



TECHNOLOGY

Turbojet®





Method	Type of soil					Behaviour
	Organic	Clay	Silt	Sand	Gravel	
Mortar columns		██████████				Low efficacy in heterogeneous soils
Jet Grouting			██			The geometry of treatment depends on soil consistency; large amounts of debris are produced
Tremix		██████████				Soil mixing is possible in soft soil conditions
Turbojet		██				Good mixing also in heterogeneous soils, with high control of final geometry



The diameter is guaranteed also in heterogeneous soils

Treatment of soils containing organic matter

Reduced flushing fluid compared to jet grouting

Column diameters up to 2400 mm

Max column depth about 30 m

Lower cement consumption compared to jet grouting

TURBOJET® is an important advancement in in-situ soil mixing technology: it allows to construct columns of consolidated soil rapidly and cost-effectively, ensuring high quality standards.

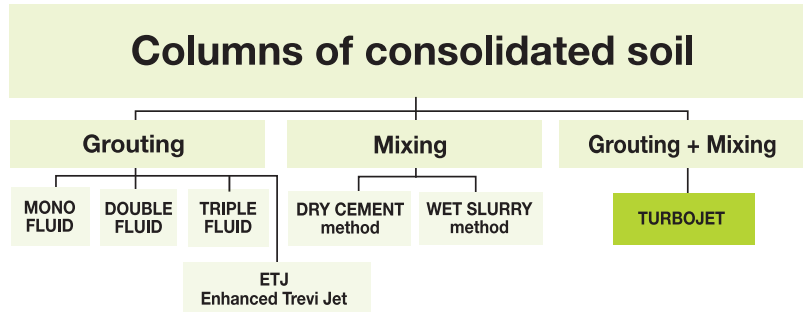
The system is suitable for a wide range of soil types from cohesive soil of low consistency (containing up to 15% of organic matter) to non-cohesive soil of loose to medium consistency (*sand and gravel*). The TURBOJET® technology relies on a specially designed tool combining the high kinetic energy "jet" effect with mechanical mixing performed by suitably positioned blades. This way, high quality and fast mechanical breakdown, alongside effective soil-mixing with high speed jetting are guaranteed.

Moreover, the amount of binder to be used can be continuously modified, ensuring no waste of the same.

The geometry of the columns is not affected by soil characteristics, but it remains unaltered throughout the whole depth, thanks to the breaking action of the tool blades.

Standard operating sequence

During drilling, an initial treatment is performed by injecting a cement grout down to the design depth. Then treatment is repeated while uplifting the tool, to ensure the best result is achieved.

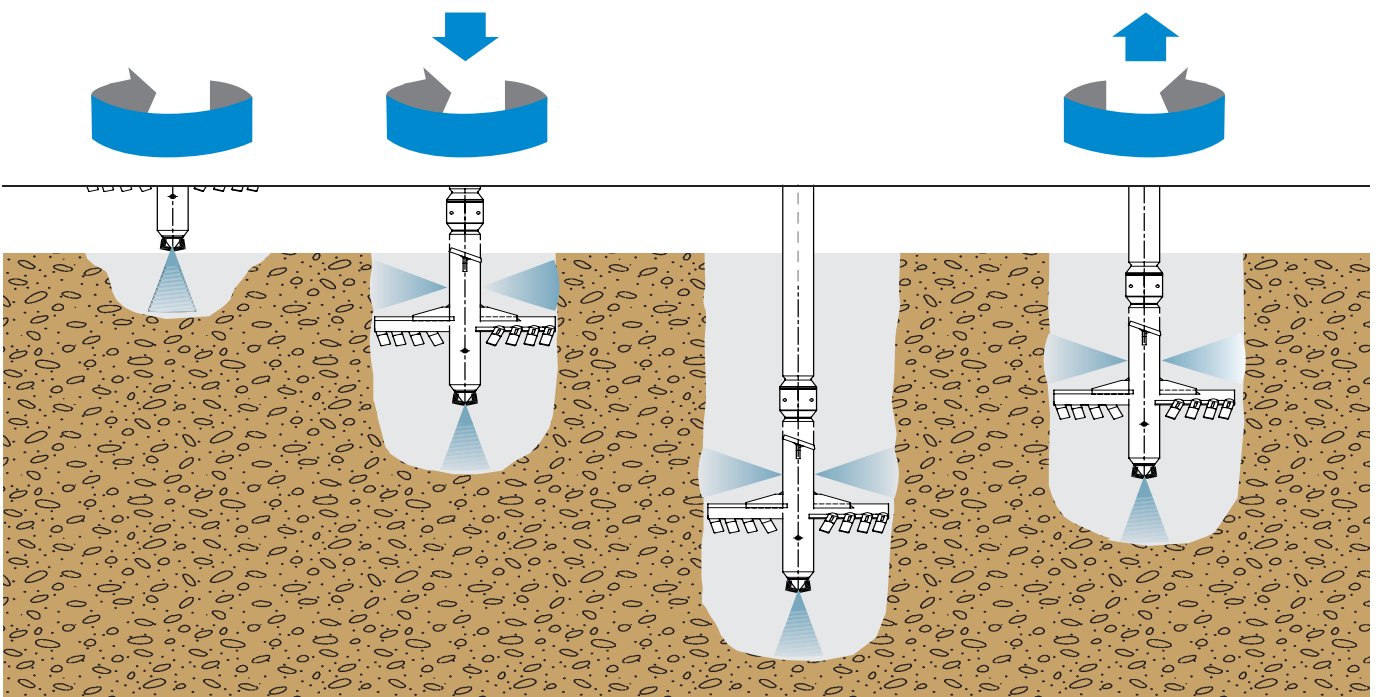


TURBOJET WORKING PARAMETERS		
Drilling speed	m/min.	0.5 - 1.5
Rotation speed at drilling	rpm	25 - 55
Extraction speed	m/min.	0.5 - 2.0
Rotation speed at uplifting	rpm	35 - 55
Cement grout flow rate	l/min.	100 - 200
Cement grout pressure	MPa	5 - 40
Cement per m ³ of soil	kg/m ³	150 - 450
Average industrial production	m ³ /hour	10 - 50



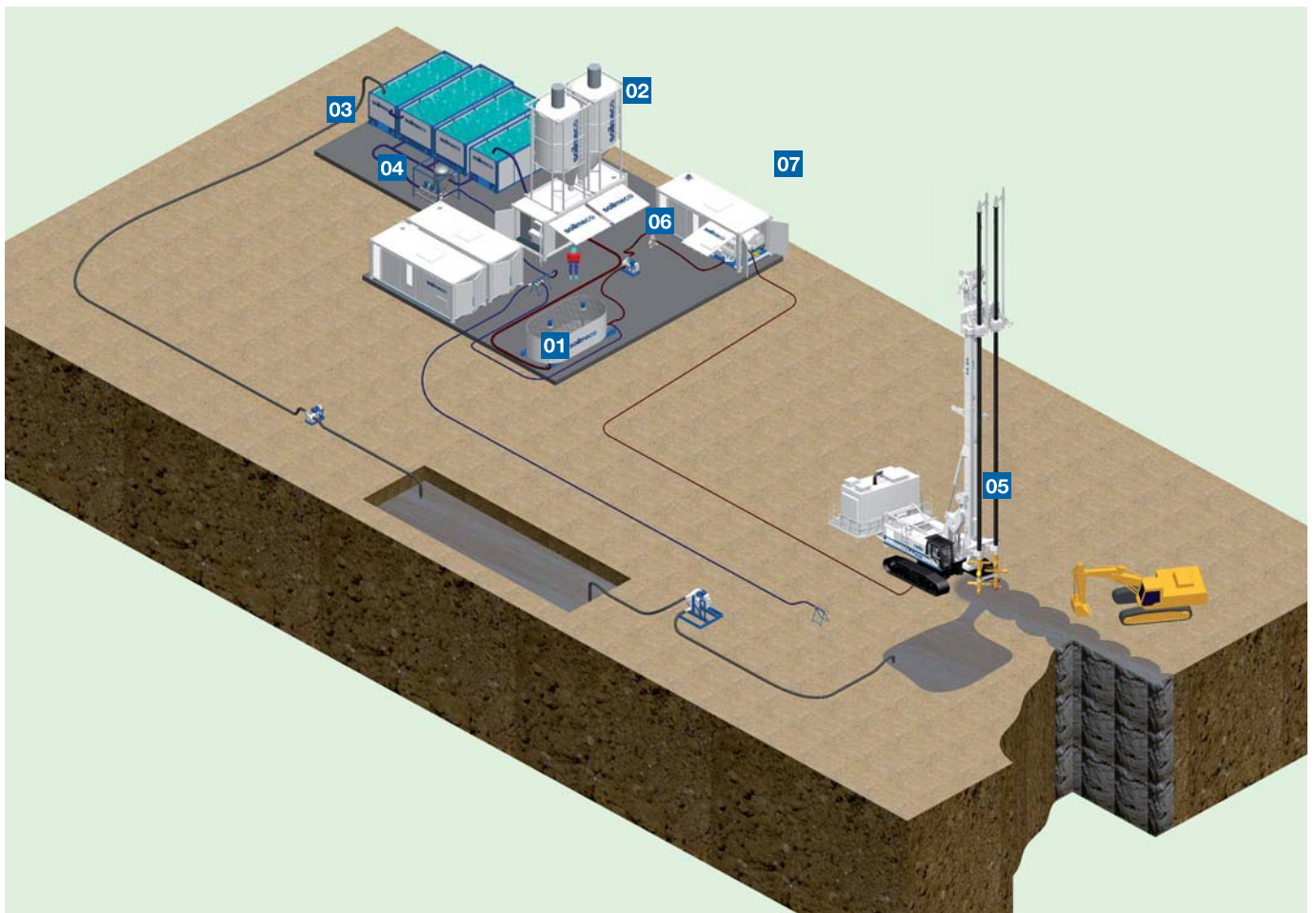
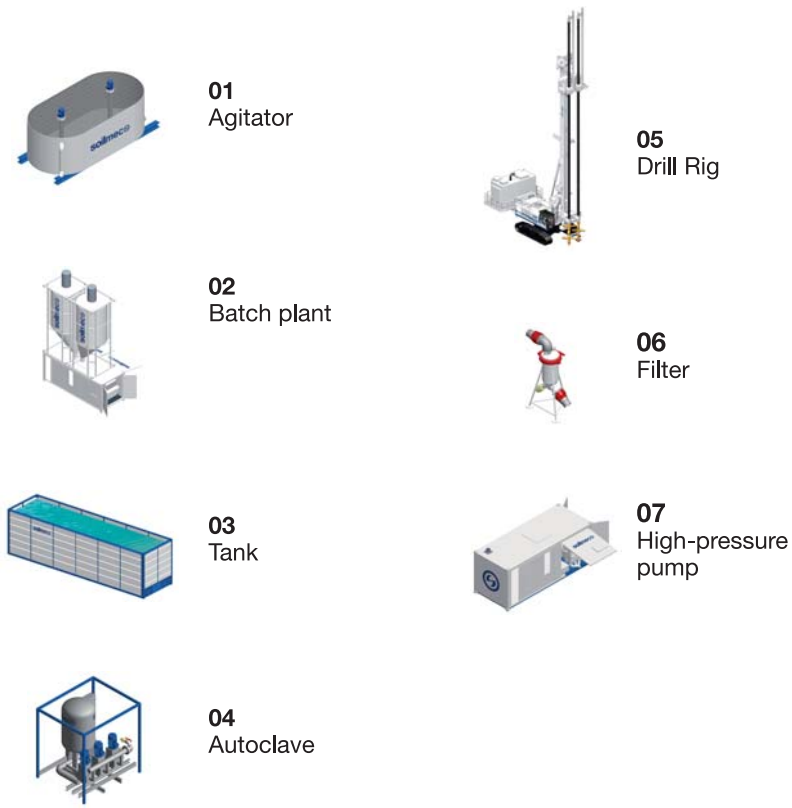
STEP 1
Drilling and simultaneous treatment with high-pressure injection of cement grout

STEP 2
Uplifting and simultaneous treatment with high-pressure injection of cement grout





Jobsite equipment



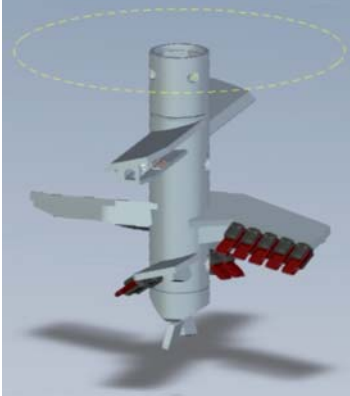
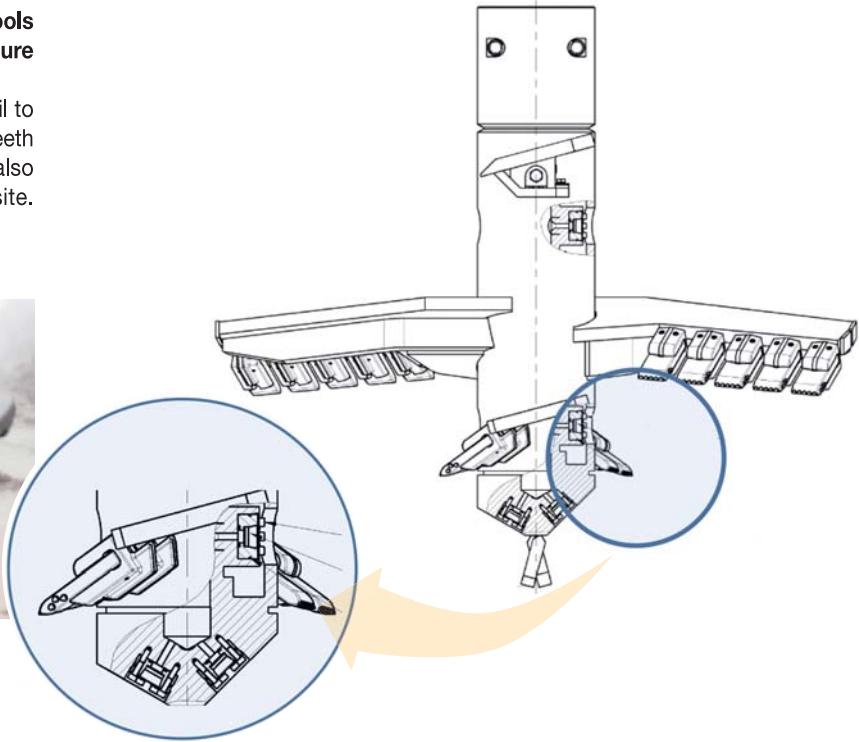
Test field at Tuttle Creek Dam (KS, USA). The geometry of triple fluid jet grouting columns installed (on the left hand side) reflect the consistency of the soil, whereas the DMM columns (right hand side) have a perfectly cylindrical shape.



Tools

Tools have been developed alongside with drill rods. **The new range includes single or double-pass tools of a diameter of 600 to 1600 mm, ensuring pressure up to 400 bar.**

The tools are designed according to the type of soil to be treated and can be fitted with a wide range of teeth to increase specific operating features. They are also specially built to minimize downtime on the jobsite.



Special tools

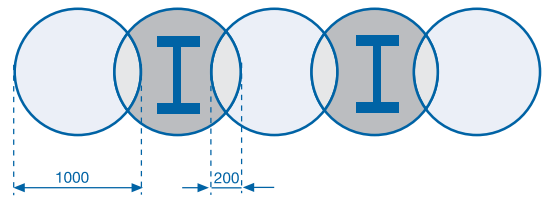


Turbojet tool to install bottom slabs

The Turbojet technology allows to construct secant columns with preset and controlled geometry.

A special tool featuring a toothed core bit allows to cut primary columns to ensure column intersecting, proper execution of joints and secondary column verticality.

Retaining wall using DMM elements (typical scheme)

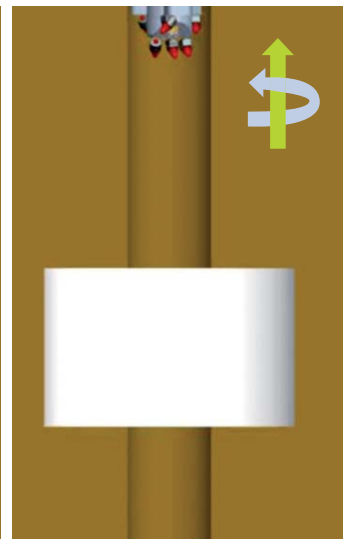
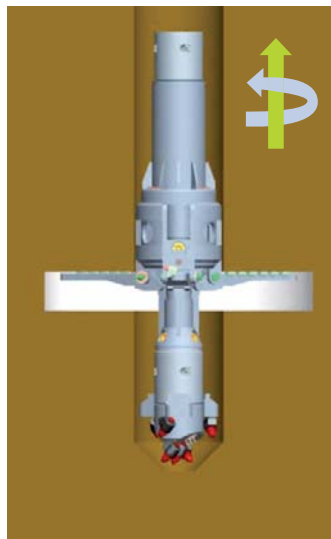
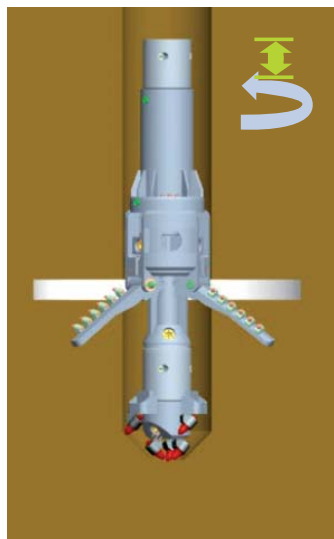
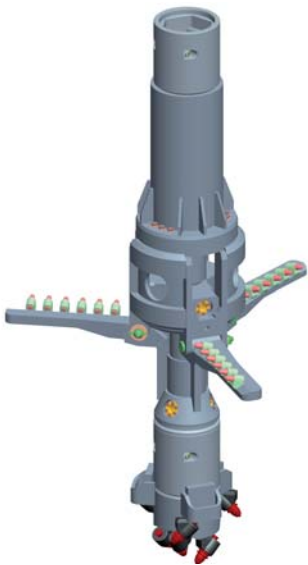


TJ-Idle

The TJ-Idle has been specially developed to perform grouting operations involving blind boring.

The TJ-idle tool is equipped with foldable wings. When the **wings are closed, the tool diameter is 500 mm** (used to advance to the design depth). Once the final depth is reached, the injection grout pressure lets the wings open and treatment is performed during uplifting. The drilling/mixing treatment is performed using the rig's hoist force which is highly performing with respect to the pull-down force, thus ensuring the verticality of the column. When the high pressure grout flow is interrupted, the wings close to minimum diameter and the column is interrupted where needed, for time and injected grout savings.

One single tool is suitable for all diameters from 800 to 1500 mm.



Trevi TurboMix (TTM-TTM2)

The **Trevi TurboMix** is similar to Turbojet and features one or two shafts. It is powered by two high-pressure pumps and fitted with a double rotary head assembled on the same mast. The most performing version has an additional hydraulic power pack on the turret counterweight to deliver the higher power needed by the twin rotary.

This technology guarantees the following operating benefits: maximum verticality, very high mixing quality even in case of plastic clays or if pre-cutting techniques cannot be used, excellent productivity, good quality of intimately mixed grout and soil.

The most performing version allows to bore primary and secondary double columns of 1600 mm-diameter and distance between centres ranging from 1200 to 2000 m, up to a maximum depth of 24.4 m.







World leader in ground engineering, Trevi has been working for more than 50 years throughout the world, strengthening its ability to provide solutions to any ground engineering issues. Trevi works in the field of special foundation, soil consolidation, dam remedial works, tunnel construction and consolidation, marine works, rehabilitation and cleanup of contaminated sites and construction of underground automatic multi-storey car parks. Trevi is committed to continuous innovation and search for solutions to complex problems of civil engineering worldwide. Experimenting cutting-edge technologies, entrepreneurship and investing in research and human resources are the strengths of a company based in more than 30 countries.



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