BIOREX

Biological Remediation of Explosives

Treatment of Metal and Explosive Contaminated Effluents

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Presentation outline

- Reactive filters
  - Background and projects at Mälardalen University
  - Filtration mechanisms
- Filter Materials
- Laboratory experiment conducted
- Applications
- Current and future projects within the area

Reactive Filter Technology Projects

Orientation of applications

Retention of P from sewage water

Retention of metals from

- Storm water

- Landfill leachate

- Metal contaminated groundwater

Treatment of industrial effluents

Reactive Filters

- **Diffusion**
  - random microscopically small movements of molecules, atoms or ions
  - high concentration to low concentration
  - transports solutes into the boundary layer of a particle

- **Sorption**
  - any reaction between the particle surface and solute

  - adsorption
  - absorption
  - desorption

Occur in any filter system!

Defines reactive properties!

Heavy metals

- ## Water soluble
  - ### Easily spread
- ## Elements
  - ### Not degradable
- ## Hazardous
  - ### In high or low concentrations

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Example of tested sorbent materials

Natural (biomass)	Rocks and minerals	Industrial waste	Agricultural by-products
Peat	Clays	Paper mill sludge	Agricultural waste
Barks	Zeolites	Paper industry waste	Peanut shells
Spruce wood, coal, cork	Coal	Blast furnace sludge	Olive mill residues
Fungal biomass	Polonite®	Electric furnace slag	Cassava waste
Cactus		Fly ashes	Maize starch
Cocoa shells		Activated sludge	Oat by-products
Juniper fibre		Sawdust	Agro-based fibres
Seaweed			Grape stalk fibres
Marine algae			Husk of black gram

Sorbent criteria in the project

- Availability
  - Close to site
  - Worldwide
  - Large quantities
- Low cost
- Low Maintenance
  - On-site
  - Pre-treatment

Sorbents chosen

- Blast Furnace Slag
    - Waste-product from steel manufacturing
    - Two species:
        - ˜ Amorphous
        - ˜ Crystalline
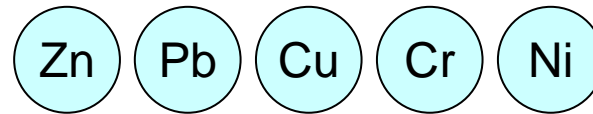
- Pine Bark
    - Waste-product from forest industry

Experiment example
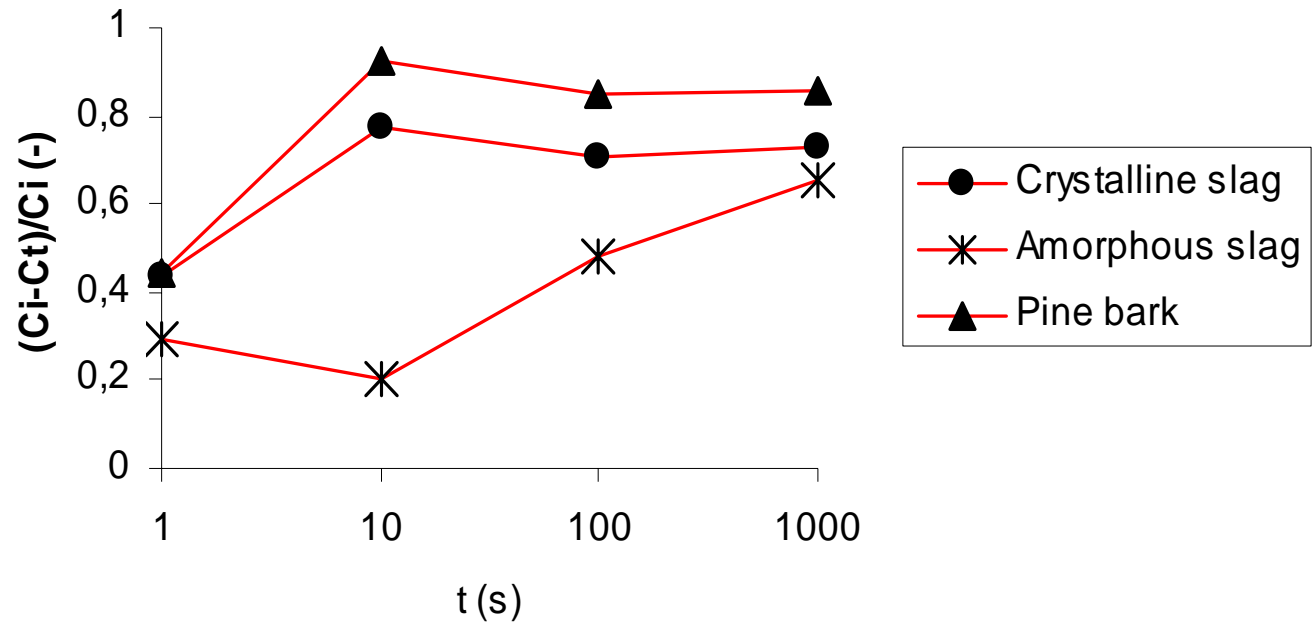
Methods

- Batch experiment
- Metal mix solution;

  (Zn) (Pb) (Cu) (Cr) (Ni)

- Three concentrations; 0.2, 2 and 20 mg/l
- Four shaking times; 1, 10, 100 and 1000 s
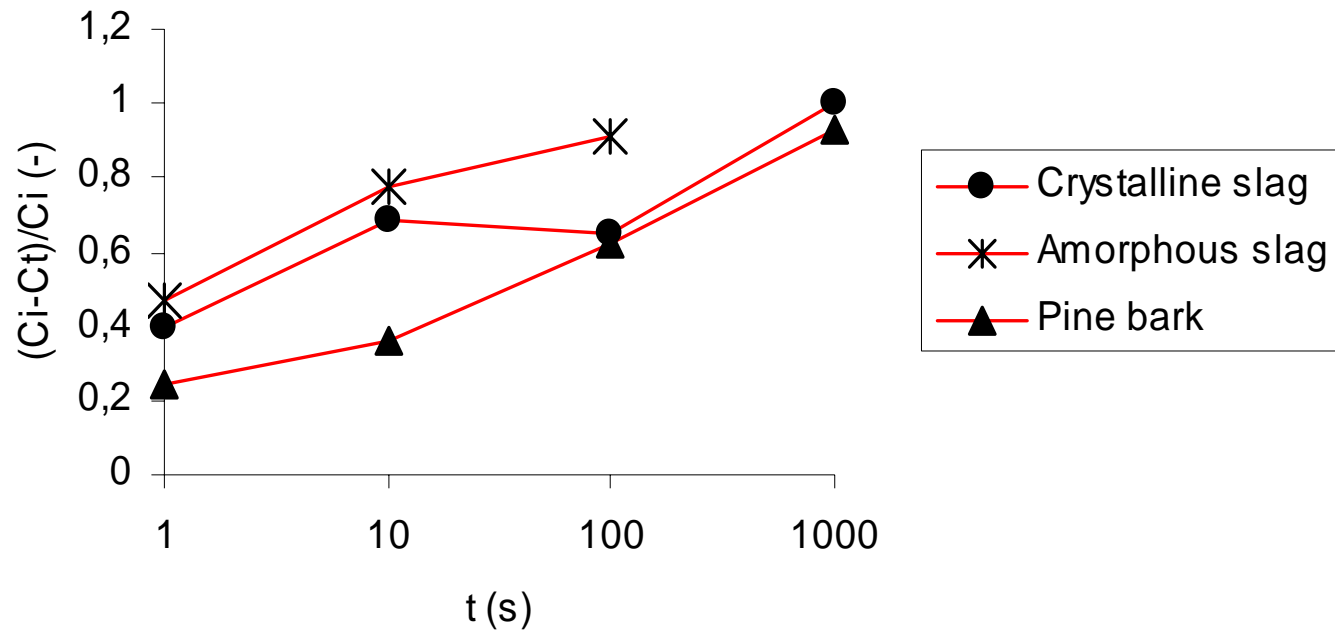
Pb retention (1)

Ci = 0.2 mg/l

Pb retention (2)

Ci = 2 mg/l

Pb retention (3)

Ci = 20 mg/l

Applications

- Shooting range ground water treatment
- Ammunition/disposal factory site storm water run-off
- Industrial effluents
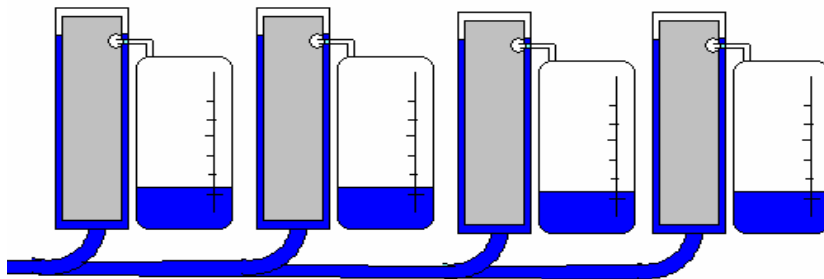

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On-site project

On-site project

- Column set-up

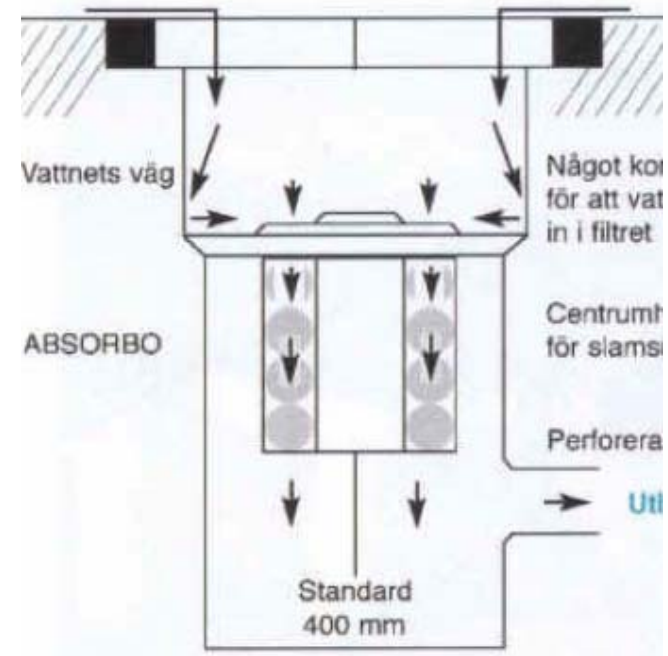pine bark   amorph-ous slag   crystalline slag   inert sand

Treatment under ground

Storm water run-off

Barriers

Treated groundwater

Barrier

Contaminated groundwater

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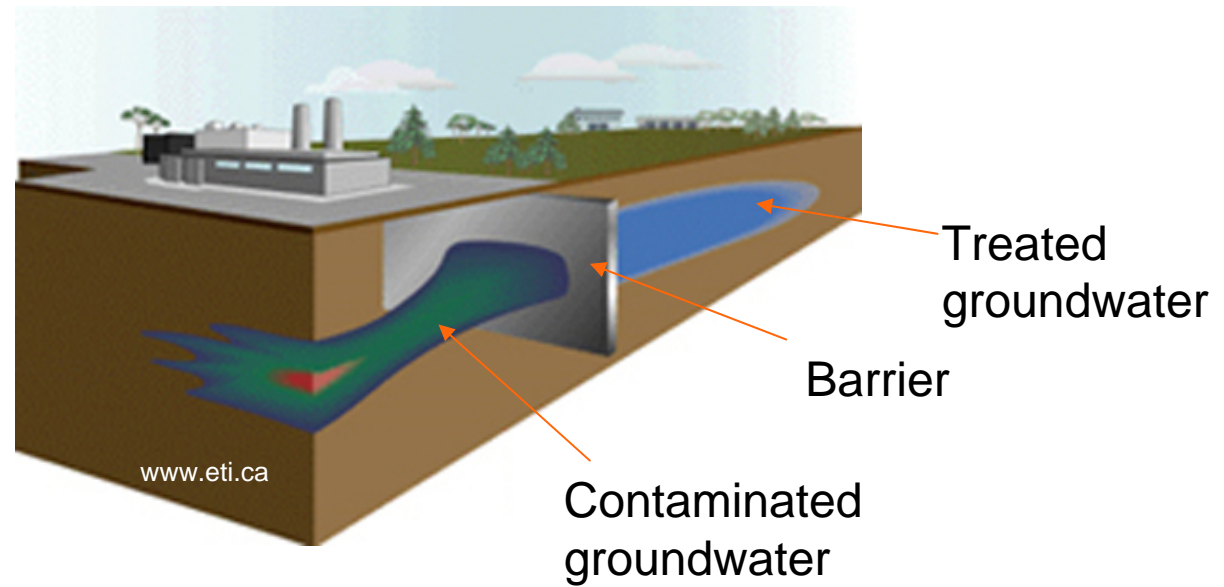
Saturated materials

Pine bark

- Incineration with recycling of trace metals to the forest
- Regeneration with acid

Blast furnace slag

- Immobilization and use for top covers on landfills

Further research

- Capture of TNT from industrial process water in disposal industry
- Pine bark
- Saturated materials can be degraded by bacteria in bioreactor →

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