TBM tunnelling in difficult ground conditions

Andre Germann, Regional Head DACH / Eastern Europe
Lars Langmaack, Technical Manager TBM

www.meyco.basf.com
Soft ground
Positive attributes

- If soil is right, TBM is right
- Treat at front
- Torque control
- Wear reduction

Benefits at all stages!!!
Benefits of foam use

- Clean Cutter
- Clear belts
- Bunker fully utilised
- Vertical conveyor effective

- Cohesive soil turned "grippy" "not slippy."
Rheosoil: anti clay agent

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

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

Use of MEYCO ABR5
Perfect consistency, no free water
MEYCO® ABR 5

**Benefits**

**without ABR**

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

**with ABR**

- 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
TBM drive in blocky ground
Problem: fractured rock + water
Microcement-Injection (pre-injection) in Sochi
Problem: blocky rock + water
PU Injection (post-injection) in Sochi
Environmental Studies
General Risk Characteristics

important factors of eco-compatibility

Aquatic toxicity

Risk to surface water

(mammal) toxicity

Risk to air

Persistence (biodegradation)

Bioaccumulation

Aquatic toxicity
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**
  - 1st 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
- Tail sealants
- 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