

Specification of Remediation techniques

Pre-requisites:

An efficient and feasible remediation project is only possible with the right site specific information. To obtain these, an excessive site research should be done, which should contain the following conclusions:

- The type of soil;
- Determination of source zone and plume zone;
- From which compounds is the soil matrix constructed;
- Type of contaminants present in the soil;
- Depth of which the contaminants at the different depths;
- Location of the saturated zone;
- Permeability of the soil;
- Percentage of organic compounds in the soil;
- Groundwater level, flow direction and flow speed;
- Results on nitrate, sulphate, TOC, DOC, oxygen, redox, pH, methane, ethane, ethylene in groundwater.

Time span and feasibility:

Time is one of the terms, which can express the efficiency and feasibility. The knowledge about the site specific characteristics of soil and contaminants, is not only finding the suitable technique, but also necessary for the estimation of required remediation time.

Since efficiency and feasibility are relative terms, it can only be determined with a frame of preconditions. Therefore, the following factors are determinative for the time span:

- Soil characteristics;
- Characteristics of pollution(s);
- Target value;
- Accessibility of site;
- Accessibility of contaminant;
- Available time;
- Available budget.



Specification of our technologies



Category	Biological		Chemical oxidation		Chemical reduction	Physical				Electro / chemical	Electro / thermal/BIO	Steam/ thermal / extraction
Technology	Aerobic	Anaerobic	PerozoX®	Perman-ganate	Granul-X® / zerovalent iron	Soil vapour extraction	Groundwater extraction	Multi Phase Extraction (MPE)	Air-sparging	Electro Reclamation	Electro(bio) Reclamation	Steam enhanced +MPE
Type of contaminants	Diversity of compounds depending on presence of bacteria, e.g.: BTEXN, MTBE, mineral oil, chloro-ethane, VC, monochloro benzene etc.	Diversity of compounds depending on presence of anaerobic bacteria e.g.: chlorinated solvents, light PAH, TEX, etc.	Chloroethene / ethane, mineral oil, BTEX, light PAH, cyanide, phenols, phthalates, MTBE	Chloroethene, TEX, phenols, etc.	Chlorinated solvents, heavy metals	Volatile compounds, e.g.: light oil fractions (C6-C10) chlorinated solvents	Diversity of water soluble components	Mineral oil / Aromatics (BTEXN), chlorinated solvents, etc.	Volatile components e.g.: VOC, light oil (C6-C10), etc.	Heavy metals, cyanide	Chlorinated solvents, BTEX, mineral oil, PAH	PAH, mineral oil, BTEX
Soil type	Medium to high permeable soils	Medium to high permeable soils	Permeable sandy soils (Low organic matter)	Permeable sandy soils (Low organic matter)	Highly permeable when injected	Permeable (Sandy)	Highly permeable (Sand, gravel)	Permeable (Sandy)	Permeable (Sandy)	Low/medium permeability (Clay, loamy, sand soils)	Low/medium permeability	Medium to high permeable soils
Extraction / mobilization	No extraction/ mobilization needed	No extraction/ mobilization needed	Combined with soil vapour extraction to prevent ozone emissions and VOC to open air	N.A.	N.A.	Vapour extraction	Extraction of contaminated groundwater	Simultaneous extraction of vapour, water and NAPL	Must be combined with soil vapour extraction	Extraction needed to capture mobilized contaminants	High capacity extraction needed to capture mobilized contaminants	Extraction with high temperature resistant equipments
Maximum depth	100 m	100 m	20-30 m	20-30 m	10-20 m barrier 100 m injection	Depth of un-saturated zone	100 m	Dependent of groundwater depth	20 -30 m	20 m	30 m	± 25 m
Advantages/ dis-advantages	Low costs/ Not suitable in high concentration source zones, depended on soil permeability, long duration	Low costs/ Not suitable for high concentration source zones, long duration / risk of temporal accumulation of partial dechlorination products	Small underground system/ Dependent of soil permeability, soil organic matter soil pH must be < 8	Small underground system/ Dependent of soil permeability, soil organic matter, amount of reduced minerals	Low costs, Granul X prolonged reactivity	Depending on soil permeability	Depending on soil permeability	Depending on soil permeability	Low costs / Depending on soil permeability	Dependent on soil pH and buffering capacity	Dependent of soil electrical conductivity	Only applicable in unsaturated zone, and in combination with MPE