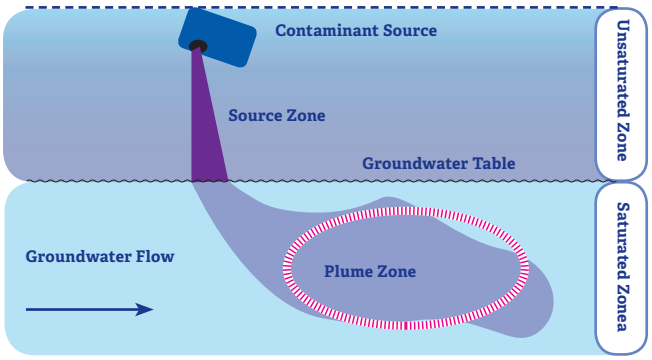
HEXAVALENT CHROMIUM BIOLOGICAL REDUCTION

PRINCIPLE

Chromium naturally occurs mainly in trivalent Cr(III) and hexavalent Cr(VI) forms. While trivalent chromium is a biogenic element, hexavalent chromium has significantly harmful effects on the environment because of its solubility, mobility, high oxidation potential and toxicity in general.

Hexavalent Chromium Biological Reduction (HCBR) is an in situ method utilizing specific bacteria strains capable of Cr(VI) reduction to Cr(III). Suitable organic substrate supporting growth and multiplication of Cr(VI)-reducing bacteria is added to a saturated zone.

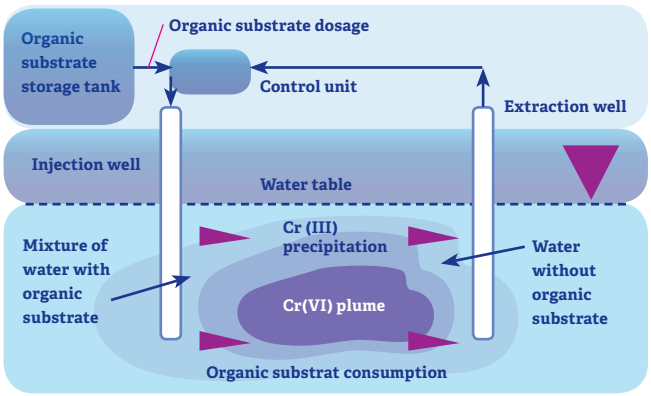
Produced Cr(III) is precipitated in form of insoluble particles (bioimmobilization process).



Groundwater situation example

DESCRIPTION

Typical HCBR system consists of the organic substrate storage tank, dosage system with a control unit, injection wells for infiltration substrate to saturated zone and monitoring wells for groundwater sampling. Groundwater is pumped from extraction wells, mixed with organic substrate and infiltrated back to injection wells.



HCBR system diagram

TECHNOLOGY APPLICABILITY

HCBR is typically applied for in situ remediation of groundwater and soil in a saturated zone contaminated by Cr(VI). The method is suitable preferably for remediation of plume zones. At the contamination´s sources there could be concentrations of chromium too high to enable sufficient growth of Cr(VI)-reducing bacteria.

Main advantages of the technology

- Affordable
- Simple to install and operate
- Applicable for large contaminated areas

Potential limitations

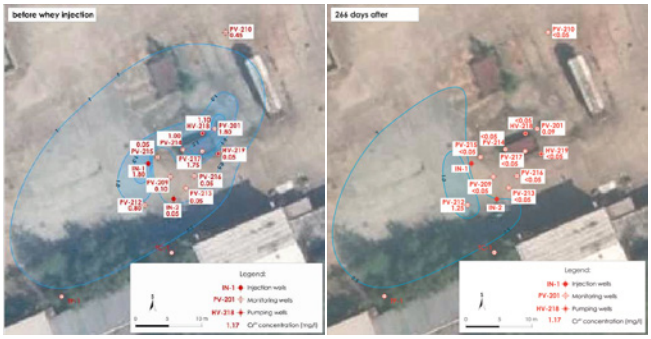
- The low permeability of saturated zone may negatively affect efficiency of the method
- High chromium concentrations at the source of contamination may restrain the growth of Cr(VI)-reducing bacteria
- Long-term process (several months)

Services and products

- Investigation and evaluation of sites contaminated with Cr(VI)
- Laboratory tests for bio-reduction potential evaluation
- Laboratory and half-scale tests for verification of the efficiency
- Design and project approval
- System installation, operation and monitoring
- Supervision of HCBR remediation projects

Data for technology design

- Extent and level of contamination
- Bio-reduction potential of indigenous microorganisms (laboratory tests)
- Availability of organic substrate
- Required target limits for remediation
- Geological and hydrogeological conditions at the site
- Facilities and installations at the site (buildings, utilities etc.)
- Production, operational and other limitations for the site remediation
- Deadlines for the site remediation



Kortan site - Cr(VI) concentrations in groundwater before and after substrate application

REFERENCE PROJECT

Demonstration project of biological reduction of Cr(VI) was held at Kortan site, Hrádek nad Nisou (Czech Republic) in cooperation with ENACON and Technical University of Liberec. Contamination by Cr(VI) originated from historical production of chromium salts for the purpose of the leather manufacturing industry.

Concentration of Cr(VI) in groundwater before the remediation varied from 0.8 to 1.8 mg/l. Aquifer was formed in quaternary sands and gravel with clay (permeability from 10^{-5} to 10^{-6} m/s), groundwater level was from 4 to 5 m b.g.l.

After 10 months of remediation the levels of Cr(VI) and Cr(total) concentration in groundwater dropped below the detection limit (<0.05 mg/l).

Laboratory batch test of bio-reduction potential

Organic substrate infiltration

DEKONTA, a.s.
Dretovice 109, 273 42 Stehelceves
Czech Republic

Phone: + 420 312 292 960 / + 420 235 522 252
Fax: + 420 235 522 254
info@dekonta.cz / www.dekonta.com

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