



Oily Water / Produced Water Treatment

Ferrate-based Advanced Oxidation Process



Product Applications

- Produced Water Treatment
- Wastewater Treatment
- Drainwater Treatment
- High Organics Waste Treatment
- Refineries & Petrochemical

Ferrate (Supercharged Oxidant)

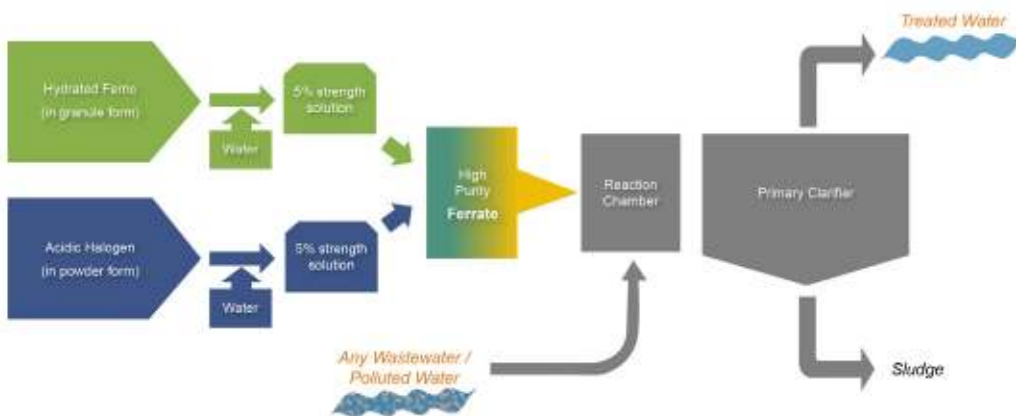
Ferrate (FeO_4^{2-}) is a supercharged form of iron with in the +6 oxidation state, also known as Iron (VI). Ferrate is extremely powerful to serve multiple treatments from a single application. It does not create toxic Disinfection By-Products thus, is environment-friendly, and solves a various range of treatment challenges than other standard oxidants. Most importantly, Ferrate is often the least expensive and most effective treatment option. Ferrate is a versatile oxidant is designed to move away from chlorine, as well as ozone, peroxides and ultraviolet light.

Ferrate-Based Advanced Oxidation

The process of mixing Hydrated Ferric solution (iron catalyst) and strong Acidic Halogen Oxidant solution (oxidizing agent) is the easiest method to produce pure Ferrate in the reaction tank. The purity of Ferrate is more than 99% in the mixed form. This Ferrate production scheme is an exclusive and proprietary process.

Ferrate (VI) from Hydrated Ferric solution & Acidic Halogen agent is the safest oxidant, inexpensive and "environmental friendly", especially for water and waste water treatment applications. This Reduction-Oxidation process is an ideal treatment for industrial and municipal effluent containing hazardous organic and inorganic compounds. Using the high purity ferrate, there is no need to dose poisonous and corrosive gasses like chlorine, hypochlorite or ozone. These oxidants have deleterious side effects. Additionally, the handling of chlorine, hypochlorite, HOCl, chlorine dioxide or ozone are potential danger to workers due





OXIDANT	REDOX POTENTIAL
Ferrate	2.20
Ozone	2.08
Hyd. Peroxide	1.78
Permanganate	1.68
Hypochlorite	1.48
Perchlorate	1.39
Chlorine	1.36
Dissolved O2	1.23
Chlorine Dioxide	0.95

to their high toxicity. And a major disadvantage of chlorine and chlorine dioxide or any other chlorine-containing oxidant produce, chloramines, chlorinated aromatics, chlorinated amines or hydrocarbons. All these oxidants are potential mutagens or carcinogens, are for sure more toxic than the parent contaminants.

Both of the compositions in Hydrated Ferric catalyst and Acidic Halogen are oxidation products and 100% biodegradable. The ferrate molecule precipitates out of solution as $\text{Fe}(\text{OH})_3$ and now the adsorption process starts to collect cation as well as anions from the water. The iron containing product will be easily filtered out by Advanced Catalytic Media Filtration leaving iron-free water containing innocuous by-products.

Ferrate from the above process is the most stable form of Ferrate (VI) because it is generated with Ferric Hexahydrate granules. The oxidant used in this process is a strong acid halogen which generated high voltage of oxidant without any DBPs.

REDOX potential of the oxidant is as high as Hydroxyl Radicals.

The high purity Ferrate spontaneously decomposes in the presence of the target contaminants, in any kind of water into strong oxygen and the most powerful adsorbent-based ferric hydroxide with the surface area of 3500 m²/gram.

The chemical formation reaction is:
 $\text{Fe}(\text{OH})_3 + \frac{3}{4}\text{O}_2 + 2\text{OH}$

This reaction is the strongest for the Oxidation-Adsorption of metals, non-metal and or organic contaminants in water and wastewater treatment. These include ammonia, cyanide, thiocyanate and very high concentration of hydrogen sulfide.

As many of the reactions are pH-based reaction it can be controlled in the process with Acidic Halogen Oxidant (the most powerful oxidant and disinfectant against viruses and Coli-form Bacteria). Inactivation of viruses and all kind of bacteria occur faster as the pH drops, a phenomenon that has been attributed to mono-protonated form of HFeO_4 .

Technology Advantages

- Ferrate is the most powerful common oxidant/ disinfectant for water and wastewater treatments.
- Multiple Treatment Capability
- Low-Operating Cost
- Safe & Non-toxic Reagents required
- No Disinfection By-Products
- Capable to treat Difficult Biosolids
- Versatile Supercharge Iron which can perform as an Oxidant, Disinfectant & Coagulant

