

ALLWEILER PUMPS HELP EXCAVATE THE WORLD'S LONGEST TUNNEL

In tunnel construction, excavation occurs two ways depending on geologic conditions at the site: by conventional drill-and-blast and by precision-operated “mills in the mountain” known as tunnel boring machines, or TBMs. The Brenner Base Tunnel through the Alps, destined to become the longest underground railway connection in the world at a planned length of 64 kilometers, is being excavated using TBMs supplied by Herrenknecht of Schwanau, Germany.

Spanning the distance between the stations Innsbruck, Austria, and Fortezza, Italy, the tunnel's purpose is to shift freight and passenger traffic from highways to rail, relieving the motorway. At the existing Brenner rail route, which is more than 150 years old, suitable track expansion is not possible, due to the steep ascent to the Brenner pass at 1,370 meters above sea level and the way the current line winds through the landscape.

Two TBMs are excavating the exploratory tunnel, with one in Austria for the stretch between Ahrental and Pfnos, and the other in Italy for the stretch between Mules and Brenner. Another two TBMs are foreseen for the main tunnels between Mules and Brenner. Excavation work began in 2007 and will last until 2024. Excavation work at the construction site Ahrental began in 2014 and will last until 2019. The TBMs contain nearly every type of pump manufactured by Allweiler, a CIRCOR brand.

THE CHALLENGE

A PUMP PARTNER TO DELIVER LONG SERVICE LIFE

TBMs pierce rock with a rotating drilling head having hydraulic cylinders that operate under extreme pressure, removing the spoil and securing the excavated tunnel with steel-reinforced concrete profiles. TBMs achieve an excavation exactly according to desired profile while providing workers with enhanced personal protection. The daily excavation output of a single TBM can be up to 60m.

In a TBM, the following pump types are used:

- › Filter oil and cooling system pumps
- › Grout pumps for ring-gap mortar injection
- › Proportioning pumps with quench`
- › Water pumps

Herrenknecht's director of fluid engineering for traffic tunneling, Albert Feisst, needed to source pump systems that could comfortably deliver a service life to the TBM of 15 years, and that meant turning to Allweiler.



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THE SOLUTION

A FULL COMPLEMENT OF HIGH-PERFORMING, RELIABLE PUMPS

CIRCOR's team put together a comprehensive solution with products from across the Allweiler portfolio for each pumping need. Every pump and drive used in TBMs must be dimensioned so that pump performance will never be exhausted during normal operations. Feisst pointed to Allweiler's individualized precision configuration of the pumps as a key aspect of achieving the desired service life.

Filter oil and cooling system pumps - To achieve a maintenance-free service life of 2-3 years for these applications, CIRCOR recommended durable three-screw pumps. These carry feed oil for the entire hydraulic system at a pressure of 25-50 bar and lubricate the gearboxes with low viscosity oil (up to 460/mm²/sec) at pressures up to 60 bar. Alongside these, other three-screw pumps are used in the hydraulic system's cooling circuit and as filter pumps, at pressures of 16 bar. These pumps are proven to be insensitive to the disturbances that can occur at machine startup and during the gearbox's run-in phase; they are also very reliable when temporarily operated under cavitation and aeration conditions.

Some of the three-screw pumps used, in the “TRILUB” series, offer a very long service life in the mid-pressure range, designed in such a way to provide a very good price/performance ratio. Pumps designed for higher pressure have a pressure relief valve for additional safety. This helps avoid excessive pressure conditions and damage to the overall system.

Additional pressure-maintaining and control valves keep system pressure steady as consumption fluctuates. Piston-based pilot control of the valves results in very small hysteresis values and therefore fine control over the pumps. An optional control-oil filter prevents foreign objects from clogging the control nozzles and contaminating the valves. Solenoid valves and controllers allow the operator to preselect several different system pressures and start the pumps in an unpressurized condition. This makes it possible to have virtually pressure-free circulation and operation, such as when starting the pump or when the system stops for a short period of time.

Grout pumps for ring-gap mortar injection - TBMs use steel-reinforced concrete profiles known as tubing to stabilize the tunnel walls in newly dug sections. The space between the ground and the tubing must be filled with a special two-component mortar and compacted. Progressing cavity pumps move this bentonite-cement suspension to fill the empty spaces with pressures of up to 20 bar and capacity of up to 120 liters per minute. To ensure that the suspension quickly cures and hardens, a separate progressing cavity pump adds the accelerator component to the discharge side of the pump. To ensure no contact with the ambient atmosphere, mechanical seals are secured with a pressureless quench with a hydraulic seal.

Proportioning pumps with quench for accelerator - Progressing cavity pumps also move the foaming agent tenside dissolved in water and polymers to keep dust down and lubricate the cutting tools. This approach produces the best results, especially with non-cohesive, water-permeable ground. These pumps operate in a pressure range up to 16 bar and a capacity of 0.2-2.5 liters per minute. A very steep performance curve is required so that the pump will proportion liquids precisely even when capacity and speed are low.

Water pumps - Finally, centrifugal pumps move water at high pressure.

All pumps utilize frequency converters to operate across a wide control range. These devices precisely adjust capacity to the oversized drives. The optimized controllers enable pumps to deliver good efficiency with low energy costs even when working below their performance limits.

FOR ADDITIONAL INFORMATION VISIT:
circorpt.com/industrial

THE RESULTS

ALLWEILER PUMPS PERFORM AT THE CORE OF EVERY TBM

For more than 30 years, Allweiler pumps have played a mission-critical role in Herrenknecht's TBMs. "Allweiler is the best supplier we have when it comes to service and customized solutions," Feisst said. "Their pumps often stay in service for two to three years without maintenance."

With every TBM on a project being adapted to the specific project, Allweiler's technical oversight ensures each pump system achieves the most precise configuration during installation for optimum functioning and durability in its critical role.

Because Herrenknecht's TBMs are in operation around the world, having easy access to local support is another imperative. With nearly 100 subsidiaries and partners around the globe, Allweiler readily meets this requirement.

