



# TBM tunnelling in difficult ground conditions

Andre Germann, Regional Head DACH / Eastern Europe

Lars Langmaack, Technical Manager TBM

[www.meyco.basf.com](http://www.meyco.basf.com)



Soft ground



## Positive attributes

- n If soil is right , TBM is right
- n Treat at front
- n Torque control
- n Wear reduction
- n Benefits at all stages !!!

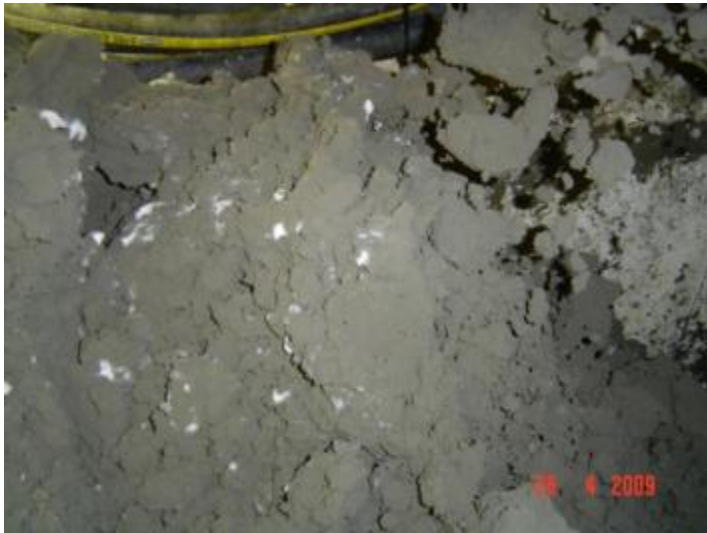


# Benefits of foam use



- n Clean Cutter
- n Clear belts
- n Bunker fully utilised
- n Vertical conveyor effective
- n Cohesive soil turned “ grippy  
“ not slippery.

# Rheosoil: anti clay agent

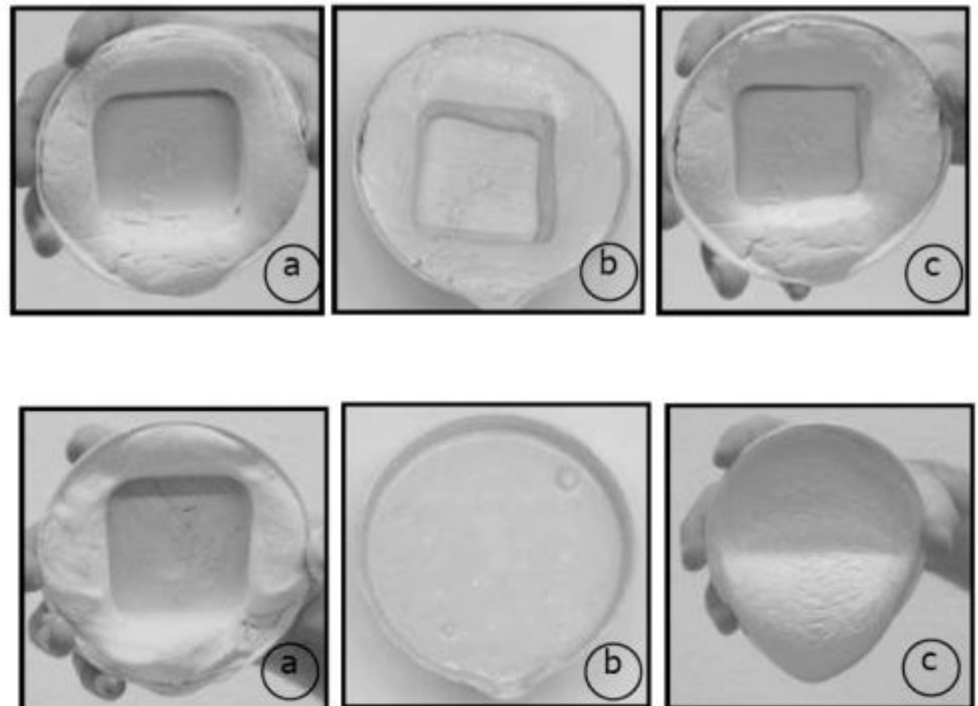
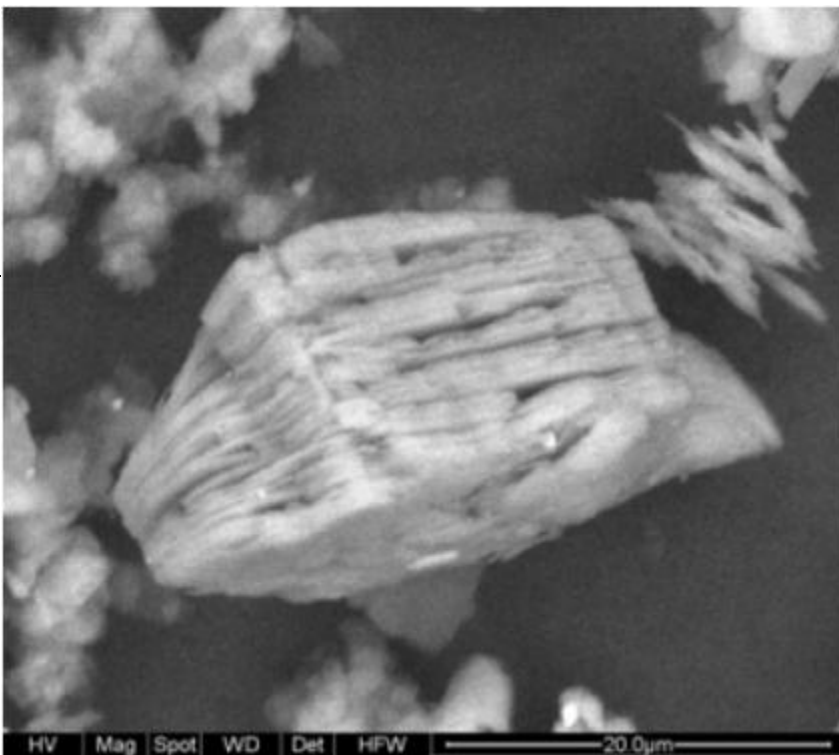


- n Rheosoil – single component
- n Simple foam generators
- n No bunker/vertical conveyor
  - n Clean muck cars
  - n Constant muck away



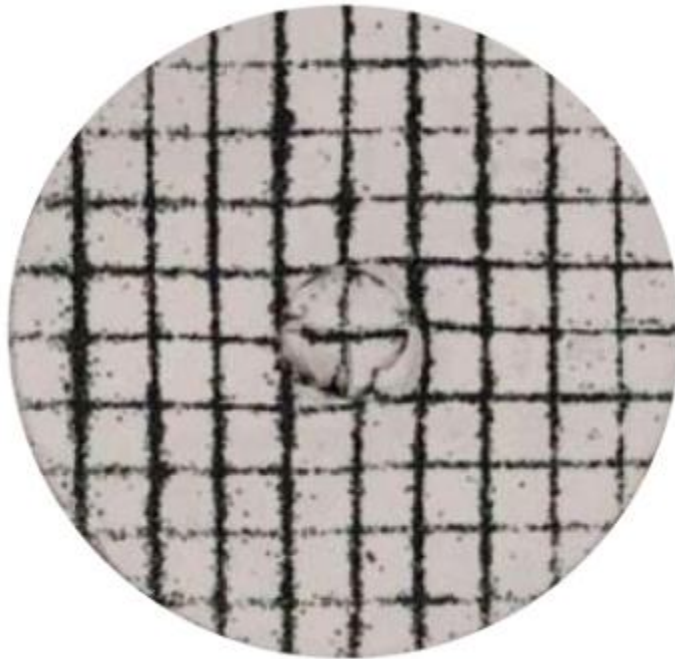
- n Production.

# Clay behaviour





# Clay behaviour shear vane



Clay & water



Clay & RHEOSOIL solution

# Problems with clay clogging in Sochi



10m Herrenknecht TBM, tunnel #5



# Problems with clay clogging in Sochi



Use of water, no foam  
Very big lumps, conveyor belt damaged

# Problems with clay clogging in Sochi



Use of more water,  
Transport & handling difficulties

# Problems with clay clogging in Sochi



Use of Rheosiol 143, perfect consistency, high advance rates  
Clean cutterhead





# Hard rock

# wear examples ...

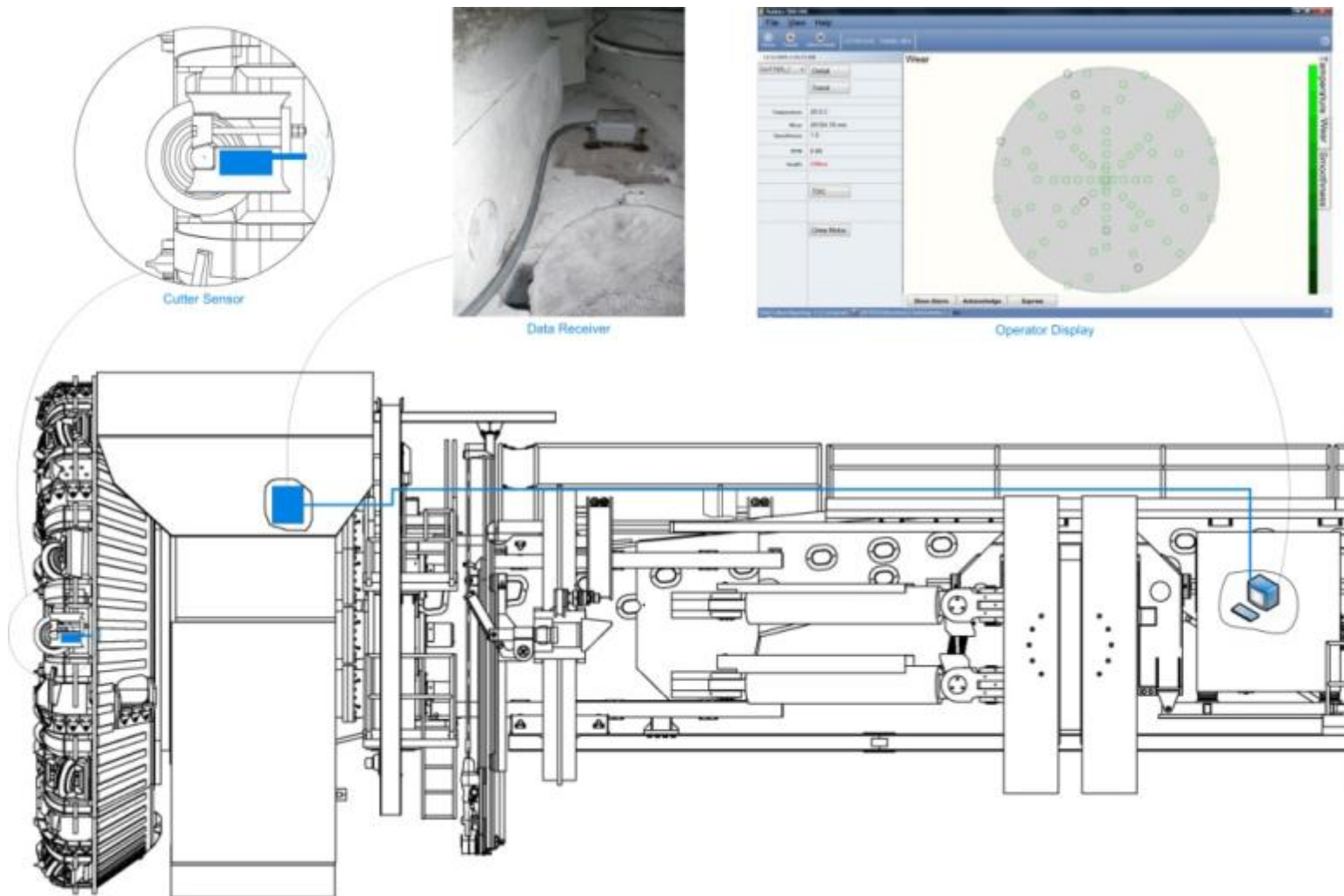




NTNU personal on site

Dust Monitor

Robbins Cutter Instrumentation System





# Problems with clay clogging in Sochi



# Problems with clay clogging in Sochi



Use of MEYCO ABR5  
Perfect consistency, no free water



Hard rock / soft ground mix  
Lots of water against clogging  
Huge handling difficulties



# MEYCO® ABR 5 Benefits

*without ABR*



disappearance of dust  
longer life time of electronics,  
healthier working conditions

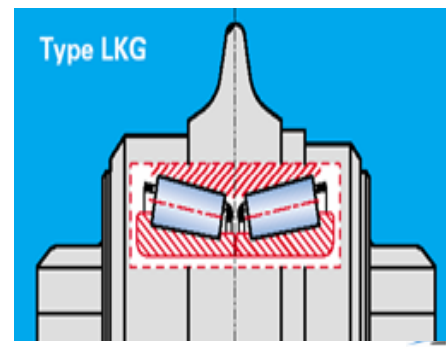


clean & cool cutters  
easy & quick to change  
no muck clogging



drastic reduction of cutter  
temperature,  
no cutter blockage any more  
around 15% wear reduction  
reduced downtime

*with ABR*



**BASF**  
The Chemical Company

**MEYCO**  
Expanding Horizons Underground





TBM drive in blocky ground

# Problem: fractured rock + water



# Microcement-Injection (pre-injection) in Sochi

**BASF**  
The Chemical Company



**MEYCO**  
Expanding Horizons Underground



# Problem: blocky rock + water



# PU Injection (post-injection) in Sochi





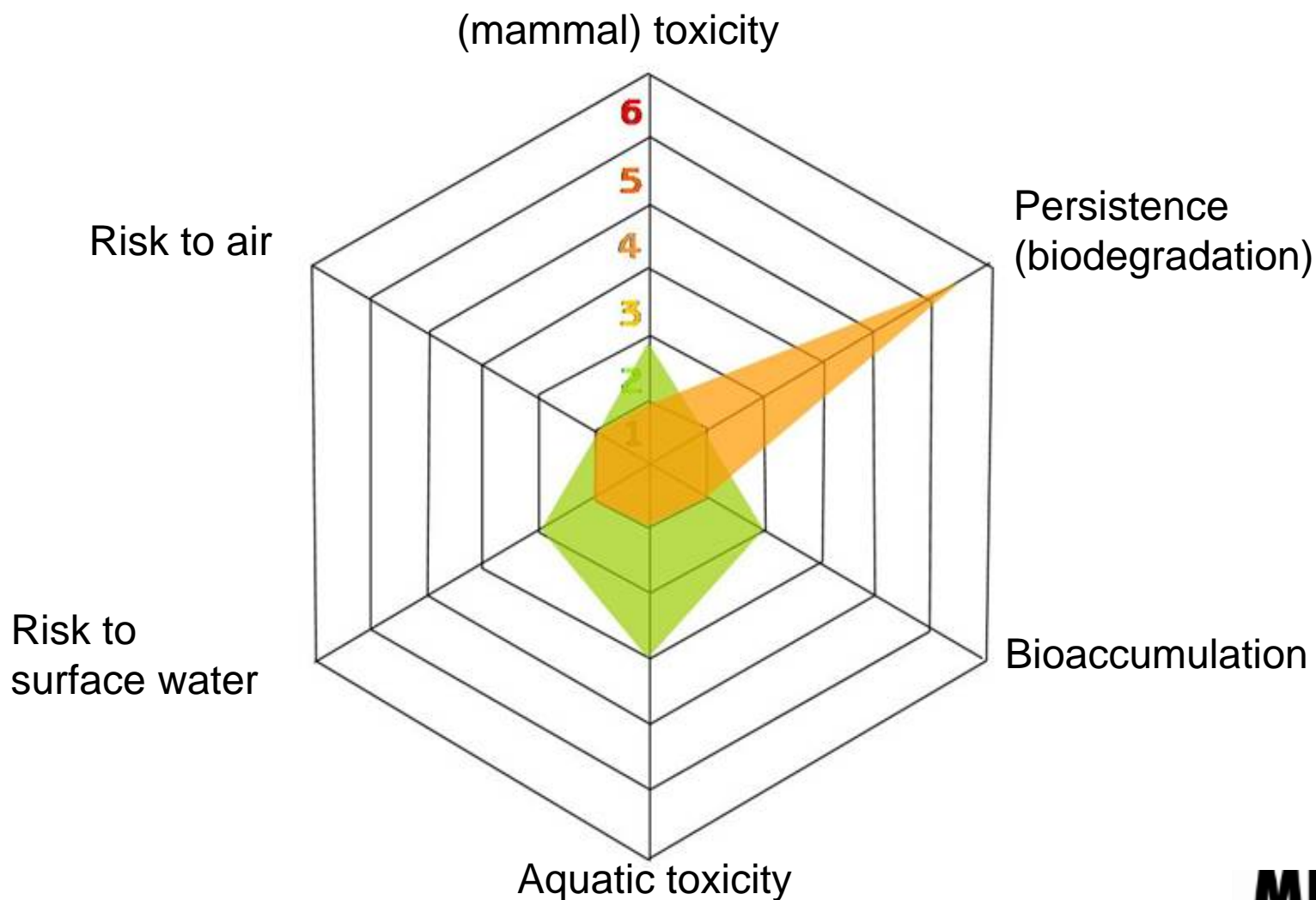


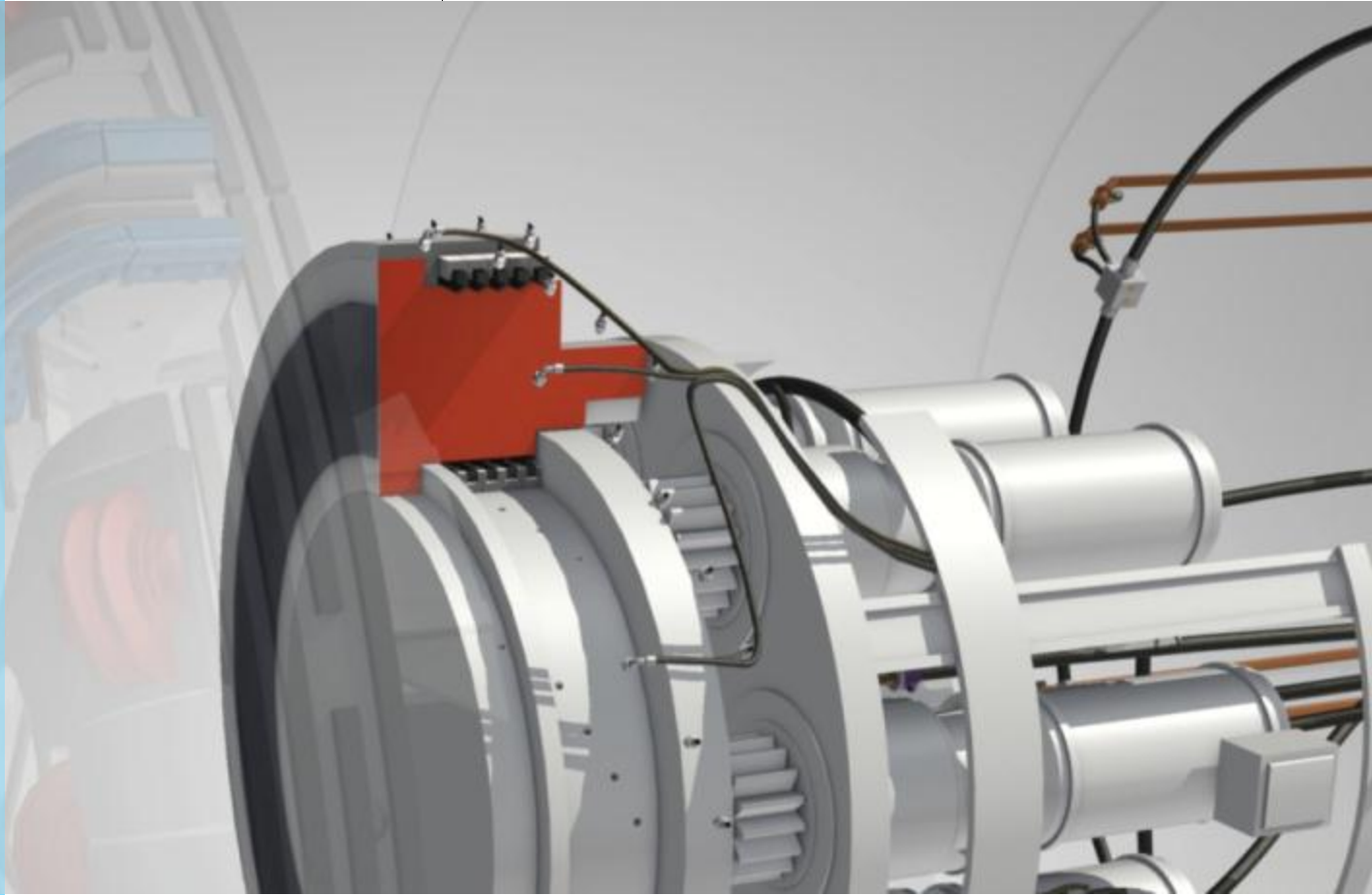
# Environmental Studies



# General Risk Characteristics

## important factors of eco-compatibility





# Main Bearing Greases

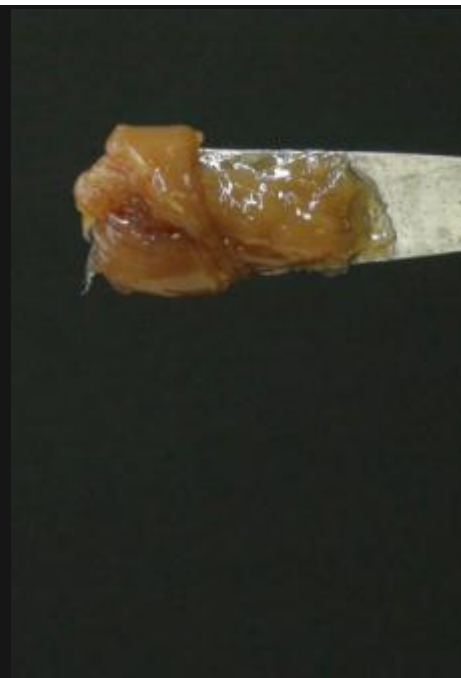
# Main bearing greases with Merkel agreement



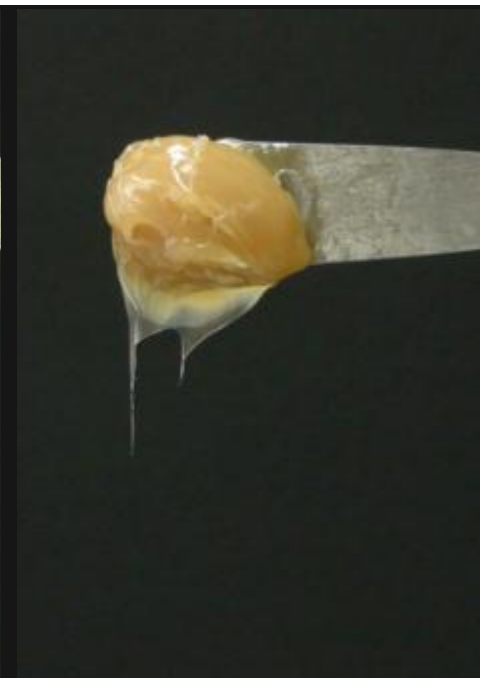
**MEYCO BSG 1**  
Main bearing sealing  
Biodegradable  
Plant oil based



**MEYCO BSG 11**  
Main bearing sealing  
synthetic oil based



**MEYCO EPB 1**  
Main bearing lubrication  
Biodegradable  
Plant oil based



**MEYCO EPB 11**  
Main bearing lub  
synthetic oil based





# Tail Sealants

# Tail sealants



MEYCO TSG 7

- 1<sup>st</sup> fill grease
- stiff but pumpable
- not mixable with annulus grout



MEYCO TSG 6

- driving grade
- highly resistant against water
- allrounder



MEYCO TSG 16

- driving grade
- highly resistant against water
- different rheology

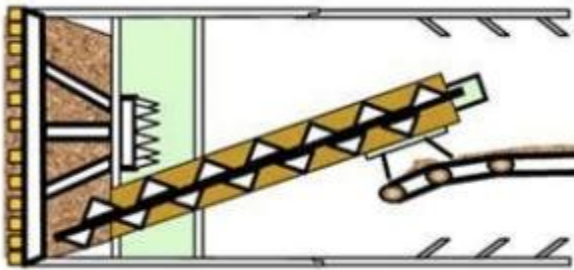


MEYCO TSG 26

- fire resistant
- eco-friendly because 100% oil-free
- passes waterpressure tests

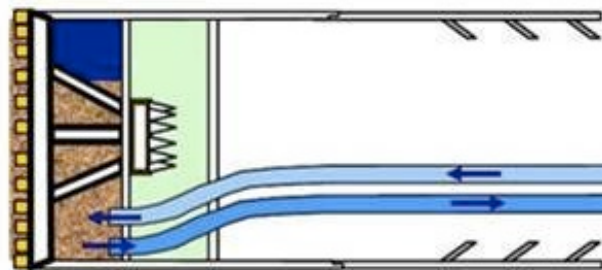
# Product families according to TBM types

**EPB machine**



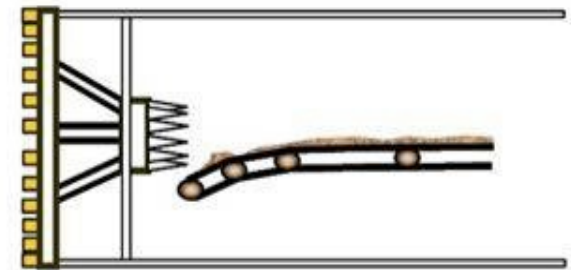
- Soil conditioners (Foams & Polymers)
- Anti-Clay-Agents
- Anti-Abrasion-Agents
- Main bearing sealing
- Main bearing lubrication
- Tail sealants
- Annulus grout additives
- Segment concrete additives

**Slurry machine**



- Bentonite additives (Improvement & Separation)
- Anti-Clay-Agents
- Main bearing sealing
- Main bearing lubrication
- Tail sealants
- Annulus grout additives
- Segment concrete additives

**Hard Rock machine**



- Anti-dust & Anti-wear additives
- Anti-Clay-Agents
- Main bearing sealing
- Main bearing lubrication
- Tail sealants
- Annulus grout additives
- Segment concrete additives
- Injection & void filling
- shotcrete