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Technical Bulletin:
Ferric Salts for Solids Removal

Coagulation and Flocculation

The nonsettleable solids, such as fine silts, of influent water streams are colloids and will never settle out of solution. These colloids form due to a 'like' electrical charge, typically negative, on each of the particles. The mutual charge repels each particle from each other, producing a stable colloidal state in which all particles are equally apart and suspended. This accounts for the brown color of ponds.

Similarly, settleable solids are larger particles such as sands. They take significant time to settle out of solution, which is impractical for treatment plants.

The solution is to apply ferric salts to a stream for coagulation to remove turbidity. Ferric ions (Fe^{+3}) are positively charged and attracted to the negatively charged particles; their interaction yields an overall neutral charge. Coagulants are rapidly mixed to increase molecular interaction. The highly oxidized, cationic state of ferric ions makes ferric salts an effective primary coagulant due to the efficient destabilization of charge. Weak Van der Waal's forces then cause the neutral particles to attract each other and begin to clump.

Within the flocculation basins, a 'sweeping floc' mechanism occurs with sufficient application of ferric salt. Ferric ions react with hydroxide, carbonate, or bicarbonate ions in solution to form insoluble ferric hydroxide, $Fe(OH)_3$.

Polymeric hydrocomplexes of ferric hydroxide then form that amorphously 'sweep' and entrap particles in its floc. Although metal salts consume alkalinity in this process, Pencco offers polyferric sulfate that already has these polymeric complexes in a soluble form before addition to water.

Application of polyferric sulfate captures the advantages of coagulation and the floc mechanism without the characteristic effect on alkalinity.

Sludge Conditioning

When considering sludge, the primary goal is volume reduction due to the disposal costs associated with sludge content.

Ferric salts assist in sludge thickening and dewatering by compacting the colloid-like sludge with its cationic character, as previously described. As water is removed, the TSS reduction from floc formation increases the filtrate clarity.

The additional weight of iron molecules increases the compression and weight of the sludge, making the sludge blanket more stable and less affected by changes in hydraulic loading.