



Job Report Soil Stabilization

WR 2500: The new ICE line from Cologne to Frankfurt, Germany





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Walter Grüber, July 1999

The construction of the new ICE high-speed rail link from Cologne to Rhein-Main airport in Frankfurt is at present the longest construction site in Europe. Due to the chosen solid track construction method, this project also sets new standards of quality and precision. The contractors responsible for the soil stabilization work have opted for the Wirtgen WR 2500 stabilizer. Up to six machines of this type are currently in use at this site.

The 204 km long high-speed rail link runs through the morphologically very diverse area of the Rheinisches Schiefergebirge with its Siebengebirge, Westerwald and Taunus mountain ranges, with rapidly changing terrain and soil conditions. Several tunnels, valley-spanning bridges, high dams and deep through-cuts were required. Due to the high train speeds of up to 300 km/h, not only the pavement structure but also the foundations and subgrade pose a particular challenge.

High vibration speeds are generated, causing aggregate displacement in non-cohesive soils and liquefaction and plastic lateral displacement in cohesive soils. In addition, stability must also be provided for traditional civil engineering works such as bridges, tunnels, retaining walls and dams. When it comes to compacting, the quality requirements compared to “normal” construction sites, such as motorway sites, are also much higher.

Maximum earthwork performance

Additional requirements, such as the extremely short construction time and gradients of up to 1 in 25 demand top performance from the contractor companies. Heilit & Wörner, for example, responsible for earthwork in Lot C, speaks of “earth” as their “civil engineering work”. Approximately 4.1 million cubic meters of soil down to a maximum depth

of 20 m were excavated, together with 1.6 million cubic meters that had to be removed from the tunnels. 2 million cubic meters of this excavated earth mass are being conditioned for technically very sophisticated dam structures. The excess earth mass will be heaped up along the A 3 motorway near built-up areas to provide lateral noise barriers to improve the current noise situation.

In general, as preparation for the ICE line, the native soil or the prepared subgrade mixed with material from the tunnels and cut-throughs is compacted and, depending on its existing condition, improved to provide the appropriate support for the track substructure. Four additional layers are laid at this stage. Two initial layers of 50 cm each, consisting of high-quality material, mainly from the tunnels, are followed by two 30 cm layers that have been improved by the addition of 2–5 % cement. A 50 cm frost blanket completes the work. The quantity of additives used depends on the moisture content and compaction of the native soil or delivered rock material.

The Wirtgen high-performance WR 2500 stabilizer plays an essential part in ensuring the quality, profitability and punctual completion of the earthwork. Its convincing technical advantages compared to conventional machines in practical applications are particularly evident in a major project of this type, which makes enormous demands on man and machine.

Example 1: Soil stabilization with Terrafix at Montabaur station

At Montabaur, south-west of the A 3, a new ICE train station is being built with four tracks for both stopping and through-



Soil stabilizing with Terrafox for building the new railway station Montabaur.

trains and with a direct link road to the motorway, including a park-&-ride system. The land between the new ICE station and the old train station is being built up as a mixed district for services, business and residential use. Due to the high moisture content of the soil here, further exacerbated by the poor climate conditions, soil improvement by the Wirtgen WR 2500 has been decided.

The company responsible for carrying out this work is EBS Scharnbach from Kottenheim / Eifel, a company that specializes in soil stabilization and currently has a total of five crews engaged on the ICE site. Just under half of the company's 20 employees have been working full-time on the ICE project since September '98. The order covers a total of about 2.2 million cubic meters of soil stabilization work over a stretch of about 25 km. The only way to complete the work within the specified deadline and with perfect technical quality is to use excellent machines.

To stabilize the soil, EBS uses six spreaders to add "Terrafox", a binder made from lime and cement by the Otterbein company. Next, the native layer of mudstone and clay is improved with the Wirtgen WR 2500 by milling down to a depth of 30 cm and mixing in 2–8 % of binder.

With this process, the lime absorbs water from the soil, whilst the cement solidifies the material. The Wirtgen stabilizer is the ideal machine for this purpose: with its variable-capacity mixing chamber, it can obtain the optimal mixing result at each working depth. Klaus Scharenbach singles out the fast advance rate of up to 35 m/min on this section for particular praise. With such high capacity, a daily progress rate of about 10,000 m³ was achieved. In other words, depending on the moisture content, about 30 metric tons of Terrafox from more than 20 silo vehicles were processed per day.

Example 2: Soil solidification with cement in a cut-through near Idstein

The Josef Rädlinger company of Cham is a subcontractor employed for the earthwork of Lot C. At one section of the site near Wiesbaden, the ground has to be improved with cement. Originally, a motorway noise barrier was built on this section, but it is now being moved. The cut-through for the ICE line required the removal of soil down to a depth of



High performance when soil solidificating with cement near Wiesbaden.

about 2 m. The native soil after excavation has a very high silt content and is therefore extremely difficult to compact. This subgrade is very sensitive to water, i.e. in wet weather the ground rapidly goes soft.

By adding cement, it is made durably strong and resistant to water and frost.

To achieve optimal compaction, about 120 metric tons of cement are required for a stretch of about 400 m.

This requirement corresponds to one day of soil stabilization with the WR 2500, even though this Wirtgen machine is in fact capable of much more. About two extra hours have to be planned for the actual compacting work.

The advantages of this machine come into their own at this section: firstly, thanks to the ample milling depth of 50 cm, the work can be performed in a single pass.

Otherwise, the upper layers of soil would first have to be excavated and then separately improved before the remaining material could be stabilized at correspondingly shallow depths. In addition, a soil as awkward as this would be impossible to process without the all-wheel drive, large wheels and in particular the powerful mixing rotor of the WR 2500.

Example 3: Homogenization of stony ground for optimal compaction near Bad Camberg

Since back in summer 1997, the Rädlinger company has been working on a total stretch of 42 km from Bad Camberg to Wiesbaden. Since early 1998, two Wirtgen WR 2500 stabilizers have been in use. The completion of the stabilization work is planned for the end of '99. By then, a total of up to 1 million cubic meters will have been treated by the WR.

The economic efficiency of the Wirtgen machine is especially demonstrated by its mobility and versatility in operation, says Hans Pirzer, site supervisor for Rädlinger. Thanks to this flexibility, both machines are in almost constant use for different tasks on the site, so that no costly downtimes are incurred by the operator. For example, while one machine is busy optimizing the soil by adding various binders at one part of the site, the other machine is crushing material supplied to a cut-through section north of Bad Camberg, in order to ensure optimal compaction. Optimal compaction is only possible with small aggregate sizes. However, the soil mixture



In two to three passes, this coarse aggregate is crushed to a maximum sieve size of 10 cm.

from the tunnel excavations has piece sizes of up to 50 cm and hardness ratings of 30–50 N/m². In two to three passes, this coarse aggregate is crushed to a maximum sieve size of 10 cm. This optimally prepared layer is then compacted.

Another technical advantage of the Wirtgen machine in the processing of hard rock is the patented HT3 interchangeable tool-holder system. With this system, worn tool holders can be replaced directly on site in a matter of minutes, thereby saving both time and money.

Example 4: Soil stabilization with lime near Siegburg

An example of a “classic” application for the WR 2500 – soil stabilization with lime – is currently being carried out near Siegburg by the Stetter company from Rainau-Buch (Ostalb-kreis). This company specializes in the stabilization, improvement and solidification of soil and is the subcontractor responsible for soil stabilization on a stretch of about 50 km from the Bonn/Siegburg intersection to the Neuwied/Dierdorf exit. Stetter too has found that the WR 2500 is the ideal machine for mixing lime into wet soils that could hardly even

be driven over by normal working machinery. In the northern part of this section, the existing rock material is wet through, with the result that it cannot be sufficiently compacted. This fact poses no problem to the WR 2500, which mills the soil to a depth of 50 cm and improves it by mixing in about 2–4 % lime. The soil crumbles immediately, and the moisture content is reduced. The plasticity, compacting and load-bearing properties are improved, making the subsequent construction work much easier. The soil becomes resistant to both water and frost.

Stetter’s site supervisor, Frank Niemann is full of enthusiasm for the all-wheel drive and especially for the high performance and compact construction of the machine: despite the most awkward soil conditions, the WR 2500 has no problem delivering a daily work rate of about 12,000 m³ through a wide variety of different, sometimes stony soils of clay, loess and silt, which can become very slushy, in particular in bad weather.

In all these stabilization tasks, the economic advantage of the Wirtgen WR 2500 is primarily seen in its high performance, which results in shorter construction times and there-



Overview on the construction site. In the foreground you can see the WR 2500 soil stabilizing with Terrafix.

fore greater productive output over the same period of time. Other advantages of the machine, such as the variable mixing chamber, patented tool-holder system, a powerful

milling and mixing rotor and all-wheel drive, set new standards for the benefit of both owners and contractors in the new ICE line project.



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