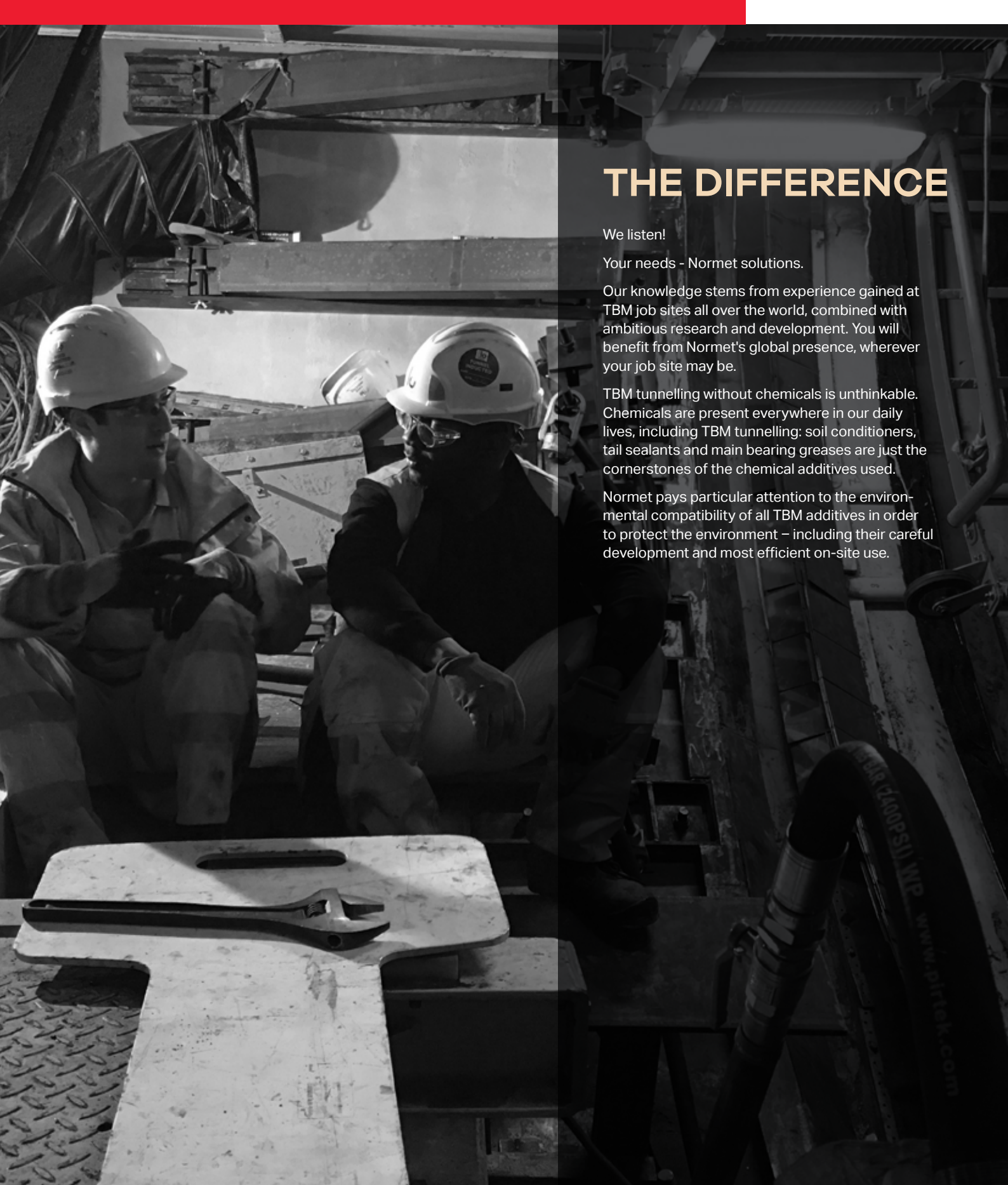


normet



TBM TECHNOLOGY





THE DIFFERENCE

We listen!

Your needs - Normet solutions.

Our knowledge stems from experience gained at TBM job sites all over the world, combined with ambitious research and development. You will benefit from Normet's global presence, wherever your job site may be.

TBM tunnelling without chemicals is unthinkable. Chemicals are present everywhere in our daily lives, including TBM tunnelling: soil conditioners, tail sealants and main bearing greases are just the cornerstones of the chemical additives used.

Normet pays particular attention to the environmental compatibility of all TBM additives in order to protect the environment – including their careful development and most efficient on-site use.

PRESERVING OUR FUTURE

Normet's research and development team are dedicated to continually enhancing our TBM chemical technology, allowing us to deliver products with optimum performance and absolute minimum impact on the environment. To compliment this, our global team of TBM technicians provide product guidance and support throughout the project life cycle, working along side you to maximise excavation efficiency.

EXPERIENCE & KNOWLEDGE

Normet's experience and know-how are dedicated to maximizing your TBM's advance rate while protecting the environment as best as possible.

In order to be really environmentally friendly, products need to be more than just biodegradable.

Eco-compatibility means:

- > Having only minimal toxicity
- > Showing high biodegradation or inert behaviour
- > Using renewable raw materials whenever possible
- > Delivering high efficiency to minimise the quantities used



SOIL DISPOSAL

Soil conditioned with Normet soil conditioning additives, if applied correctly, may not show any different soil characteristics compared to its natural state apart from the consistency and organic content (TOC, BOD).

Therefore, the soil generally remains in the same disposal class as the original soil, though each job site must be evaluated as an individual case. Normet also offers soil conditioning agents free of anionic surfactants.

AQUATIC TOXICITY

Due to the extremely high sensitivity of aquatic organisms, aquatic toxicity is one of the most critical areas – not only for soil conditioning additives, but for all chemicals used on a TBM.

To be sure that the selected chemicals are as safe as possible for aquatic organisms, special acute toxicity tests are performed according to OECD guidelines. LC₅₀/EC₅₀ values and NOEC data are available upon request.





CHEMICALS FOR TBM TUNNELLING

Modern tunnelling – and especially TBM tunnelling – is unthinkable without chemistry. Like in our daily lives, many things used quite naturally are based on modern chemistry: visible success – invisible contribution.

SOIL CONDITIONERS



Soil conditioners allow cutterhead torque to be reduced and ensure that the working chamber is filled regardless of the geological conditions present.

TAIL SEALANTS



Together with the wire brushes, tail sealants seal the gap at the shield tail against ingress of water, soil or annulus grout.

MAIN BEARING GREASES



Main bearing sealants and greases protect and lubricate the main bearing sealing system.

ANNULUS GROUTS



Efficient and trouble-free annulus grouting is vital to maximise TBM uptime, reduce settlement risk and protect the lining and gaskets.

Further chemicals are used for pre-injection for soil stabilisation, start and reception shafts, safe havens, cross passages and many more applications. Modern chemistry has also allowed new innovations to be developed to significantly increase safety and reduce costs in difficult geometries, such as sprayable waterproofing membranes and structural support liners (SSL).



SOIL CONDITIONING

In EPB tunnelling, the soil conditioning agents have to be selected according to the geological conditions.

The correct choice and use of well-adapted soil conditioners makes a considerable difference in the success of a tunnelling project – both in highly permeable soils and in sticky clay conditions.

Ground conditions originally judged to be 'difficult' can be transformed to be (more) manageable, drastically reducing the time for cleaning the TBM working chamber and cutterhead, thus avoiding unnecessary and/or frequent chamber interventions.

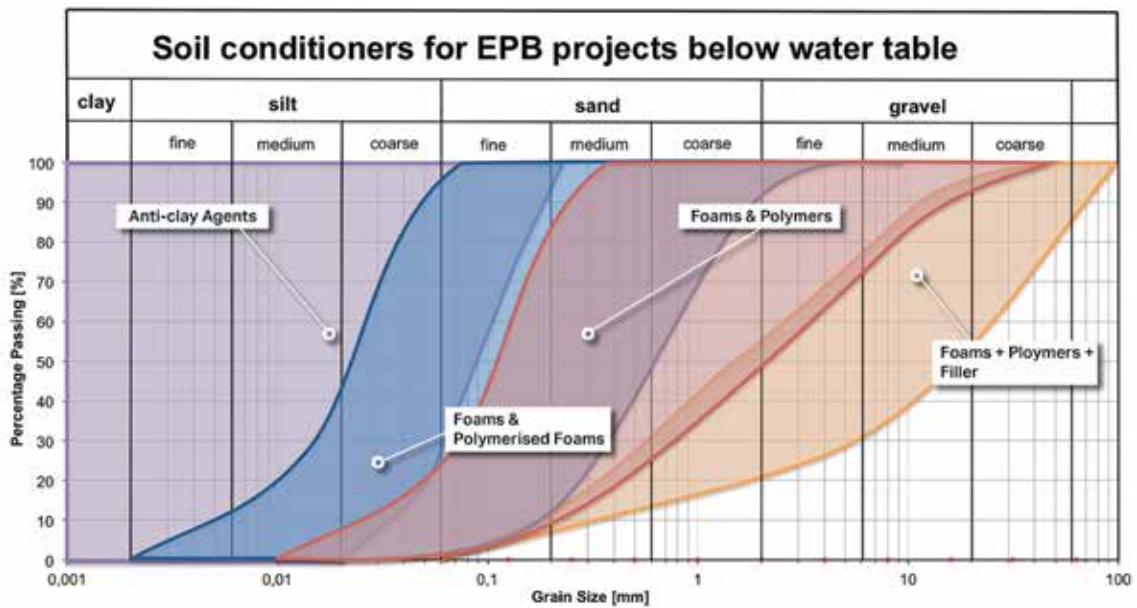
Soil conditioners allow TBM cutterhead torque to be reduced and decrease the cutterhead tool and screw wear, enabling the TBM to work in pressurised closed mode even under difficult mixed face conditions or in soils with high clay content.



STANDARD & POLYMERISED FOAMS

Standard and polymerised soil conditioners are normally used for silty to gravelly sands. Different foam types may be used depending on the nature of the soil and its humidity or the groundwater pressure.

Soil conditioners reduce cutterhead torque and enable the TBM to advance quickly and securely in fully pressurised EPB mode. The compressible earth paste smooths out the pressure variations in the working chamber and forms a plug in the screw conveyor.



NORMET RANGE OF STANDARD FOAMS

- > TamSoil 195CF

NORMET RANGE OF POLYMERISED FOAMS

- > TamSoil 265CF
- > TamSoil 267CF (ECO Friendly)

Soil conditioners also reduce friction and wear, which is especially important for increasing the efficiency and life of the cutterhead, cutterhead tools and screw conveyor.

SPECIALITY CHEMICALS FOR TUNNEL BORING MACHINES

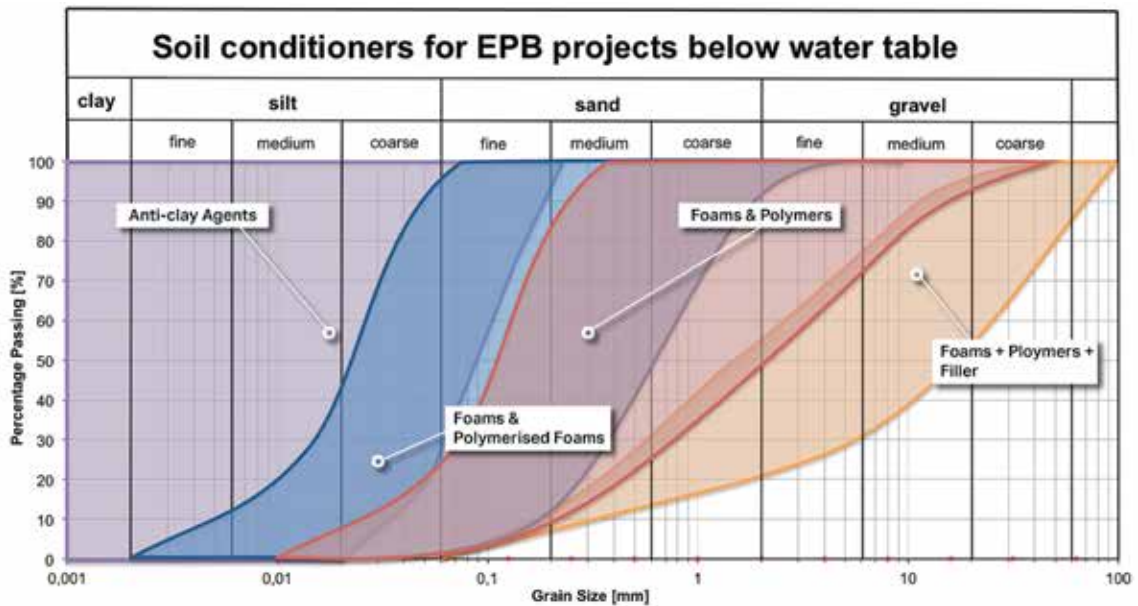


ANTI-CLOGGING AGENTS

Normet offers a complete range of anti-clogging agents that significantly reduce clay clogging and re-agglomeration effects.

Hard rock and slurry TBMs may also face clay clogging and adhesion problems, in which case non-foaming anti-clay agents are required.

Due to the complex nature of clay and clayey soils, different clay formations also require different anti-clay agents.



NORMET RANGE OF FOAMING ANTI-CLOGGING AGENTS

- > TamSoil 284AC
- > TamSoil 285AC
- > TamSoil 287AC (ECO Friendly)

NORMET RANGE OF LIQUID NON-FOAMING ANTI-CLOGGING AGENTS

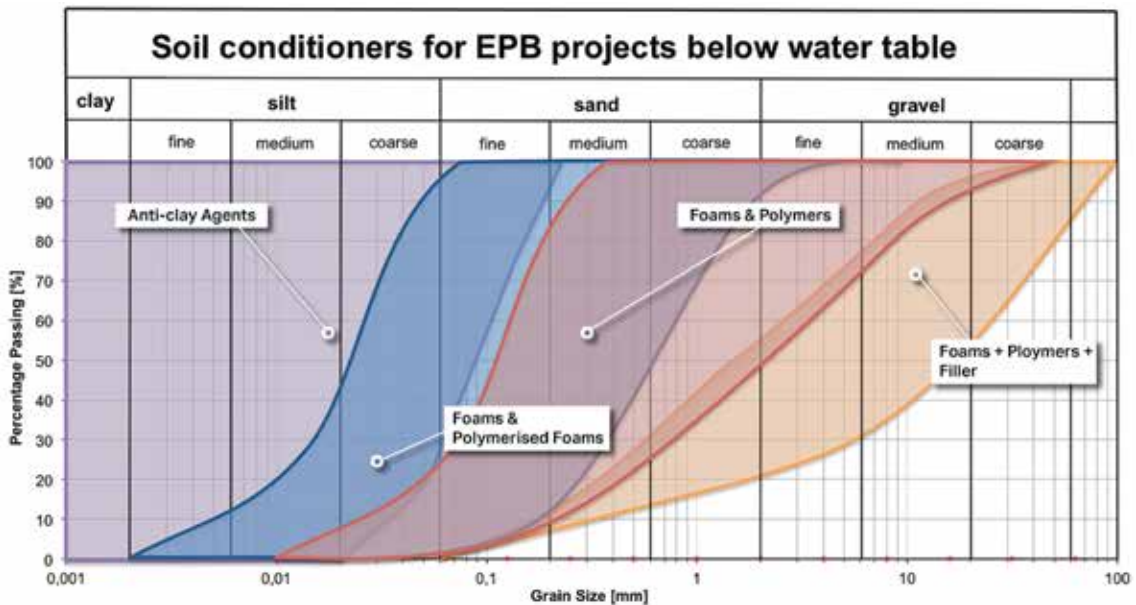
- > TamSoil DSA2



POLYMERS

Polymers are generally used when tunnelling through water-bearing grounds, where the excavated soil becomes very liquid and difficult for the screw conveyor and conveyor belt to handle.

TamSoil 500CP is a liquid polymer specially designed to improve soil stability and optimize the permeability of the excavated material where foam alone is not enough to tackle the increase in water content.



NORMET RANGE OF SPECIALLY DEVELOPED POLYMERS

- > TamSoil 500CP
- > TamSoil 700CP
- > TamSoil 1000CP

TamSoil 700CP is a unique liquid polymer specially designed for tunnelling below the groundwater level with a high water-binding capacity and a very quick reaction where foam alone is not enough to tackle the increase in water content.

TamSoil foams and polymers can also be employed with an additional fine filler suspension to handle coarse soils.

TamSoil 1000CP, a very strong water-binding polymer, should be used separately and can be injected into the working chamber or screw conveyor to create a secure watertight plug.



ANTI-WEAR & ANTI-DUST

Excessive wear, high temperatures and cutter blockages are issues in hard rock TBM tunnelling. In most cases, these effects are combated by using onto a simple water sprinkler system to cool down the cutterhead and reduce the dust level.

Nevertheless, disc cutter wear, temperature, related cutter blockages and dust remain persistent, especially in abrasive rock conditions.

Normet believes it is time to make a step change and use efficient anti-dust and anti-wear additives. The functionality of our anti-wear additives has been proven in extensive laboratory trials at Colorado School of Mines (USA) and on TBM job sites.



NORMET RANGE OF SPECIALLY DEVELOPED FOAMING ANTI-DUST AND ANTI-WEAR AGENTS

- > TamSoil 800AD (anti-dust)
- > TamSoil 830AW (anti-wear)
- > TamSoil 860AW (anti-wear) - For pure hard rock machines

IMPORTANT: GET THE TBM PREPARED!

The minimum requirement at the design stage is to install a rotary union and dedicated foam pipework to the cutterhead nozzles to avoid a standstill on site. The cost increase at this stage is only minimal.

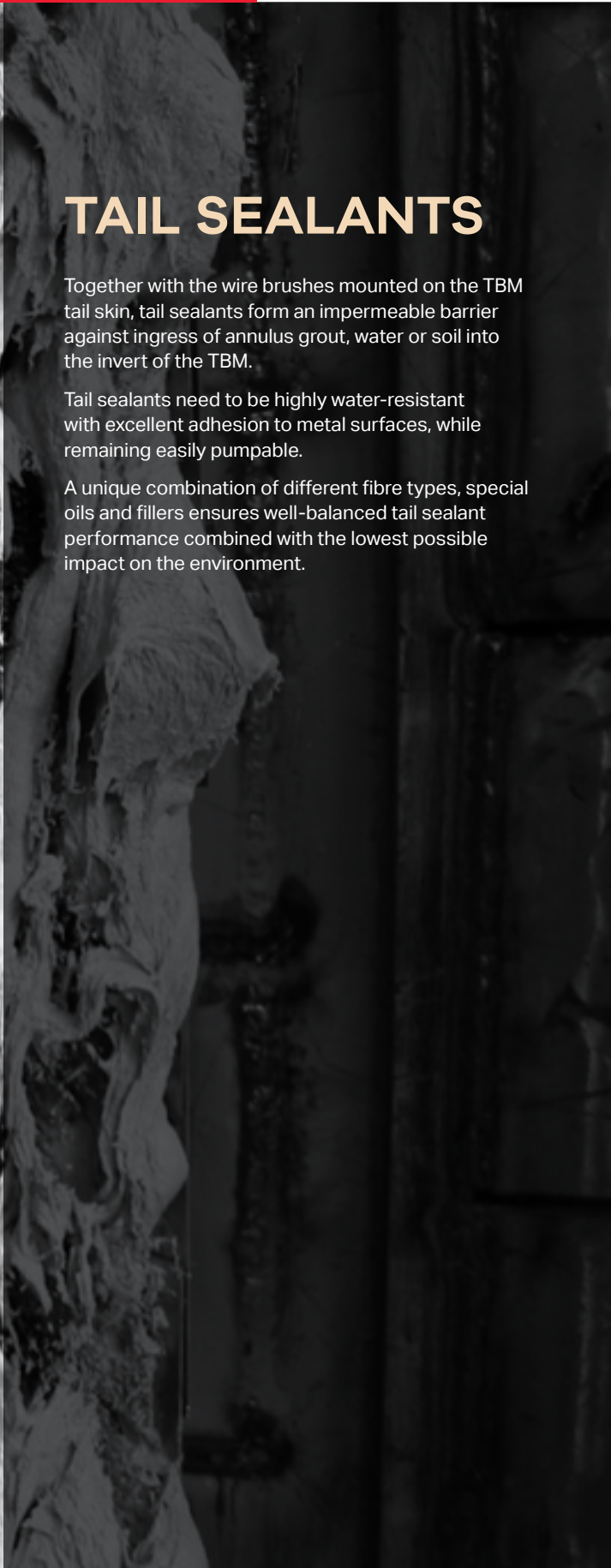


TAIL SEALANTS

Together with the wire brushes mounted on the TBM tail skin, tail sealants form an impermeable barrier against ingress of annulus grout, water or soil into the invert of the TBM.

Tail sealants need to be highly water-resistant with excellent adhesion to metal surfaces, while remaining easily pumpable.

A unique combination of different fibre types, special oils and fillers ensures well-balanced tail sealant performance combined with the lowest possible impact on the environment.





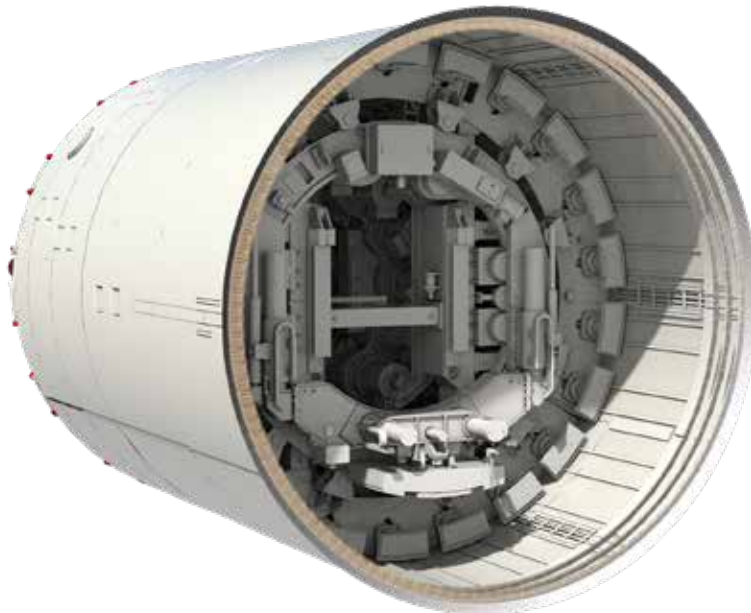
TAIL SEALANTS

TamSeal TG91 is our high specification driving grade tail sealant for challenging water and ground conditions and is pumped into the sealant chambers as the TBM advances.

The special fibre composition of TamSeal TG91 allows excellent flow and distribution inside the sealing chamber and ensures perfect interaction with the brushes. TamSeal TG91 is biodegradable and self-extinguishing. TamSeal TG66 compliments our range of tail sealants and has been formulated for less demanding geology and ground water pressure.

TamSeal TG92 is the first fill grade, needing to be pumped into the wire brushes before the TBM starts up.

Once applied inside the brushes, the first fill grade protects them against wear, water soil and annulus grout ingress while keeping the brushes highly flexible for protect long-term sealing. TamSeal TG92 is biodegradable and self-extinguishing.



NORMET RANGE OF TAIL SEALANTS

- > TamSeal TG92 (First fill grade)
- > TamSeal TG91 (For challenging water and ground conditions)
- > TamSeal TG66 (For less demanding geology and water pressure conditions)

SELECTED JOB SITE REFERENCES

- > Singapore T208, NFM Slurry TBM, up to 4 bar
- > India, Chennai, HK EPB TBMs, up to 3 bar
- > India, Kolkatta, HK EPB TBMs, up to 4 bar
- > Mexico, TEP, HK EPB
- > UK, London, NFM EPB

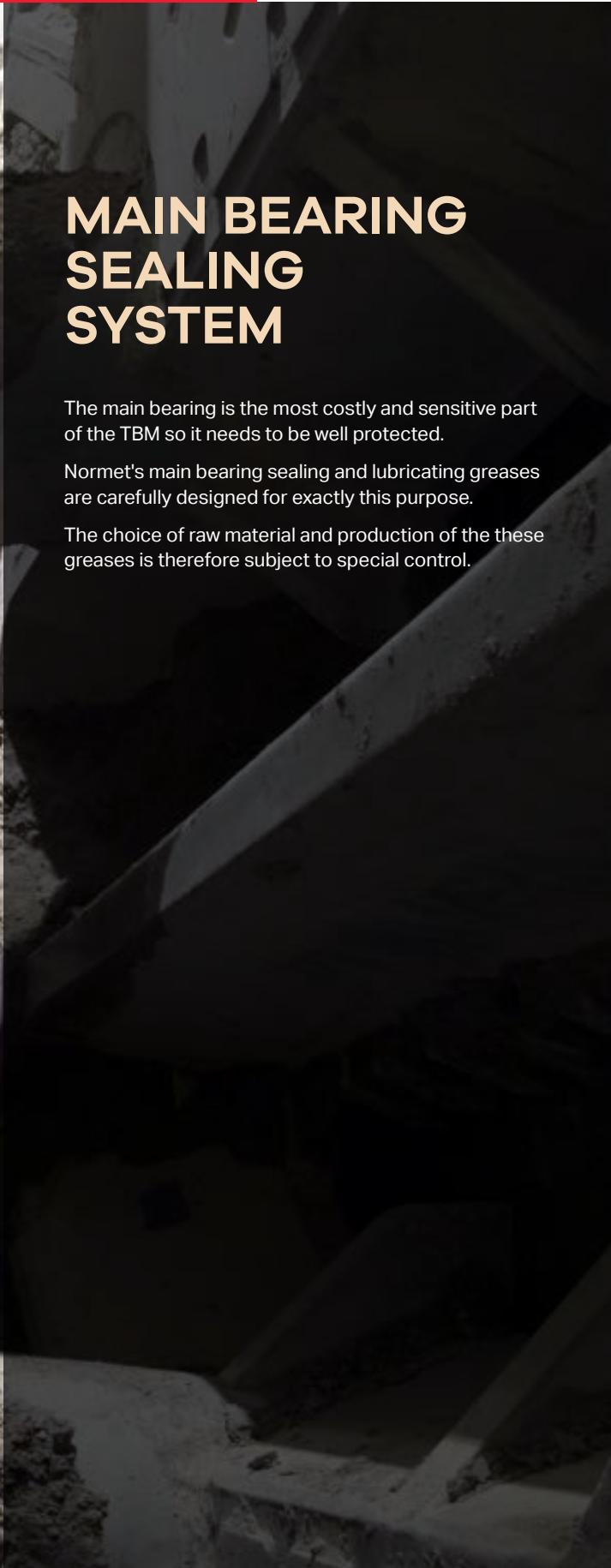


MAIN BEARING SEALING SYSTEM

The main bearing is the most costly and sensitive part of the TBM so it needs to be well protected.

Normet's main bearing sealing and lubricating greases are carefully designed for exactly this purpose.

The choice of raw material and production of these greases is therefore subject to special control.





MAIN BEARING GREASES

TamGrease BS1 is a main bearing sealing grease (excluder grease) with excellent adhesion and cohesion properties to completely fill the labyrinth and prevent ingress of soil or water. Consumption of the main bearing greases is defined by the TBM supplier.

Water spray-off (ASTM D4049) <7%

TamGrease BL11 and BL12 are EP2 grade bearing lubrication greases, combining good adhesion and cohesion properties with excellent lubrication properties. They are injected into the chambers created by the lip seals.

Water spray-off (ASTM D4049) <15%



NORMET RANGE OF MAIN BEARING GREASES

- > TamGrease BS1 (excluder grease)
- > TamGrease BL11 (EP2 grease)
- > TamGrease BL12 (EP2 grease)

SELECTED JOB SITE REFERENCES

- > India, Chennai, HK EPB TBMs
- > Mexico, TEP, Robbins EPB
- > Canada, Toronto, LOVAT TBMs

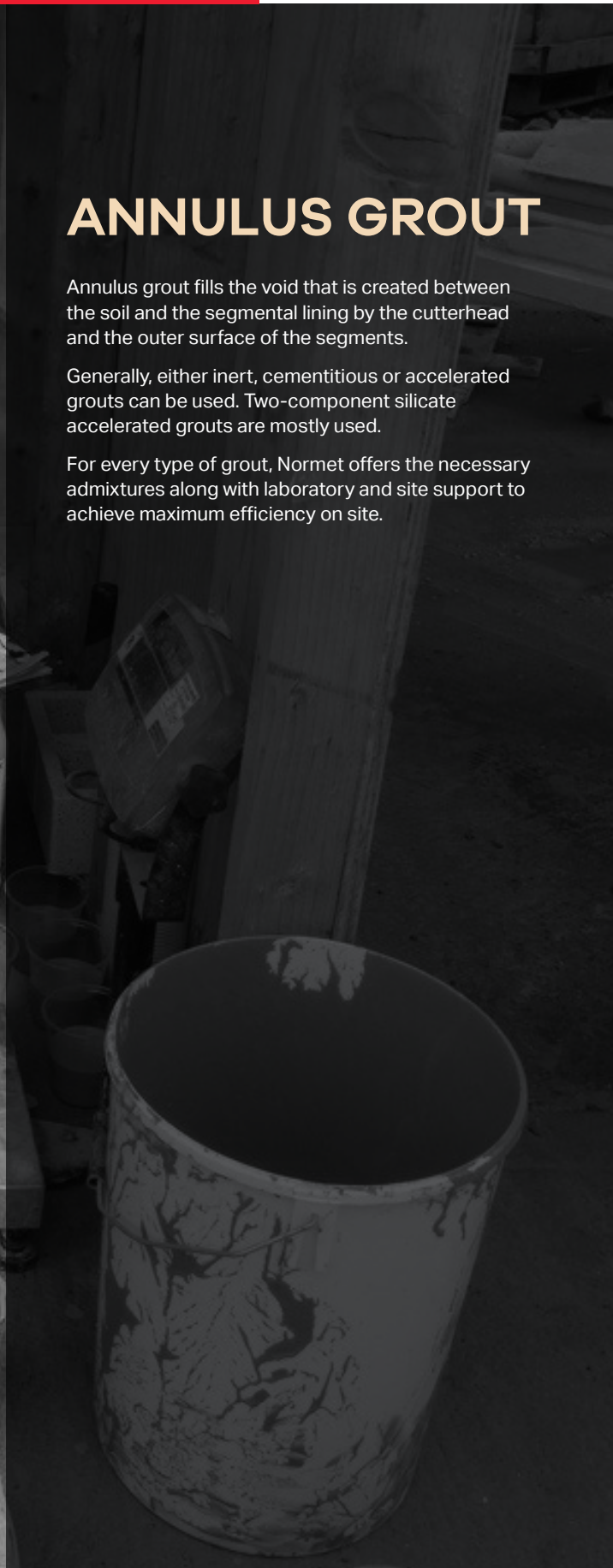


ANNULUS GROUT

Annulus grout fills the void that is created between the soil and the segmental lining by the cutterhead and the outer surface of the segments.

Generally, either inert, cementitious or accelerated grouts can be used. Two-component silicate accelerated grouts are mostly used.

For every type of grout, Normet offers the necessary admixtures along with laboratory and site support to achieve maximum efficiency on site.





ANNULUS GROUT ADMIXTURES

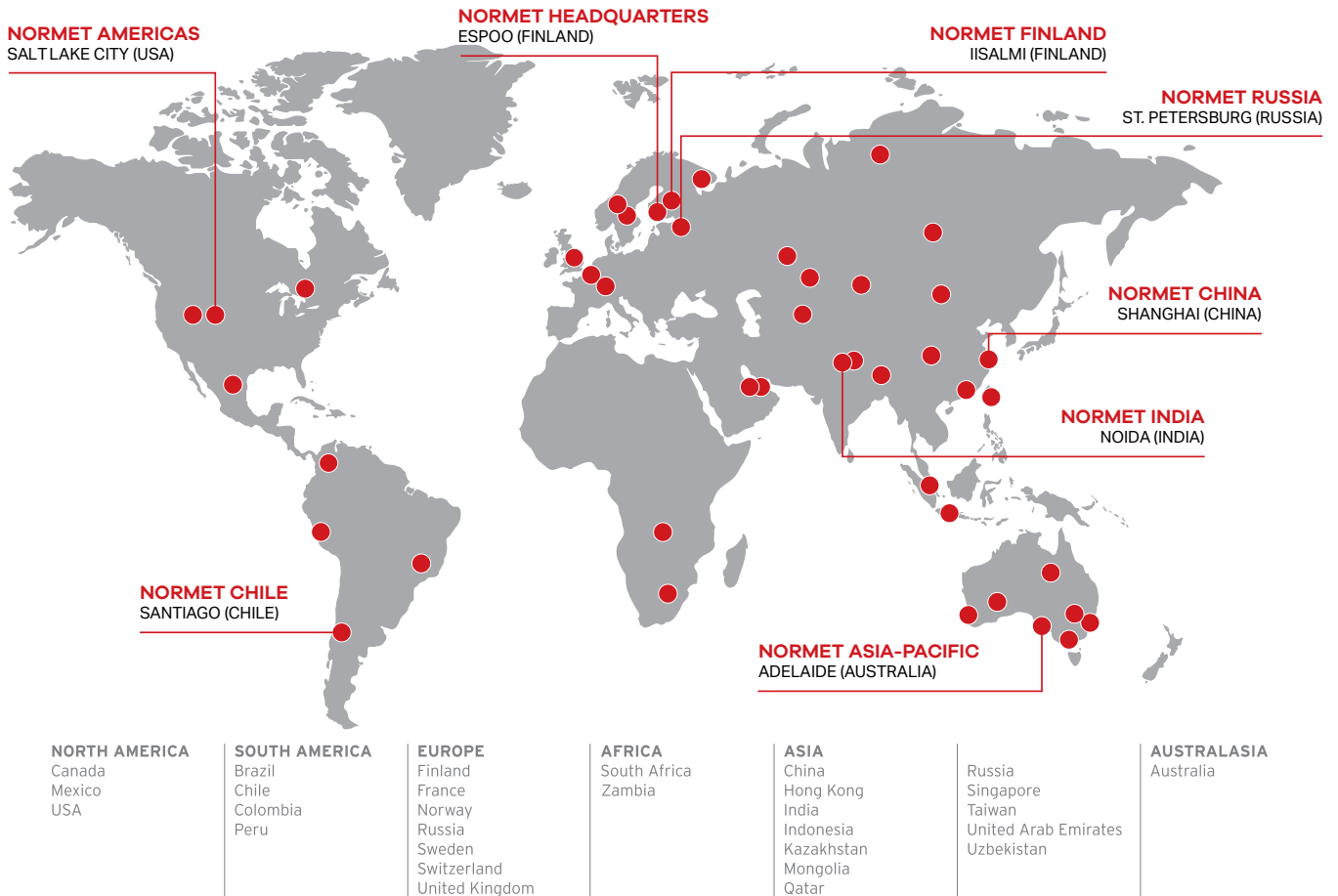
Efficient and trouble-free annulus grouting is essential to maximise TBM uptime, reduce settlement risk, fully embed the lining to transmit forces around the ring and, last but not least, protect the lining and gaskets. No matter whether job sites have chosen to use two-component mortar or pea gravel grout, Normet can provide guidance and support to reduce the learning curve and build confidence in the team.

Normet offers training both in the lab and on site for all tunnel workers dealing with annulus grout. Whether it's about design, batching or cleaning, we are keen to share our knowledge with our customers to make life as easy as possible.



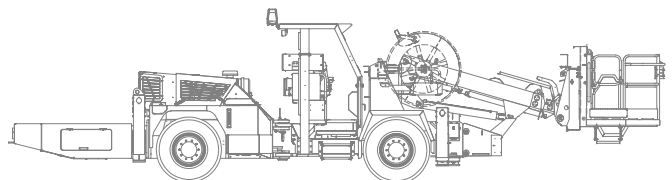
NORMET RANGE OF PRODUCTS FOR ANNULUS GROUTS

- > TamCem R (standard annulus grout retarder)
- > TamCem 8BFG (standard annulus grout retarder)
- > TamCem 9BFG (retarder with latent accelerator)
- > TamShot 10SS (annulus grout accelerator)
- > TamCem HCA (superplasticiser)



WE ARE HERE FOR YOU

For more information, please contact your local Normet representative, visit www.normet.com for contact details.







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Subject to technical and design modifications without notice. Technical properties have been achieved under theoretical and normal conditions.
Please consult the respective machine manual for all matters related to safety, operation and maintenance.

TBM Technology Brochure - Version 1.21