

Ground Water, Surface Water, and Leachate

Precipitation/Coagulation/Flocculation

Introduction:

The process of precipitation/coagulation/flocculation transforms dissolved contaminants into insoluble solids, assisting in the contaminant's subsequent removal from the liquid phase through sedimentation or filtration. The process usually uses pH adjustment, addition of a chemical precipitant and flocculation.

Description:

The precipitation of metals has been the main method of treating metal-impacted industrial wastewaters. In the treatment of ground water, the metal precipitation method is utilised as a pre-treatment for other treatment technologies such as chemical oxidation or air stripping, where the occurrence of metals has the potential to hinder with the other treatment processes.

Metal precipitation from impacted water involves the alteration of soluble heavy metal salts to insoluble salts that will precipitate. The precipitate can be removed from the treated water by means of physical methods such as clarification (settling) or filtration. The process typically uses pH adjustment, the supplement of a chemical precipitant and flocculation. Metals then precipitate out from the solution as hydroxides, sulphides, or carbonates. The solubility's of the metal contaminants and the cleanup standards needed dictate which process is used. In a few situations, process design brings about the production of sludge's that can be sent to recyclers for metal recovery.

Coagulants and Flocculation:

Chemical precipitants, coagulants, and flocculation increase particle size through aggregation. The process can generate extremely fine particles that are held in suspension by electrostatic surface charges. Such charges bring about clouds of counter-ions to form around the particles, giving rise to repellent forces that stop aggregation and decrease the effectiveness of the solid-liquid separation. Consequently, chemical coagulants are regularly added to prevail over the repulsive forces of the particles. The three types of coagulants are inorganic electrolytes namely alum, lime, ferric chloride, and ferrous sulphate, organic polymers, and synthetic polyelectrolytes. The use of coagulants is followed by low-shear mixing in a flocculator to encourage contact between the particles, permitting particle growth throughout flocculent settling.

Flocculant settling refers to a dilute suspension of particles that flocculate for the duration of the sedimentation process. As flocculation takes place, the particles intensify in mass and settle at a quicker rate. The amount of flocculation that arises hinges on the chance for contact, which varies with overflow rate, the depth of the basin, the velocity gradients in the system, the concentration of particles, and the range of particle sizes. The result of these variables can be achieved by means of sedimentation tests.

Applicability:

Precipitation changes dissolved ionic species into solid-phase particulates that can be removed from aqueous phase through coagulation and filtration. Application of this remediation technology involves removal of dissolved toxic metals and radionuclides. Sludge's may be suitable for metal recovery.

Limitations:

- If the source of contamination is not removed, the treatment of ground water may be excessive.

- The existence of multiple metal species may lead to removal difficulties as a result of the natures of different compounds.
- Soluble hexavalent chrome needs extra treatment before undergoing coagulation and flocculation.
- Reagent addition has to be thoroughly controlled to preclude unacceptable concentrations in treatment effluent.
- Efficacy of the system depends upon adequate solids separation techniques such as clarification, flocculation, and/or filtration.
- The process could generate toxic sludge that requires appropriate disposal.
- Process can be costly, depending on reagents used, required system controls, and required operator involvement in system operation.
- Dissolved salts are added to the treated water as a result of pH adjustment.
- Treated water will often require pH adjustment.
- Metals held in solution by complexing agents such as cyanide or EDTA, are complicated to precipitate.

Data Needs:

Lab-scale tests should be undertaken to assess the operating conditions and characteristics namely reagent type and dose, optimum pH, retention time, flow rate, temperature, flocculent selection, suspended solids, precipitate settling and filtration rates, and sludge volume and characteristics.

Performance Data:

The precipitation of heavy metals has been undertaken in industrial wastewater treatment for several years. Lately, the process has been employed in the electronics and electroplating industries as a pre-treatment technology for wastewater discharge to a publicly owned treatment works.

As a result of its accomplishment in meeting needs relating to the discharge of treated wastewater, metal precipitation is acknowledged as an established process for use in remedial activities involving the treatment of ground water. Precipitation in combination with sedimentation or flocculation and filtration, is becoming a commonly selected choice for heavy metal removal from ground water in pump and treat operations.