



# Solutions in hydro-dams and dykes with injection resins

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# Summary

1. Effects of erosion from water
  1. Concrete dams
  2. Land dams
2. Waterproofing in positive sides
  1. EPDM film + sealants
  2. Diving injection resins
3. Waterproofing + consolidation in negative sides
  1. 2-C structural polyurethanes
  2. Acrylic gels



# Waterproofing in positive sides of the dams



## PROOFMATE FD Foil

EPDM (Ethylene-Propylene-Diene-Monomer)

- High elasticity (400%)
- UVA resistance
- High chemical resistance
- High durability High tear resistance

## PROOFMATE F

SPPO (Silane Terminated Propylenoxide)

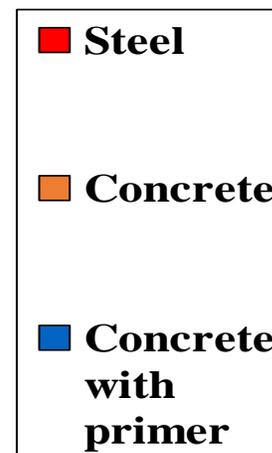
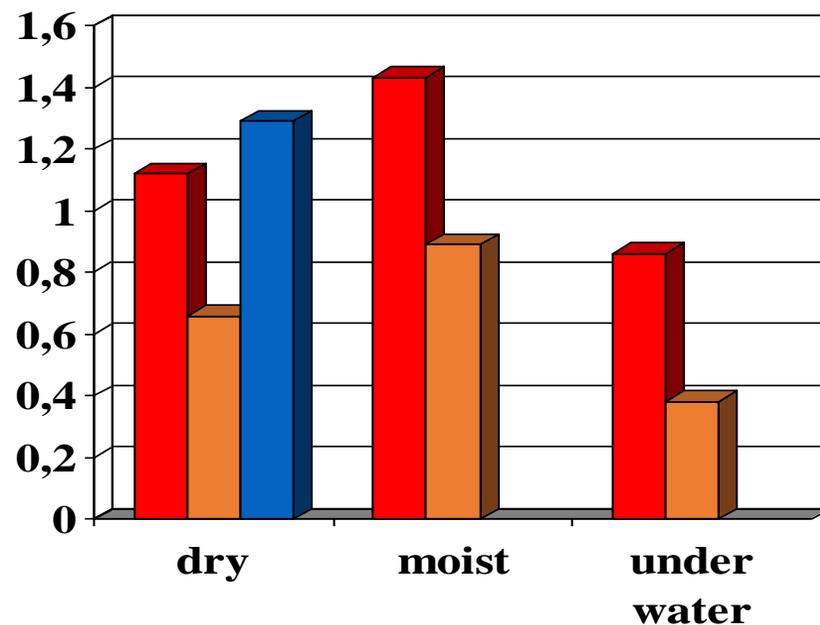
- High elasticity (400%)
- UVA resistance
- High chemical resistance
- High durability
- Sealed on wet and underwater surfaces



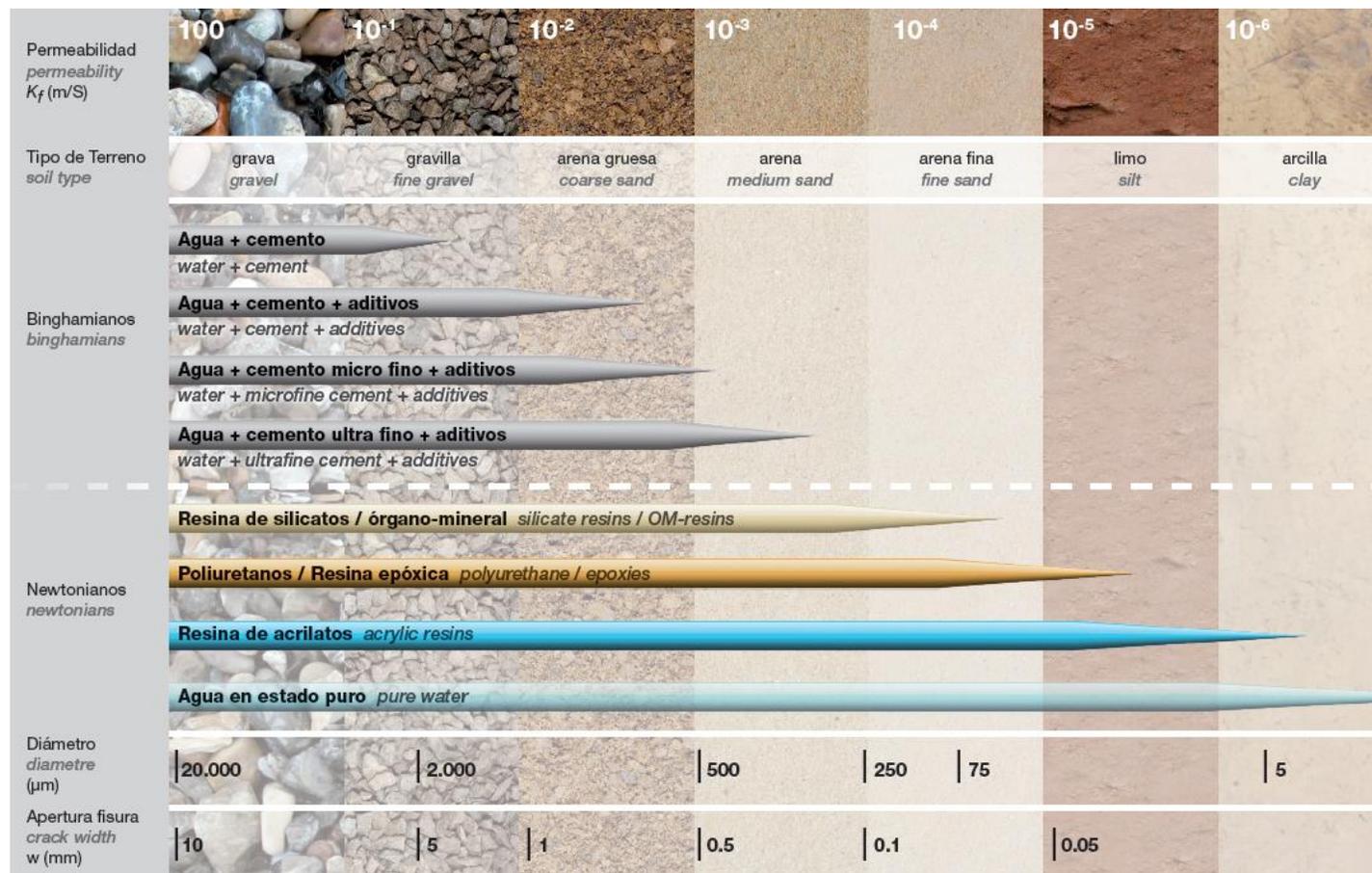
# SPPO sealants and adhesives

Adhesion Strength

[N/mm<sup>2</sup>]



# Viscosities and penetrability in the ground



# Behaviour in the presence of water



# Types of injection resins:

## Foaming resins

- Fill gaps and cavities
- Sealing of leakages
- Ground consolidation
  
- Immediate effectiveness
- Not self-flammable
- Approved for use in groundwater



# Types of injection resins:

## Foaming silicate based resins

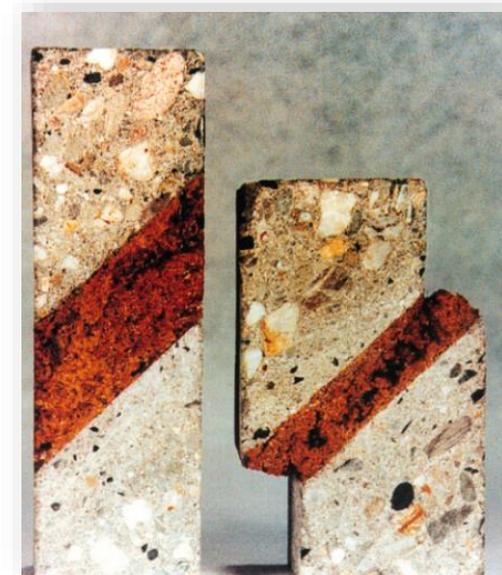


# Treatments in the negative side of the dams

## 2-component structural polyurethanes

### **PUR-O-STOP FS system**

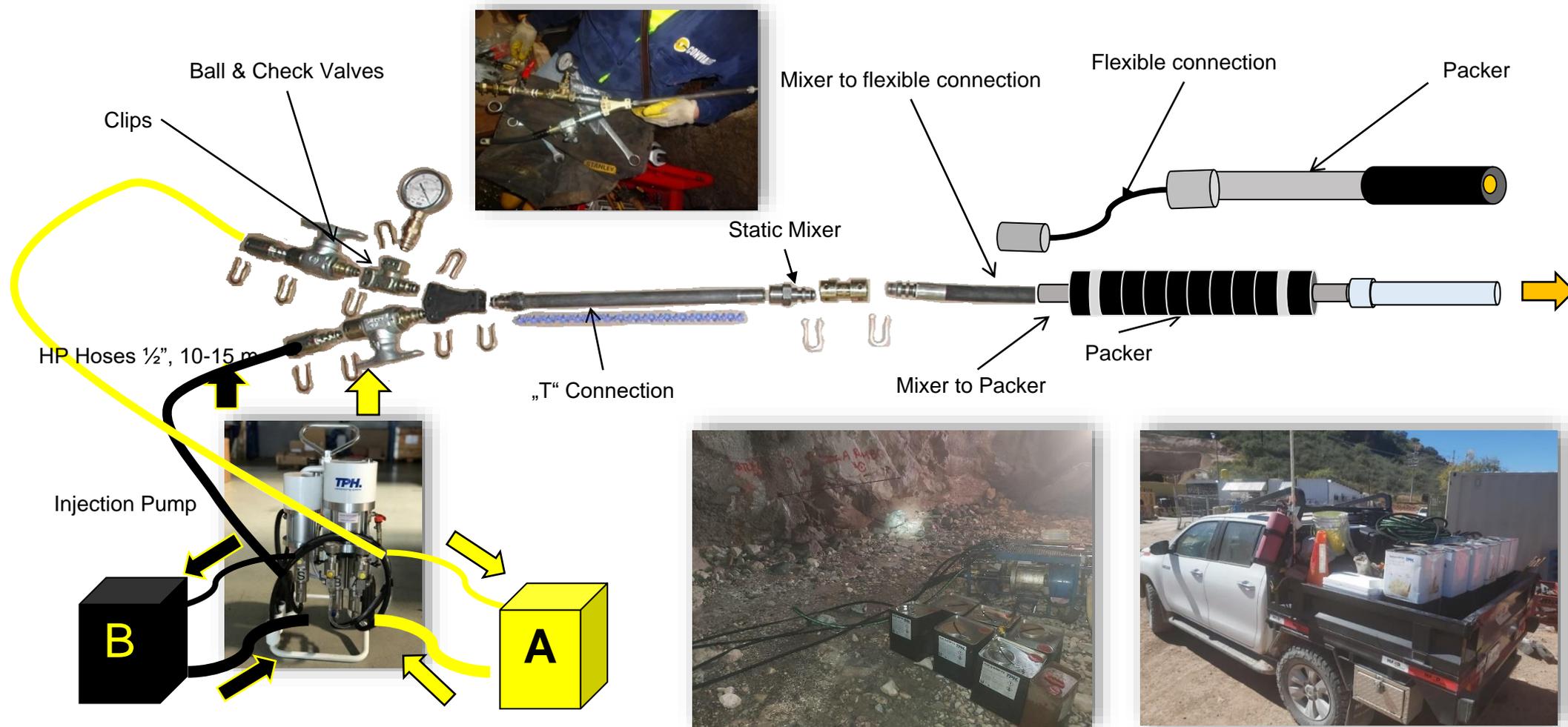
- Excellent mechanical properties:
  - Compressive strength 74 MPa
  - Bending tensile strength 29 MPa
- Produces a hard foam when reacts in contact with water
- Waterproofing and ground consolidation
- Immediate effectiveness
- German certifications
  - Durability
  - Chemical resistance
  - Contact with groundwater
  - CE marking according to EN1504-5



# Types of injection resins: 2-C structural polyurethanes



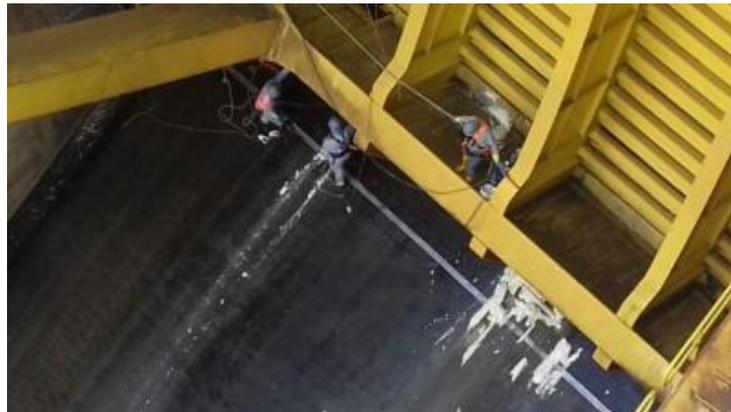
# 2-C injection equipment systems



# Sealing waterways in concrete dams



# Sealing waterways in concrete dams



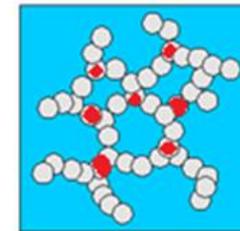
Courtesy of SULTEC

# Types of injection resins:

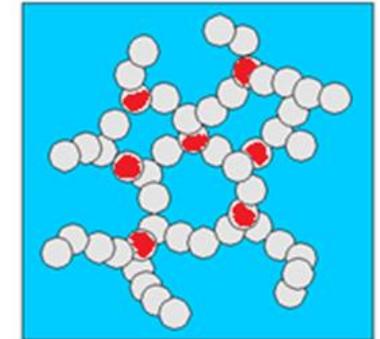
## Acrylate gels

### Acrylic gels are "hydrostructural" resins

- Adjustable pot life, from seconds to hours.
- Water-like viscosity, high ground penetrability
- Approved for use in groundwater
- Durability certifications and chemical resistance



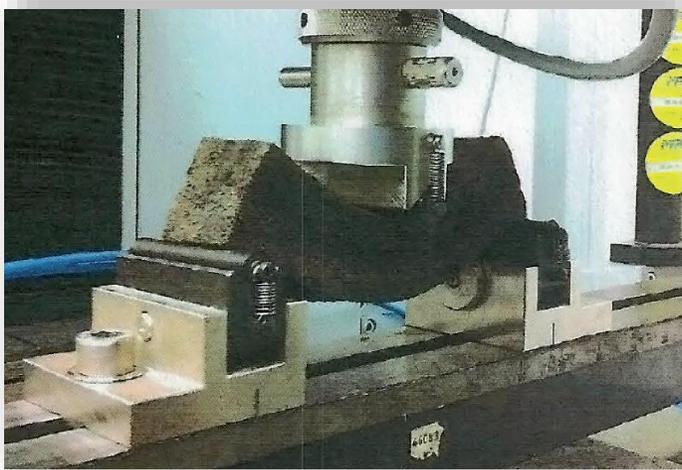
gets water  
↔  
loses water



# Flexible soil stabilization

## Acrylic gels

- High Flexibility
- High penetrability in the soil
- Slope Stabilization
- Mining Tailings



# Flexible soil stabilization

## Ground spikes



# Case story in an hydro-dam

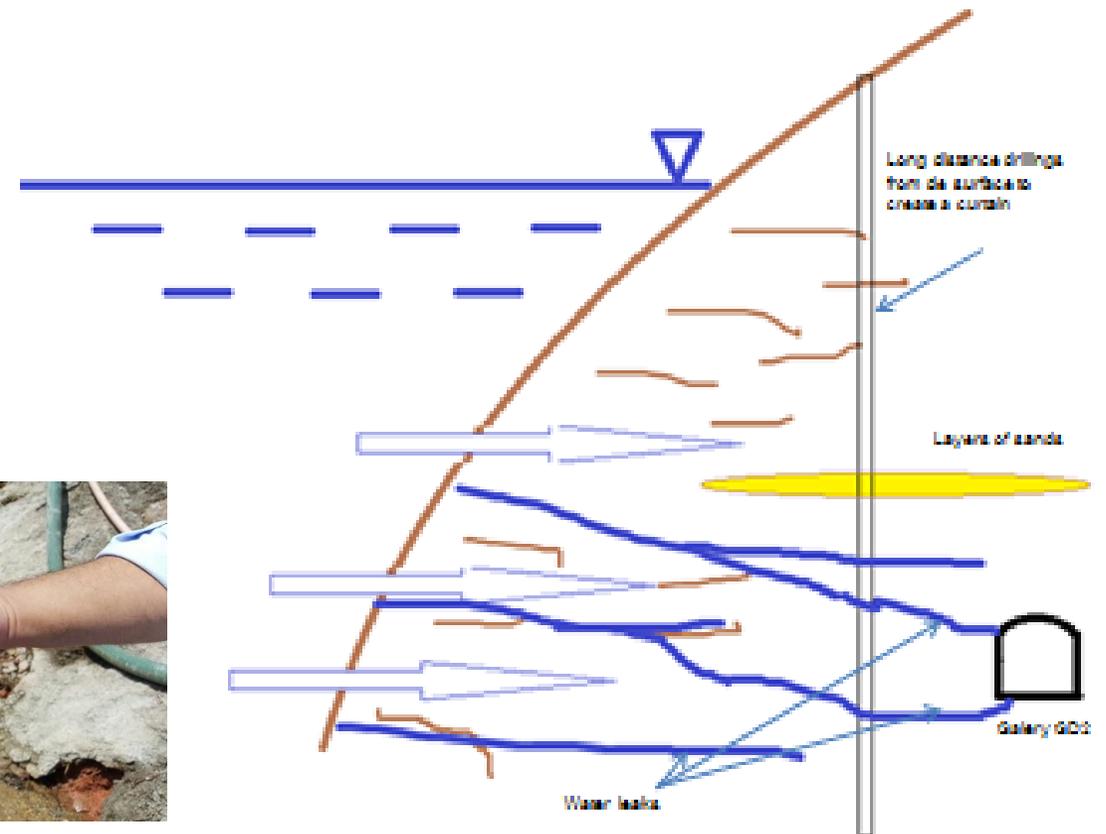
- **Project details:**
  - Lake 8250 ha.
  - Volume 1.824 hm<sup>3</sup>
  - Max. Dimension > 24 Km
  - Power Capacity 400 MW,
  - Energy Generation 2.216 GWh / year



# Case story in an hydro-dam

## Main problems:

- Drag ground > 200 m<sup>3</sup> in Drainage gallery 2 (DG2)
- High pressure waterways (6 bar)



# Case story in an hydro-dam

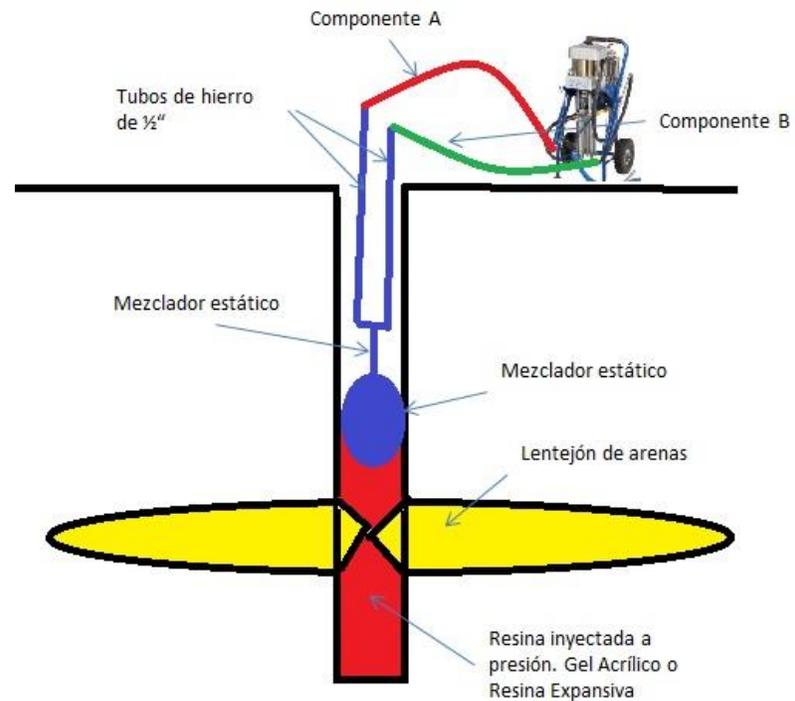
## Main problem:

- Blockage of perforations due to the presence of limes



# Flexible soil stabilization in drillings

## Acrylic gel RUBBERTITE



# Flexible soil stabilization in drillings



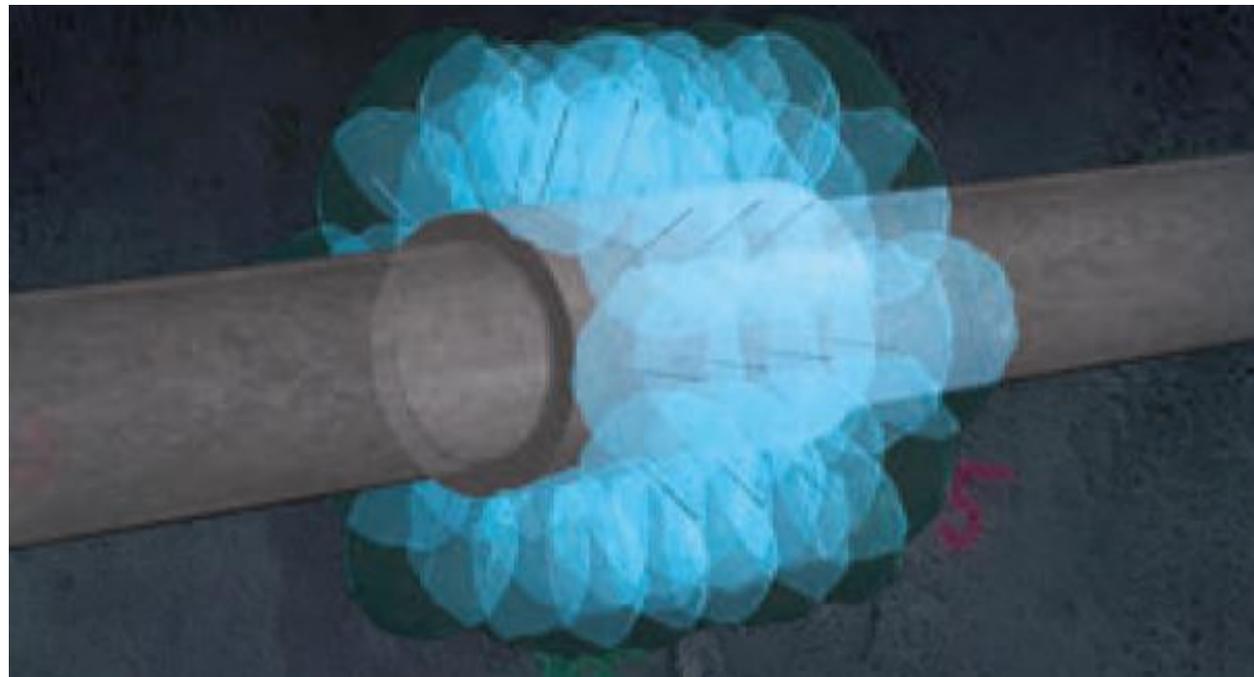
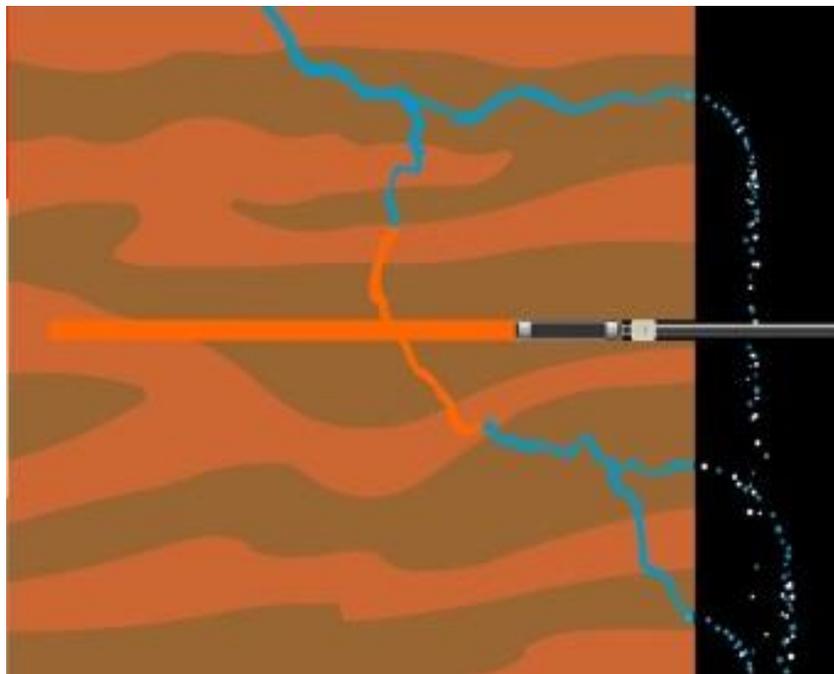
# Consolidation and sealing in drainage gallery



# Consolidation and sealing in drainage gallery

## TPH technical proposal:

- Structural Polyurethane 2-C PUR-O-STOP FS-F + Thixo add PUR-O-STOP FS-TX for ground consolidation in conditions of strong waterways



# Consolidation and sealing in drainage gallery

## On-site testing:

- PUR-O-STOP FS-F ground consolidation



# Case story in an hydro-dam

## Results:

- The flexible soil stabilization with acrylic gel allowed the completion of the cement curtain
- **Drainage gallery:**
  - 90% decrease in land drag
  - Gallery flow from 200 l/s to 20 l/s
- **It was possible to raise the water level of the lake**
  - Higher Energy Generation Efficiency
  - Increased supply of drinking water to populations



# General conclusion



***SECURITY***

***COST-BENEFIT***

***PRODUCTIVITY***



Thank you very much for  
your attention!!

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