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KEMSOLID®

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Rock cutting technology for civil engineering — fast, efficient and environmentally friendly.

KSI 16000 installed on a 265,000 lbs excavator sealing a mine tailings basin.

Content

Kemsolid is the name of KEMROC's new division dedicated to soil stabilization and ground improvement. This newly established business is focused on the development, testing and manufacturing of soil mixing attachments. Planning and design firms, construction companies, appraisers and clients also receive a full package of expertise and advise from foundation engineering specialist.

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The Kemsolid TSM solution

The TSM or Trench-Soil-Mixing is a method of creating in-situ soil-cement structures. KSI soil mixing attachments can be installed on excavators or drilling and piling equipment to achieve production of soil-cement cut-off and retaining walls.

Once the blade has achieved the required depth using the moving cutter chain a binder is piped through to the lowest point of the blade and injected into the soil. A mixing process follows until a uniform suspension with the required consistency of soil and cement has been reached. This creates an impermeable, stable soil-cement structure to the required dimensions. Type and concentration of a binder will vary according to compressive strength and permeability levels required. Since this method comes from rock grinding technology, handling small unforeseen obstacles is easily overcome. At the same time, it is also feasible to integrate the soil-cement structure into solid ground or rock.

The blade of the KSI attachment continuously mixes the soil in-situ over the entire installation depth. This ensures that the soil-cement structure is uniformly and thoroughly mixed throughout the installation depth.

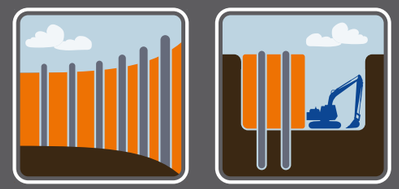
The Kemsolid TSM solution is extremely versatile for addressing soil permeability and load bearing issues. It can, for example, be used to seal excavations or contain contaminated areas. It can also be used to seal dams, dykes and other bodies of water as well as creating a barrier to dampen waves traveling from sources of vibration. In trenching and construction of large warehouses, it can be used to improve the soil between supports. It can also be used in applications where new roads are being built on soils with low load bearing capacity or the load bearing capacity must be increased to cope with extra weight or higher traffic speeds. These include some high-speed railway and motorway routes.

Exemplary use cases

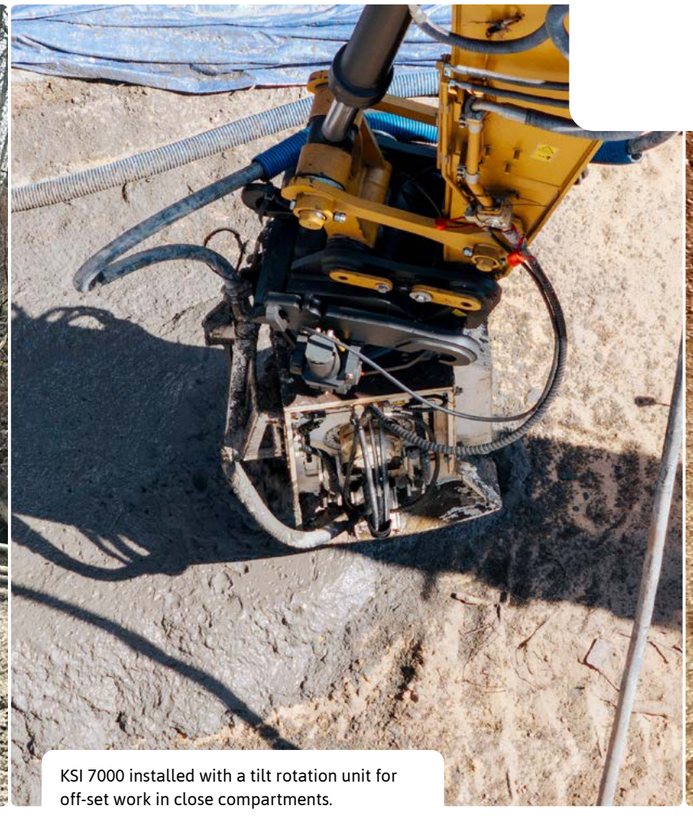
Cut-off

Ground improvement and soil stabilization

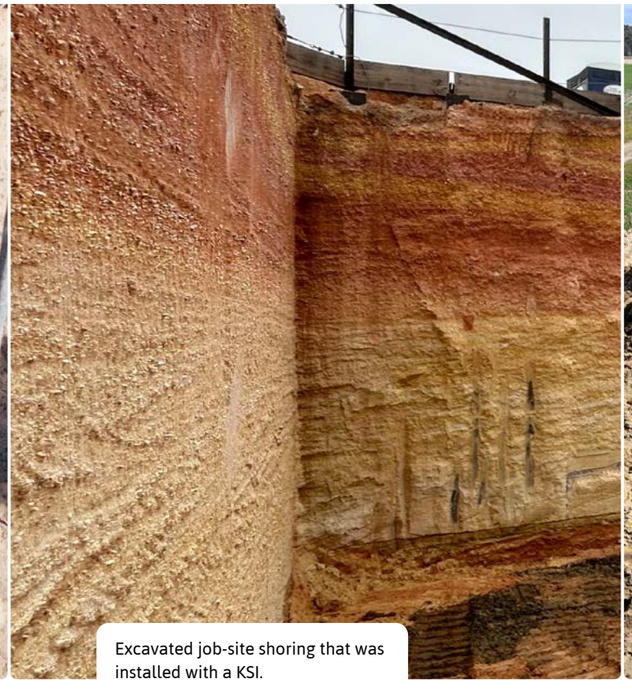
Shoring and retaining walls



KSI 7000 installed on a 75,000 lbs excavator producing a cut-off wall in though terrain.



KSI 7000 installed with a tilt rotation unit for off-set work in close compartments.



Excavated job-site shoring that was installed with a KSI.

Flood protection dam that was reinforced with a KSI.

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Process sequence

Step 1
Excavation of a guide trench (depth approx. 20 in, width same as required).

Step 2
Positioning of the mixing blade mounted on the excavator or pilling rig.

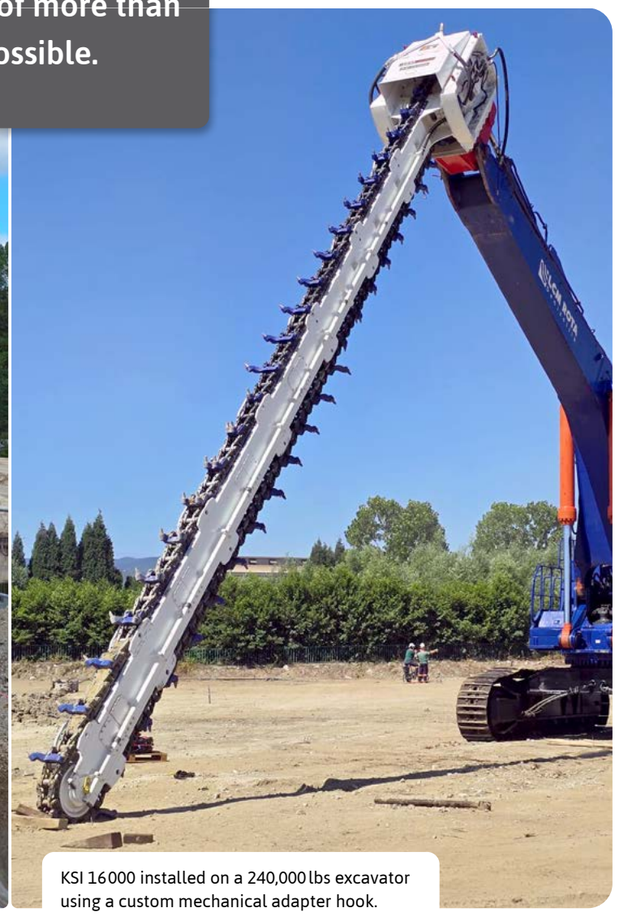
Step 3
The mixing blade is driven into the ground up to designed depth by using grout or water pumped through .

Step 4
After reaching the required depth carrier moves slowly backwards and at the same time the existing soil is cut and mixed with the grout. Typical chain speed of the trencher is 6.6–8.2 ft/s and typical carrier speed is 30–50 ft/hr.

Step 5
Reinforcing elements required for structural purposes can be inserted into the completed wall.

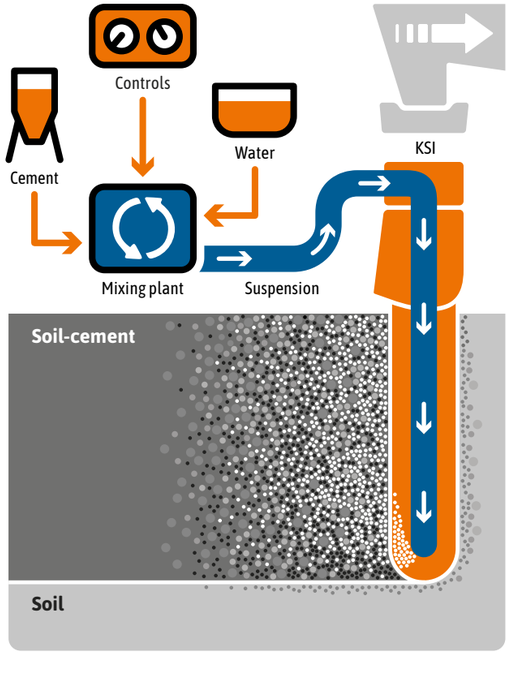
Depending on soil type and local ground conditions, production rates of more than 300 linear feet per day are possible.

KSI 7000 installed on a 90,000 lbs excavator sealing a constrution site.



KSI 16000 installed on a 240,000 lbs excavator using a custom mechanical adapter hook.

Schematic overview



Retaining wall that was installed with a KSI (cladded with shotcrete).

Slurry/binder characteristics

The slurry mix design and components depend on many different factors, especially soil conditions and purpose of the application.

Typical components are:
- Cement
- Bentonite
- Additives
- Water
- Others (e.g. fly ash)

Other common characteristics are:
- W/C ratio: 0.5–2.0 by weight
- Amount of cement: 350–1200 lbs/CY of treatment

KSI 16000 installed on a piling rig producing a soil-cement structure.

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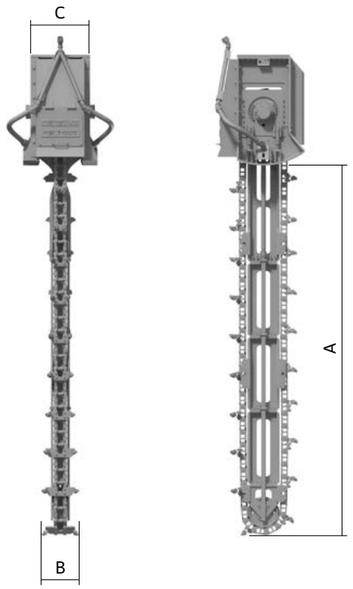
The KSI range of mixing attachments

KSI soil mixing attachments are available in three sizes for mounting on excavators between 75,000 and 100,000 lbs operating weight and can be supplied with a range of blade lengths. The KSI 7000 model can be equipped with blades suitable for mixing depths of 13, 16, 20 or 23 feet, while the larger models KSI 12000 and KSI 16000 can take blades for mixing depths from 20 to 40 feet and from 20 to 52 feet respectively. Depending on the application, the blades can be produced with cutter plates for different mixing widths.

Thanks to the ability to switch between different digging teeth technologies, the structure can be integrated into layers of weathered rock while maintaining a sealed interface.

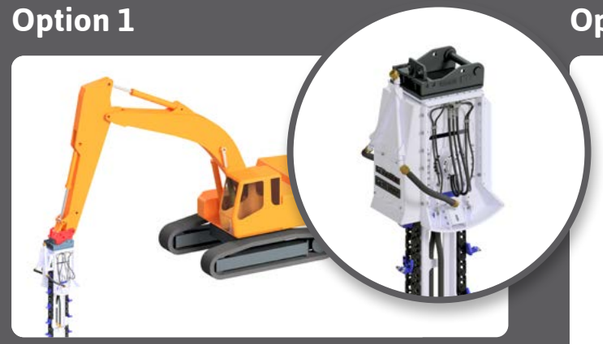


		KSI 7000	KSI 12000	KSI 16000
Carrier type	Type	Excavator	Excavator / Rig	Excavator / Rig
Recommended excavator weight	lbs x 10^3	75–120	175–265 [1]	265–440 [2]
Recommended rig weight	lbs x 10^3	–	110–155	130–220
Rated power	hp	175	295	400
Mixing depth (A)	ft	13 | 16 | 20 | 23	20 | 23 | 26 | 30 | 33 | 36 | 40	20 | 26 | 33 | 40 | 46 | 52
Mixing width (B)	in	14–20	20–26	18–38
Housing width (C)	in	39	54	64
Recommended chain speed	ft/s	6.6–8.2	6.6–8.2	6.6–8.2
Recommended oil flow [3]	gal/min	75–90	130–160	175–215
Max. oil flow [3]	gal/min	109	195	260
Max. operating pressure	psi	5,800	5,800	5,800
Torque at 5500 psi	lbf·ft	17,800	40,100	53,500
Cutting force at 5500 psi	lbf	19,700	35,000	46,700
Max. ground compressive strength	psi	1,450	1,450	1,450
Weight at max. depth & max. width	lbs	10,800	29,800	46,300
Weight (per extension)	lbs	800 (3.3 ft)	1,750 (3.3 ft)	4,200 (6.6 ft)
Standard pick	Type	DT 22/46/38/22 HC	DT 22/90/70/30 HQ	DT 22/90/70/30 HQ

[1] KSI 12000: Attachment to excavators from 110,000 to 175,00 lbs possible with special adapter.
[2] KSI 16000: Attachment to excavators from 165,000 to 265,000 lbs possible with special adapter.
[3] Oil flow: During adjustment, ensure that the maximum power does not exceed the machine's rated power at any pressure point.

Attachment and adapter options

Option 1



Excavator adapter plate with standard hole patterns for use with quick couplers (e.g. Lehnhoff, OilQuick, etc). Upgradeable with a tilt-rotation unit.

Option 2

Mechanical adapter hook for attaching the KSI directly to the excavator's boom.

Option 3

Adapter plate for drilling and piling rigs.

Quality control

Quality control of soil mixing is very important. If possible, before starting a project, preliminary tests are recommended.

Hardware and software mounted on the mixing attachment and on the excavator collect production parameters. Performance, quality and quantity data is recorded in real time.

The most important parameters are:

- Mixing depth
- Mixing width
- Chain speed
- Carrier speed
- Slurry volume
- Hydraulic oil flow and pressure

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The Kemsolid MSM solution

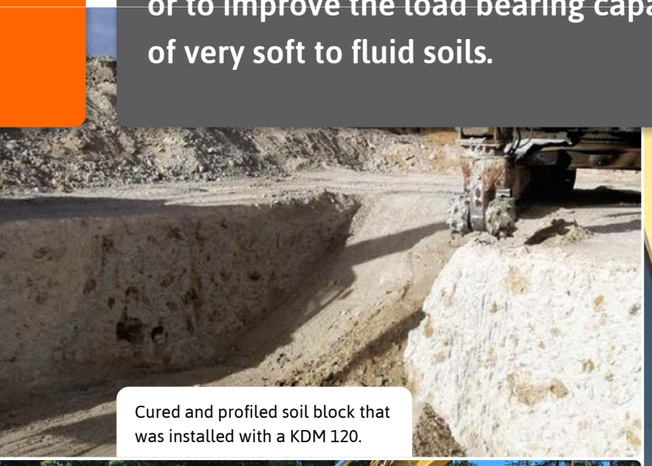
The Kemsolid MSM solution — where “MSM” stands for “Mass Soil Mixing” — is for a sub soil improvement and soil stabilization technique using mixing attachments from the KDM range on a standard excavator.

The MSM technique is used for very soft to fluid soils. By using a KDM attachment to mechanically mix the in-situ soil with either a dry binder or a suspension of mortar or cement, the soil can be consolidated or strengthened as required. Compressed air or pumps are used to supply the additive via a line on the attachment to the middle of the KDM in the soil.

Due to the operating characteristic of the attachment, mixing can continue through solid layers as well as in sandy or silty soils. Using surface material in the additive for mixing into subsurface soils is also possible.

The extension can be assembled depending on job requirement.

The MSM technique is used to stabilize or to improve the load bearing capacity of very soft to fluid soils.



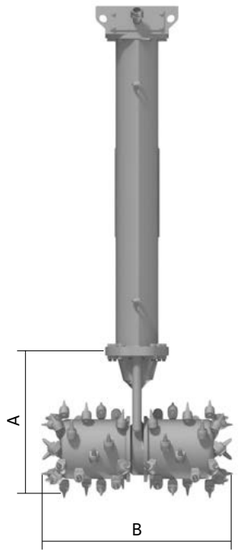
Cured and profiled soil block that was installed with a KDM 120.

Producing consolidated soil structures using a KDM 120.

KDM 150 installed on a 110,000 lbs excavator.

The KDM range of mixing attachments

Mixing attachment in the KDM range are available in five sizes for 55,000 to 110,000 lbs excavators. A variety of mixing depths can be achieved by changing the extension segments.



		KDM 120	KDM 150	KDM 155	KDM 165	KDM 175
Recommended excavator weight	lbs x 10^3	55–90	65–90	65–90	75–110	75–110
Rated power	hp	160	200	210	220	235
Cutter length (A)	in	45	45	45	47	47
Mixing width (B)	in	43 | 51	51 | 59	59	55 | 67	67 | 79
Drum diameter (C)	in	31	31	31	34	34
Recommended rpm	rpm	65	65	65	60	55
Recommended oil flow [1]	gal/min	79	86	90	95	106
Max. oil flow [1]	gal/min	95	95	95	106	111
Max. operating pressure	psi	5,800	5,800	5,800	5,800	5,800
Torque at 5500 psi	lbf·ft	20,100	21,900	24,000	26,800	31,600
Cutting force at 5500 psi	lbf	15,800	17,200	18,900	18,900	22,300
Max. ground compressive strength	psi	1,450	1,450	1,450	1,450	1,450
Weight per mixing width	lbs	3,415 | 3,750	3,750 | 3,970	3,970	4,960 | 5,510	5,510 | 5,950
Toolholder / Pick box	Type	PH 32 HD	PH 32 HD	PH 32 HD	PH 32 HD	PH 32 HD
Number of picks per mixing width	Pcs	48 | 52	52 | 60	60	56 | 68	68 | 76
Standard pick	Type	DT [2]	DT [2]	DT [2]	DT [2]	DT [2]

[1] Oil flow: During adjustment, ensure that the maximum power does not exceed the machine’s rated power at any pressure point.

[2] Type DT 22/90/70/30 HQ.

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The Kemsolid CFA solution

The CFA technique is used to produce in-situ concrete piles using conventional excavators, together with the KRX PLUS attachment range, makes the process very flexible and cost-effective. Productivity is higher when compared to using cased drilling methods.

To create piles, hydraulic power from the excavator is used to continuously rotate an auger attached to the excavator that is the full length of the pile. The auger is driven into the soil to the desired depth (piling depth) and then raised while at the same time concrete is pumped via the flushing head and hollow auger to the drill bit to fill the hole. During the entire process, the auger keeps the borehole stabilized. As required, reinforcement cages, steel girders or casing can be subsequently installed into the fresh concrete.

Due to the operating characteristic of the attachment, mixing can continue through solid layers as well as in sandy or silty soils. Using surface material in the additive for mixing into subsurface soils is also possible.

The extension can be assembled depending on job requirement.

The KRX PLUS range

The KRX PLUS range of Powertool drive units are extremely robust and use a radial piston motor to generate extremely high torque and cutting forces.

The application for the KRX PLUS range is the production of in-situ concrete piles using a flushing head, hollow stem auger and an auger drill bit.

These drive units can be also used for pre-drilling works and pile heads cutting.

		KRX 70 PLUS	KRX 120 PLUS	KRX 130 PLUS	KRX 140 PLUS	KRX 150 PLUS
Recommended excavator weight	lbs x 10^3	35–55	55–90	55–90	65–110	75–110
Rated power	hp	95	160	160	190	190
Length of drive unit	in	33	33	33	34	34
Torque at 5500 psi	lbf·ft	12,000	22,000	25,100	26,800	31,700
Max. idle oil flow	gal/min	79	95	95	103	111
Max. hydraulic pressure	psi	5,800	5,800	5,800	5,800	5,800
Weight without attachment	lbs	1,146	1,190	1,190	1,984	1,984
Hex connection, standard	in	6	6	6	6	6

KRX 70 PLUS
KRX drive unit with CFA adapter, hollow auger and pilot bit.

Tools

Picks with matching retainers

Dragontooth pick
DT 22/46/38/22 HC
Part No. 22463822

Dragontooth pick
DT 22/90/70/30 HQ
Part No. 22907030

Round attack pick
ER 15/46/38/22 C
Part No. 15463822

Round attack pick
ER 19/75/70/30 Q
Part No. 19757035

Retaining clip
ES 22
Part No. 99999996

Gypsum pick
ER 15/90/70/30 Q
Part No. 15907035

QuickSnap clip
QS 30
Part No. 99500030

KSI TWIN with double blade

Using the double blade (KSI TWIN) productivity can be increased, time required can be reduced and CO_2 emissions saved while using the TSM process to build and upgrade roads and railway lines as well as working on dams and dykes.

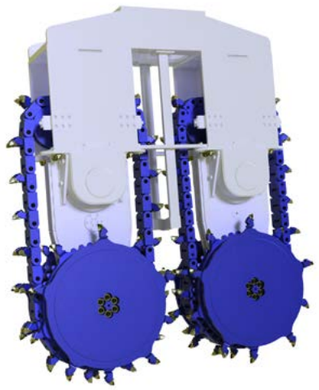
For example, parallel sealing or retaining walls can be produced in one step. This reduces working hours, especially when building new or renovating existing rapid transit routes. This also makes sealing and stabilizing dykes more effective and sustainable.

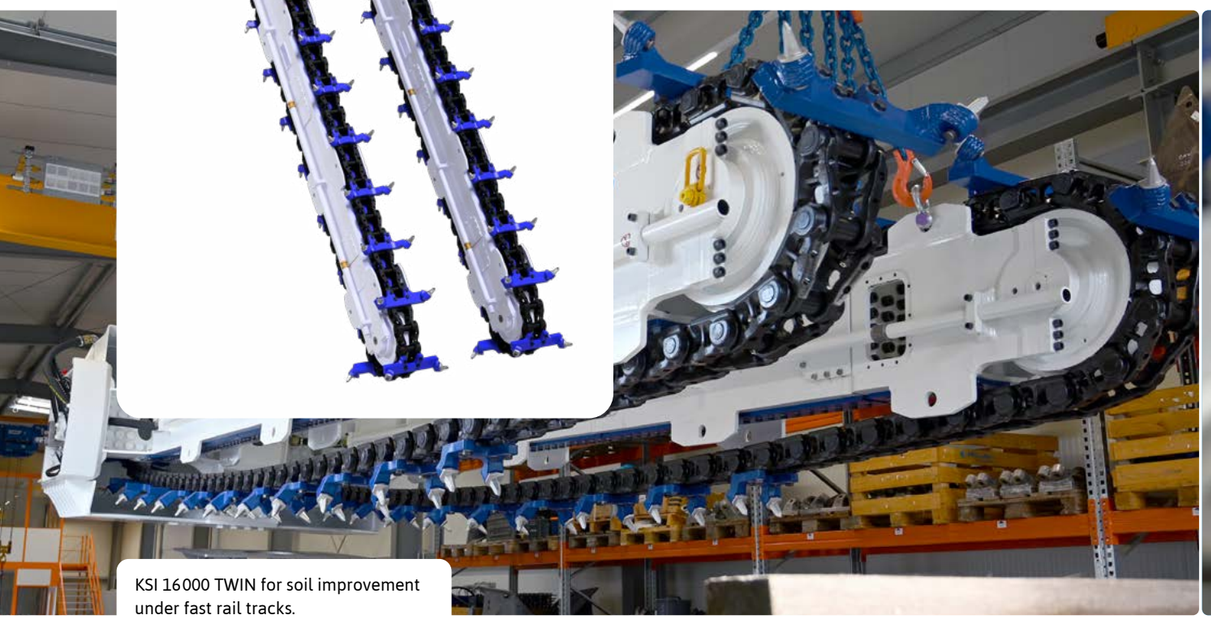
KSI HYDRA with multiple blades

The multiple blade variant (KSI HYDRA) is used for more efficient and precise production in larger projects involving stabilization and strengthening of soils. The blade widths and separation can be precisely and individually adapted to suit the local conditions on the job site thanks to a sophisticated modular construction.

Kemsolid KSM solution for Cutter-Soil-Mixing (CSM)

The KSM cutter can be used for production of soil concrete panels. The CSM technology can be a very attractive soil mixing method wherever there is limited space on the construction site and where the cut-off/retaining walls or soil improvement elements need to be very deep.





KSI 16000 TWIN for soil improvement under fast rail tracks.

Notes

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kemsolid.com

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