Ground Water, Surface Water, and Leachate

Adsorption/Absorption

Introduction:

Solutes concentrate at the surface of a sorbent in liquid adsorption, in so doing reducing their concentration in the bulk liquid phase.

Description:

Adsorption systems are commonly categorised as either physical, electrostatic or chemisorption adsorption. Weak forces, namely Van der Waals, provide the strength for physical adsorption, whilst a chemical reaction forms a chemical bond between the compound and the surface of the solid. Electrostatic adsorption involves the adsorption of ions through Columbic forces, and is usually referred to as ion exchange. In liquids, interactions between the solute and the solvent furthermore play a significant role in determining the degree of adsorption.

The most universal adsorbent used is granulated activated carbon (GAC). Other natural and synthetic adsorbents include activated alumina, lignin adsorption, sorption clays and synthetic resins.

Activated Alumina

Activated alumina is a filter media created by treating an aluminium ore so that it turns greatly adsorptive and porous. Activated alumina can eliminate a multiplicity of contaminants, consisting of fluoride, arsenic and selenium. The medium needs regular cleaning with an appropriate regenerant such as alum or acid in order for it to continue being efficient.

Forage Sponge

Forage sponge is an open-celled cellulose sponge containing an amine-based chelating polymer that selectively absorbs dissolved heavy metals. The polymer is closely bonded to the cellulose to reduce physical separation from the supporting matrix. The functional groups of the polymer (e.g. the amine and carboxyl groups) offer selective similarity for heavy metals in both cationic and anionic states, thereby preferentially forming complexes with transition group heavy metals.

Adsorption & Sorptive Clay

Adsorption and sorptive clays are exploited to treat aqueous waste streams with organic, inorganic and heavy metals contaminants. The waste stream is treated as a result of the molecular adhesion of the contaminants to an adsorptive surface.

Artificial Resins

Artificial resins are typically more expensive than GAC, but are designed in order to achieve a higher degree of selectivity and adsorption capacity for particular compounds than activated carbon. Resins are regenerated using acids, bases, or organic solvents, so they are suited for thermally unstable compounds such as explosives and are resilient to deactivation because of the adsorption of dissolved solids. Moreover, resins are often more resistant to abrasion than activated carbon, consequently increasing their shelf life.

Applicability:

The target contaminant groups for the above mentioned processes are mostly organic and selected inorganic contaminants from gas or liquid streams. Activated alumina can remove fluoride and heavy metals. The forager sponge is predominantly used to remove heavy metals. Adsorption and sorptive clays can treat organic, inorganic and heavy metals

contamination in aqueous waste streams. Synthetic resins are suited for thermally unstable compounds such as explosives, due to the resins non-thermal regeneration qualities.

Limitations:

- Water-soluble compounds and small molecules are typically not adsorbed easily.
- The treatment can be expensive if used as the main choice of treatment for waste streams that include high contaminant concentrations.
- Not applicable to sites that have high levels of oil based substances.
- Impractical treatment option when the concentration of the contaminant in question is high due to the frequency with which the absorbent unit requires replacing.
- Contaminated media often necessitates disposal as hazardous waste if they are unable to be regenerated after use.

Performance Data:

Adsorption/absorption methods have an extensive history of use as treatment options for municipal, industrial and hazardous waste streams. The concepts and engineering aspects of the technologies are well developed and they are also proven, with documented data.

Cost:

The cost to treat heavy metal contaminated ground water over a one year period with the Forager Sponge technology is estimated at £ 600 per 1000 litres, assuming the sponges are not regenerated and are replaced upon saturation. Costs for other adsorbent processes are not available.