IN SITU CHEMICAL OXIDATION (ISCO) BY USING THE FENTON'S REAGENT

PRINCIPLE

The remedial method of in situ chemical oxidation (ISCO) is based on a general principle of redox reactions, when oxidant is reduced and the treated pollutant is oxidized. Oxidation process leads to the destruction of the contaminant, or its transformation into harmless or less toxic substances.

The most common oxidizing agents used for remediation are: potassium or sodium permanganates, ozone, hydrogen peroxide and Fenton's reagent. The Fenton's reagent - hydrogen peroxide activated by Fe^{2+} in acid conditions - has relatively high oxidative effect. It can therefore be applied also in the case of remediation of sites contaminated by hard-degradable substances.

TECHNOLOGY APPLICABILITY

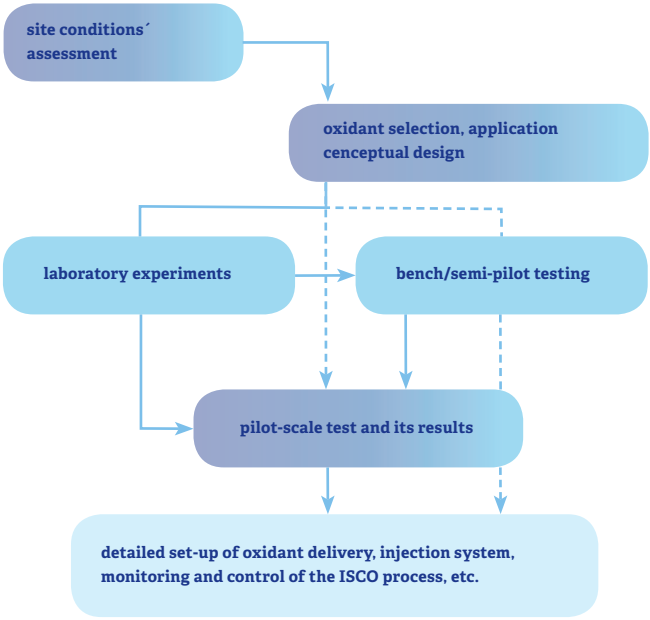
The ISCO method is applicable for treatment of contaminated groundwater and soils of saturated zones. In case of an unsaturated zone, there is theoretical possibility of washing the soil with a solution of the oxidant, or apply the oxidant in gas form (e.g. ozone), but it is expensive and the efficiency is not always guaranteed.

Key assumption to the success of this method is achieving optimal contact between the oxidizing agent and the pollutant. In some cases, contaminants are fully oxidised (e.g. if aliphatic pollutants are treated). But oxidation of more complex organic compounds may lead to the formation of toxic intermediate products. If heavy metals are present in the aquifer, possibility of their unwanted mobilisation due to the ISCO application can be caused.

It is necessary to consider the risks mentioned above, before every individual planned application of oxidizing agents into the bedrock.

DESCRIPTION

Technological system consists of the activator and oxidizing agent storage tanks (hydrogen peroxide, acid, Fe^{2+} solution), pumps, injection wells, monitoring wells and instruments for measuring and controlling the process.



Recommended application procedure of the ISCO technique

Main advantages of the technology

- The reaction rate (in hours), unlike using persulfate or permanganate
- High efficiency
- Does not react with organic soil components (lower consumption compared to permanganate)
- Leaves no residue in the subsoil (e.g. coloring water in potassium permanganate, the increased concentration of sulfates in sodium persulfate)

Potential limitations

- Security risks resulting from intense exothermic chemical reactions
- Low efficiency for sites with low permeability of the saturated zone

Services and products

- Investigation of contaminated site considering the subsequent ISCO application
- Laboratory and half-scale tests for verification the ISCO method applicability, including suggested oxidation agent and its estimated consumption
- ISCO remediation project design and permitting, including the Fenton's reagent application methodology
- Rent and delivery of equipment for the ISCO method application
- ISCO using Fenton's reagent system installation and operation
- Supervision and monitoring of ISCO remediation projects

Data for ISCO system design

- Extent and level of contamination
- 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

REFERENCE PROJECT

The demonstration project was conducted within the area of HIP Petrohemija, Pancevo, Serbia, where accidentally leaked of about 1000 tons of 1,2-dichloroethane (resp. ethylene dichloride, EDC) in 1999 and caused subsequent contamination of groundwater. Injection of oxidant and acid to the saturated zone was done under pressure.

Reagents were infiltrated every hour approximately 8 times per day. The method was applied for 34 days. The monitoring registered the temperature increase of groundwater in the reaction zone from the value of 17 °C to about 50 °C. Redox potential has risen above +540 mV and the chloride content increased from 300 mg/l to about 865 mg/l.

The average concentration of contamination in the reaction zone was initially 87.05 mg / l EDC. After the first application of the Fenton reagent is due to desorption of the contaminant, the concentration increased up to 336.95 mg / l EDC. The volume of 35% hydrogen peroxide solution necessary for remediation of 1 hectare of the contaminated site was 1,150 cubic meters. The contaminant removal efficiency was about 87%.

Monitoring well with continuous monitoring of process parameters

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

Responsible Care®

ISO 9001
ISO 14001
OHSAS 18001

dekonta