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Technical Bulletin ENHANCED COAGULATION

Introduction

The Stage 2 DBP rule builds upon earlier rules that addressed disinfection byproducts to improve drinking water quality and provide additional public health protection from disinfection byproducts. This final rule strengthens public health protection for customers by tightening monitoring requirements for two groups of DBP, trihalomethanes (TTHM) and haloacetic acids (HAA5). The rule targets systems with the greatest risk and will reduce potential health risks related to DBP exposure and provide more equitable public health protection.

Many systems have already made significant progress in lowering their DBP levels. The Stage 2 DBP rule takes a risk-based targeted approach to require treatment changes by only those public water systems that are identified as having the greatest remaining risk. The first step is a multi-year process for systems to determine where higher levels of DBP are likely to occur in their distribution system. These locations will become the system's new DBP monitoring sites. If the DBP levels at these locations are too high (i.e., above the MCL), the system will start to take corrective actions. These actions could range from simple, quickly implemented management or operational changes to major construction. The time to completion will vary depending on what they need to do. Depending on system size and the extent of needed construction, systems will begin the first year of compliance monitoring between 2012 and 2016 and must be in compliance with the Stage 2 DBP rule MCLs at the end of a full year of monitoring. Enhanced Coagulation with Ferric Chloride has been a common strategy for many water systems to meet with the Stage 2 DBP requirements.

Ferric Chloride for Enhanced Coagulation

Since the process of enhanced coagulation was introduced, Ferric chloride has repeatedly been shown to have a dramatic capacity to remove the soluble and semi-soluble organic materials that make up TOC. Many research studies have reported that Ferric Chloride is the most viable approach for removing DBP precursors from raw water.

The process of enhanced coagulation focuses on the removal of naturally occurring organic materials from potable water supplies. These materials, if chlorinated, have the potential to form disinfection by-products (DBP's). The basic premise behind enhanced coagulation lies in the ability of Ferric Chloride to remove TOC, THM precursors, and color producing organic materials.

Enhanced Coagulation is accomplished in three distinct treatment phases. First, many TOC compounds exist in water sources as semi-soluble or even soluble compounds. Many of these TOC compounds must be protonated to be de-solubilized and separated from solution. The common approach to this process is to reduce the pH of the water. This can be accomplished through the addition of mineral acids such as hydrochloric or sulfuric acid or through the addition of a Lewis acid such as Ferric Chloride. This process separates the organic molecule from the water and creates a micro-particle or micro-droplet. Although separated from solution, due to it's small size, it is not yet in a condition to be physically removed.

The next step occurs as the micro-droplets of the organic materials are adsorbed on the hydrated ferric chloride (Ferric Oxyhydroxide) floc. The rate and efficiency at which this adsorption takes place is related to the size and number of hydrated floc particles. When the floc particles are small and numerous they will have a greater charge to surface area ratio; and the level of organic material adsorption will be high. When the floc particles have grown in size, the total collective surface area will be less and the number of particles will be fewer. The charge to surface area ratio will, therefore, be lower and lead to a corresponding loss in adsorption efficiency. The point being that the process is more efficient early on when the floc particles are just forming. This leads us to recognize the need for high energy rapid mixing for coagulant dispersal.

Finally, given favorable mixing conditions, the small floc particles, by colliding with one another, will form large aggregates that can be removed through gravity settling. If necessary, the settling rates of these aggregates can be improved through the use of polyelectrolyte polymers. The sludge from this process is accumulated and processed for residual removal.

Other issues

Alkali usage – because enhanced coagulation requires low pH conditions the addition of make-up alkalinity is unavoidable. For hard waters, softening processes are often initiated after enhanced coagulation. However, it is important to recognize the potential for resolubilization of some TOC materials with high pH. Therefore, it is sometimes critical to provide solids removal for enhanced coagulation products before starting the softening process. Accomplishing enhanced coagulation in plants with limited physical resources can present some problems. Higher sludge volumes will be experienced due to higher coagulant dosages.

Benefits of Enhanced Coagulation with Ferric Chloride

- Very often the only economically viable solution
- Orders of magnitude better results than most other processes or coagulants
- Highly flexible treatment parameters
- Relatively easy to implement
- Capital investment low
- Numerous options for low cost disposal of residuals

How California Water Technologies can help

California Water Technologies' is committed to the municipal water industry. We are a producer of high quality Ferric Chloride. Our technical staff can help you analyze your treatment needs and develop a strategy to meet the D/DBPR requirements. To get a step up on meeting the regulations please call **(866) 337-7427** to talk with one of our technical representatives.