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KEMSOLID[®]

build on solid foundations

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



KSI 16000 installed on a 120-ton excavator sealing a mine tailings basin.

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Kemsolid is the name of KEMROC's new division dedicated to soil stabilisation 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 advice from foundation engineering specialist.

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 works 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 travelling 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

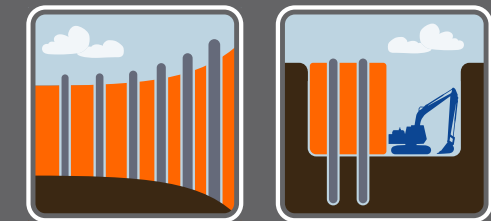
Cut-off



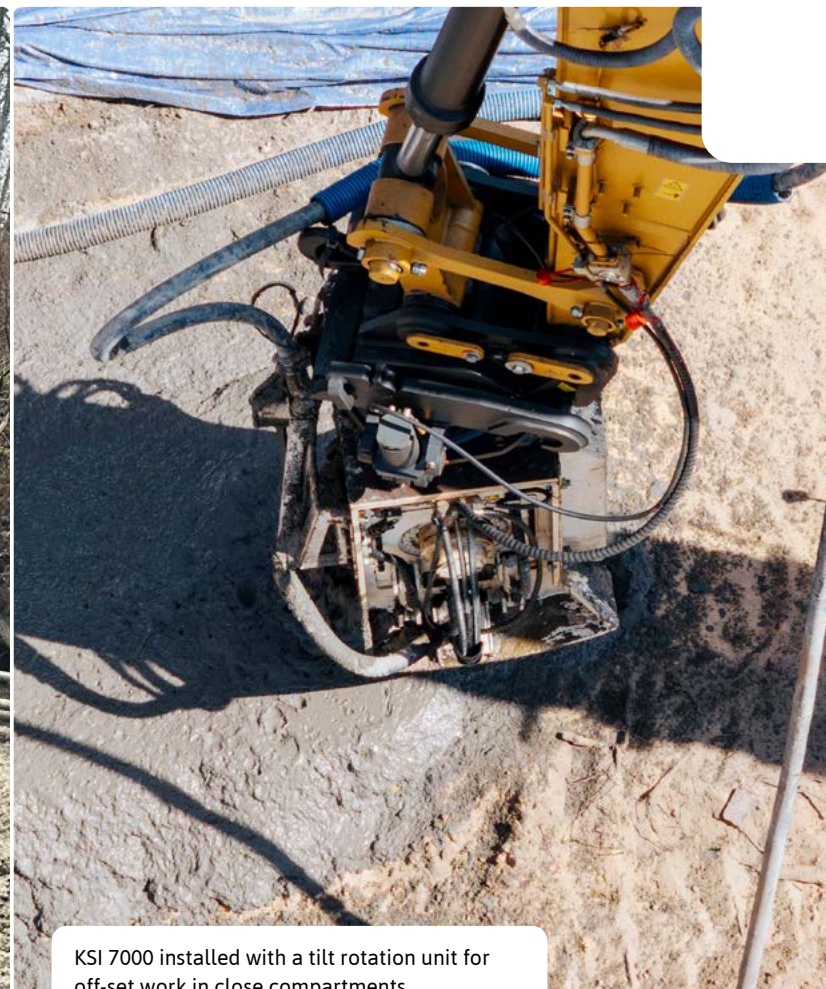
Ground improvement and soil stabilisation



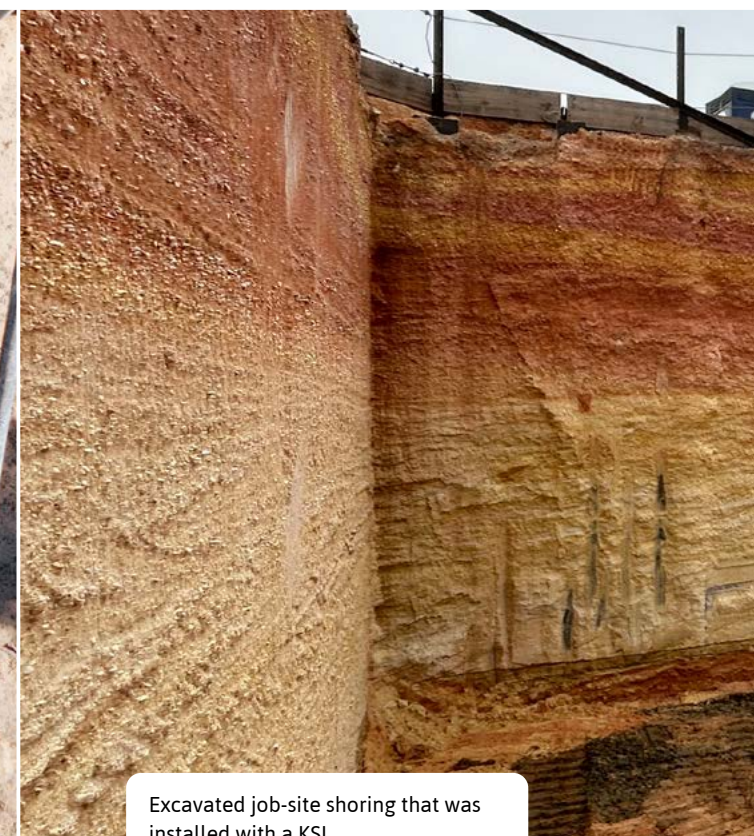
Shoring and retaining walls



KSI 7000 installed on a 35-ton excavator producing a cut-off wall in tough 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.

Process sequence

Step 1

Excavation of a guide trench (depth approx. 50 cm, width same as required).

Step 2

Positioning of the mixing blade mounted on the excavator or piling 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 2.0–2.5 m/s and typical carrier speed is 10–15 m/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 100 linear meters per day are possible.

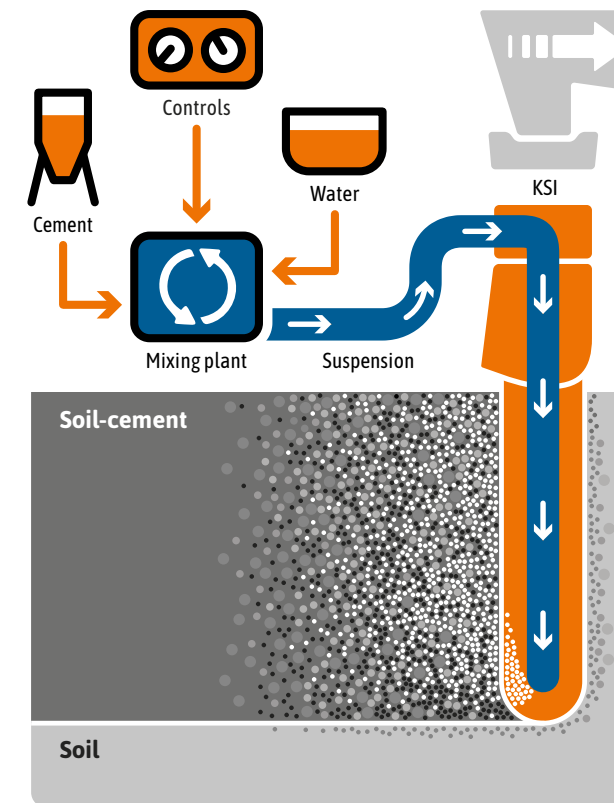


KSI 7000 installed on a 40-ton excavator sealing a construction site.



KSI 16000 installed on a 110-ton excavator using a custom mechanical adaptor hook.

Schematic overview



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: 200–700 kg/m³ of treatment



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

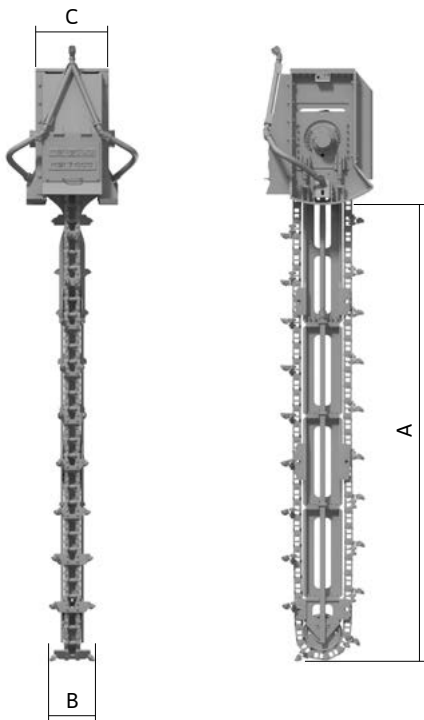


KSI 16000 installed on a piling rig producing a soil-cement structure.

The KSI range of mixing attachments

KSI soil mixing attachments are available in four sizes for mounting on excavators between 35 and 200 ton 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 4, 5, 6 or 7 meters, while the larger models KSI 12000 and KSI 16000 can take blades for mixing depths from 6 to 12 and from 6 to 16 meters respectively. Depending on the application, the blades can be produced with cutter plates for different mixing widths.

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

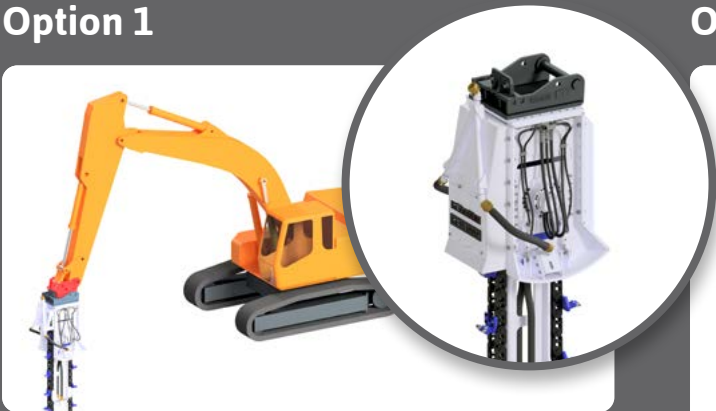


		KSI 7000	KSI 12000	KSI 12000 W	KSI 16000
Carrier type	Type	Excavator	Excavator / Rig	Excavator / Rig	Excavator / Rig
Recom. excavator weight	t	35–55	80–120 ^[1]	80–120 ^[1]	120–200 ^[2]
Recom. rig weight	t	–	50–70	50–70	60–100
Rated power	kW	130	220	220	300
Mixing depth (A)	m	4 5 6 7	6 7 8 9 10 11 12	4 6 8	6 8 10 12 14 16
Mixing width (B)	mm	350–500	500–650	400–1,050	450–950
Housing width (C)	mm	1,000	1,360	1,760	1,630
Recom. chain speed	m/s	2.0–2.5	2.0–2.5	2.0–2.5	2.0–2.5
Recom. oil flow ^[3]	l/min	280–350	490–620	600–750	660–820
Max. oil flow ^[3]	l/min	410	740	900	980
Max. operating pressure	bar	400	400	400	400
Torque at 380 bar	Nm	24,200	54,400	66,500	72,600
Cutting force at 380 bar	kN	87	156	190	208
Max. ground compressive strength	MPa	10	10	10	10
Weight at max. depth and max. width	kg	4,900	13,500	12,500	21,000
Weight (per extension)	kg	400 (1 m)	800 (1 m)	1,650 (2 m)	1,900 (2 m)
Standard pick	Type	DT 22/46/38/22 HC	DT 22/90/70/30 HQ	DT 22/90/70/30 HQ	DT 22/90/70/30 HQ

^[1] KSI 12000 and KSI 12000 W: Attachment to excavators from 50 to 80 t possible with special adaptor.
^[2] KSI 16000: Attachment to excavators from 75 to 120 t possible with special adaptor.
^[3] Setting the correct oil flow ensures that maximum output power is never greater than the rated power at any pressure level.

Attachment and adaptor options

Option 1



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

Option 2



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

Option 3



Adaptor 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

The Kemsolid MSM solution

The Kemsolid MSM solution — where “MSM” stands for “Mass Soil Mixing” — is for a sub soil improvement and soil stabilisation 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.

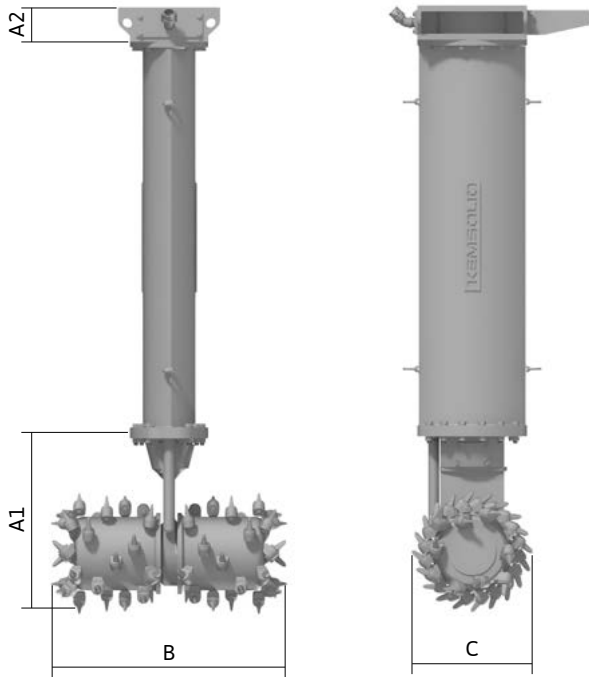
Due to the operating characteristic of the attachment, mixing can continue through solid layers as well as in sandy or silty soils. Using surface material in the additive for mixing into subsurface soils is also possible.

The extension can be assembled depending on job requirement.

The KDM range of mixing attachments



Mixing attachment in the KDM range are available in five sizes for 25 to 50 ton 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	t	25–40	30–40	30–40	35–50	35–50
Rated power	kW	120	150	155	165	175
Length of the base mixing unit without extension (A1 + A2)	mm	1,375	1,375	1,375	1,420	1,420
Mixing width (B)	mm	1,100 1,300	1,300 1,500	1,500	1,400 1,700	1,700 2,000
Drum diameter (C)	mm	775	775	775	864	864
Recommended rotation speed	rpm	65	65	65	60	55
Recommended oil flow ^[1]	l/min	300	325	340	360	400
Max. oil flow ^[1]	l/min	360	360	360	400	420
Max. operating pressure	bar	400	400	400	400	400
Torque at 380 bar	Nm	27,200	29,700	32,600	36,300	42,900
Cutting force at 380 bar	kN	70.1	76.7	84.2	84.1	99.2
Max. ground compressive strength	MPa	10	10	10	10	10
Weight per mixing width	kg	1,550 1,700	1,700 1,800	1,800	2,250 2,500	2,500 2,700
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] Setting the correct oil flow ensures that maximum output power is never greater than the rated power at any pressure level.

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

The MSM technique is used to stabilise 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 50-ton excavator.

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 stabilised. 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 drive unit with
CFA adaptor,
hollow auger and
pilot bit.

		KRX 70 PLUS	KRX 120 PLUS	KRX 130 PLUS	KRX 140 PLUS	KRX 150 PLUS
Recommended excavator weight	t	15–25	25–40	25–40	30–50	35–50
Rated power	kW	70	120	120	140	140
Length of drive unit	mm	830	842	842	875	875
Torque at 380 bar	Nm	16,300	29,800	34,000	36,400	43,000
Max. idle oil flow	l/min	300	360	360	390	420
Max. hydraulic pressure	bar	400	400	400	400	400
Weight without attachment	kg	520	540	540	900	900
Hex connection, standard	mm	160	160	160	160	160



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 CO₂ 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 stabilising dykes more effective and sustainable.



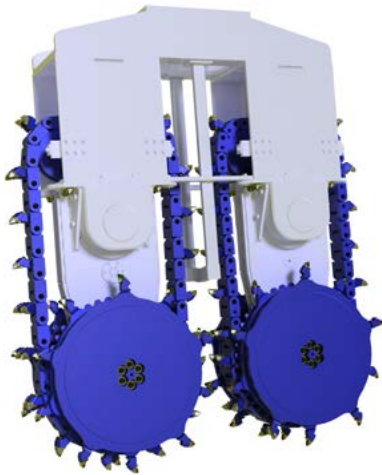
KSI HYDRA
with multiple blades

The multiple blade variant (KSI HYDRA) is used for more efficient and precise production in larger projects involving stabilisation 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.



Notes

KSI 16000 TWIN for soil improvement under fast rail tracks.



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