in the Triesting valley. The southern section of the dam running alongside railway tracks had been completed together with the soil cement diaphragm wall which had been constructed using a large excavator with the KSI mixing attachment. Wear on the sword chain for the 1,300 m length of diaphragm wall was extremely low. Only 25 cutter teeth had to be replaced on the excavator attachment. “Such low levels of wear confirm that our choice of equipment was correct”, said David Görgl, Team Leader at PORR while discussing the results. “With other comparable soil mixing processes we would have experienced significantly greater consumable costs and the end product would not have been as good. We came across large boulders in the overburden over and over again. Mixing tools used in other equipment such as paddles, cutters or augers would fail in these conditions; the boulders would destroy them. When using a drilling system, the larger boulders cause the drill string to deviate resulting in weak sections and eventual leaks in the diaphragm wall. The cutting action of the KSI attachment works perfectly under these conditions, allowing us to create a good quality product with little wear on the equipment.”

In conclusion, according to Team Leader David Görgl the KSI mixing attachment actually worked better than expected, “We achieved a high production rate while creating a

The cutter chain is fitted with exchangeable carbide tipped cutter teeth. Injection nozzles are fitted to the left and right at the front of steel plates on the chain. A semi-mobile mixing plant pumps cement suspension into the ground via hoses to the nozzles on the chain.

This combination of excavator and attachment achieved an impressive production rate. When used in conglomerate lying on dolomite, operating costs in terms of replacement consumables were well within acceptable limits.

diaphragm wall exactly to specification, so the attachment provided a favourable ratio in terms of performance to operating costs. Our conclusion after using the KSI attachment for the first time is that this is the preferred method to produce soil cement structures in difficult geological conditions."

In the next phase of construction, the actual dam, which is about ten meters high, is being built up stage by stage. The soil cement diaphragm wall will then be installed while working from the top of the dam. It will connect to the existing diaphragm wall located in the overburden below. For this section, the big brother to the KSI 5000 will be used, namelythe KSI 10000 with an impressive 10 m long mixing sword. PORR is confident that this machine from KEMROC will also perform satisfactorily when mounted on one of their excavators and provide a cost-effective alternative to other, more expensive civil engineering methods.

An eight-ton excavator prepares the site for the larger excavator fitted with the KSI mixing attachment. Removing some surface material along the line of the diaphragm wall prevents binder solution with cement from flowing away from the working area.

At various distances along the length of the hardened diaphragm wall, sections are exposed using an excavator. Tests indicate that the soil cement structure has the required shape and density necessary for this flood protection project.

Publisher

KEMROC Spezialmaschinen GmbH
Jeremiasstr. 4
36433 Leimbach
Germany

Phone +49 3695 850 2550
Fax +49 3695 850 2579
E-Mail info@kemroc.de

www.kemroc.de

KEMROC®
revolution of cutting