Ground Water, Surface Water, and Leachate

Monitored Natural Attenuation

Introduction:

Subsurface processes such as dilution, volatilisation, biodegradation, adsorption, and chemical reactions reduce the contaminant concentrations to acceptable levels.

Description:

Natural attenuation is not a technology and there is debate amongst experts about its use at hazardous waste sites. Consideration of this selection needs modelling and evaluation of contaminant degradation rates, pathways and the prediction of contaminant concentrations at down gradient receptor points, particularly when the plume is still migrating. The main objective of site modelling is to show that natural contaminant degradation will reduce contaminant concentrations below regulatory standards or risk-based levels prior to potential exposure pathways being completed. Additionally, long term monitoring ought to be performed right through the process to verify that degradation is taking place at rates consistent with meeting cleanup objectives. Natural attenuation is not the same as "no action", though it regularly is perceived as such.

Compared to other technologies, natural attenuation has the advantages of generating remediation wastes, little intrusion as few surface structures are required, can be applied to all or part of a site depending on site conditions and cleanup objectives and may be used in conjunction with or as a follow-up to other remedial processes.

Applicability:

Suitable contaminants for natural attenuation are VOCs, SVOCs and hydrocarbons. Pesticides can be naturally attenuated also, but the method may be less efficient. Additionally, natural attenuation could be suitable for some metals when natural attenuation processes produce in a change in the valence state that results in immobilisation (e.g. chromium).

Limitations:

- Intermediate degradation products may be more mobile and more toxic than the original contaminant.
- Natural attenuation is not appropriate where imminent site risks are present.
- Contaminants may migrate before they are degraded.
- Institutional controls may be required, and the site may not be available for reuse until contaminant levels are reduced.
- If free product exists, it may have to be removed.
- Some inorganics can be immobilised, such as mercury, but they will not be degraded.
- Long term monitoring and associated costs.
- Longer time frames may be required to achieve remediation objectives, compared to active remediation.
- The hydrologic and geochemical conditions amenable to natural attenuation are likely to change over time and could result in renewed mobility of previously stabilised contaminants and may adversely impact remedial effectiveness; and
- More extensive outreach efforts may be required in order to gain public acceptance of natural attenuation.

Data Needs:

The degree of degradation hinges on a range of parameters, for example contaminant type and concentration, temperature, moisture, and availability of nutrients and/or electron acceptors such as oxygen or nitrate.

Even though numerous suppliers carry out modelling, sampling, and sample analysis necessary for monitoring natural attenuation, the assessment of natural attenuation is not clear-cut and needs expert knowledge in a number of technical areas such as microbiology/bioremediation, hydrogeology, and geochemistry. When obtainable, information that should be acquired during data review includes:

- Soil and ground water quality data:
- Three-dimensional distribution of residual, free, and dissolved-phase contaminants. The distribution of residual- and free-phase contaminants will be used to define the dissolved-phase plume source area.
- Historical water quality data showing variations in contaminant concentrations through time.
- Chemical and physical characteristics of the contaminants.
- Geochemical data to assess the potential for biodegradation of the contaminants.
- Location of potential receptors:
- Ground water wells.
- Surface water discharge points.

The operation and maintenance period is established from natural attenuation evaluation and regulatory requirements. The process can continue for a number of years until the desired degradation levels are accomplished.

Cost:

Modelling establishes whether natural attenuation is a viable remedial option. The most considerable costs linked with natural attenuation are the monitoring requirements, which comprise of two key parts - site characterisation and performance monitoring. Site characterisation ascertains the degree of contamination and contaminant degradation rates. Performance monitoring tracks the migration and degradation of any contaminants therefore indicating the status of the cleanup.