Purple is the new **green.**

Ferrate Solutions Inc.

Media Kit

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FERRATE SOLUTIONS®

The History of Ferrate

World's Oldest "Breakthrough" Technology

Oxo compounds of iron (Ferrates) were first synthesized in 1715 in Germany, and since that time high valence (Fe^{4+} through Fe^{7+}) oxo anions of iron (Ferrates) have been studied by chemists. Commercial utilization of these unusual compounds however, has been extremely limited, primarily because of the difficulty in synthesizing them and their inherent instability.

The most stable of the Ferrates is Ferrate(VI), or FeO_4^{2-}. Because of the high valence of iron in these compounds they are strong oxidants, and because the residual from any chemical reaction is simply ferric iron (the most common element on earth) they should be commercially useful. In fact, given these unique properties, their use for treating water and wastewater to remove contaminants would seem like an obvious avenue to explore; but it was not until the 1970s that research in the laboratories of Dr. T.D. Waite was started on the use of ferrates for environmental applications. Ferrate(VI) research continues today world-wide generating >2,000 scientific publications per year. As anticipated, Ferrate(VI) has been repeatedly demonstrated to be a powerful oxidant of environmental contaminants, and to rapidly decompose to ferric iron which quickly precipitates from the solution. Because the residual is non-toxic ferric iron, it can be safely land-applied for disposal or recycled. This would be considered a "Green" chemical today.

Why No Commercial Ferrate(IV) Product? Anywhere?

The various methods for synthesizing Ferrate(VI) were described in detail over 200 years ago. Basically, ferric iron (Fe^{3+}) is oxidized to a high valence (Fe^{4+} to Fe^{6+}) utilizing; heat, electric power, or an oxidizing chemical. All of these oxidation reactions must take place in a caustic environment, as the synthesized Ferrate is only stable at a high pH. The end product of all of these synthesis procedures is a Ferrate material mixed either with a caustic solution, or other chemicals utilized in the oxidation process. The cost of this Ferrate product is simply the cost of the chemicals or electricity utilized for the oxidation. For example, the unit cost of Ferrate(VI) in these mixtures is inexpensive if commercial feedstocks are utilized (currently around $5.00 per lb. of Ferrate(VI) produced, which translates to approximately $50.00 per million gallons treated at a dose of 1 mg/L FeO_4^{2-}). If a highly purified Ferrate(VI) product is desired however, the mix must be further processed to separate the Ferrate(VI) from the synthesis solution.

This is a tedious (and therefore expensive) process increasing the unit cost of the Ferrate(VI) product by >15X. In summary, if a pure Ferrate(VI) product is required, the cost of it will be prohibitive for large scale environmental use, and cannot compete with other water and wastewater treatment chemicals for similar treatment. In addition, a pure Ferrate(VI) product (powder) is impossible to stabilize, handle, ship, store and apply as a commodity chemical. Essentially all of the research utilizing Ferrate(VI) to date has been done with small quantities of a laboratory-synthesized, pure Ferrate(VI) compound.

There Must Be A Way

It became clear to Dr. Waite many years ago that a pure Ferrate(VI) powder could never be generated at a competitive cost for use in large-scale environmental applications. However, it was possible that the inexpensive Ferrate(VI) solution generated without further purification could be utilized and would be competitive in price, thereby providing a commercial supply of Ferrate(VI) to the environmental market. However, because of the instability of any Ferrate product, it would need to be produced near-by or central to the site of its application. After years of research and development Dr. Waite perfected Ferrate(VI) blends, produced with inexpensive chemical feedstocks, along with support unit operations that could utilize liquid Ferrate(VI) products. For the past eight years Dr. Waite has worked on treating all types of water and wastewater using these unique Ferrate(VI) solutions.

Ferrate Solutions

The simple but elegant solution that opens this technology for global commercialization is the design and fabrication of equipment that can be utilized to produce and deliver liquid Ferrate(VI) solutions at designed doses for each treatment challenge. The formula for blending readily available chemical feedstocks to continually produce a concentrated Ferrate(VI) solution has been developed by the principals of this company. The founders of FERRATE SOLUTIONS Inc. (FS) also have the knowledge and experience to utilize proprietary formulations of different liquid Ferrate(VI) solutions to effectively treat: drinking water, domestic and industrial wastewater, sludge and gasses. FS has partnered with a major equipment manufacturer to build specialized Ferrate(VI) synthesis and support equipment. FS Ferrate(VI) treatment systems are guaranteed, and come with maintenance packages to assure worry free operation in the field.

Ferrate Technology

What are Ferrate Solutions Inc. Treatment Systems?

Ferrate Solutions Inc., provides its customers with the complete capability to treat most types of contaminated water and wastewater, both affordably and with no negative impacts to the surrounding environment. FS designs, fabricates, installs and maintains site-specific equipment that creates and delivers ferrate-based treatment uniquely designed to meet customer treatment needs.

For over 40 years, tens of thousands of publications have shown ferrate's effectiveness in environmental applications. All of this research with subsequent pilot demonstrations has been performed utilizing small quantities of laboratory-synthesized ferrate compounds. Despite the astounding results observed with ferrate treatment of water, wastewater, sludge and industrial wastes, inexpensive, commercial sources of a ferrate compound have never been available in the market place.

Why hasn't a source of commercial grade ferrate ever been available?

Ferrate (FeO_4^{2-}) products are inherently unstable and cannot be stored or transported as with other commercial grade chemicals. These characteristics have precluded the ability of large chemical suppliers to produce commercial amounts of this chemical. In addition, previous attempts to commercialize this valuable commodity were unsuccessful due to the cost (> $100.00 per pound of FeO_4^{2-}) of producing a high-purity ferrate product. FS has developed proprietary blends of ferrate products that are now available at a commercial scale for < $5.00 per pound of FeO_4^{2-}.

How did FS achieve this breakthrough in the technology?

After many years of research and experimentation in pilot studies, FS engineers have been able to design proprietary blends of inexpensive, commercially available feedstock chemicals, that when reacted together under proprietary conditions can produce a concentrated ferrate solution that is stable for weeks. This allows a workable solution of ferrate to be continuously generated nearby its point of use; either in remote locations, or central to several users of the compound.

Treatment systems.

In conjunction with our OEM, FS designs, fabricates, tests, installs, guarantees and maintains all components for site-specific designed Ferrate – based treatment systems. The FS Ferrate systems can be scaled to any size application. The unit operations of the systems are modular and easily transported to any location. These systems can be stand-alone, or interface with existing facilities. Total system design includes proprietary Ferrate synthesis, feed systems, flash mixing, flocculation, and clarification systems as required. Facilities for storage and handling of feedstock chemicals (ferric, caustic, and bleach) can also be designed and fabricated if the feedstocks are not already present at the site. All FS systems are fully process controlled and can be remotely controlled from central locations. FS engineers can interface their systems into any existing water, wastewater or industrial waste treatment system. FS treatment systems can be purchased outright or leased through one of several programs provided by FS.

Treating Florida's Blue Green Algae Problem

Florida, along with many other states, is dealing with the long-term effects of nutrient overload in its water.

Too many nutrients are feeding harmful algal blooms and bacteria.

While leaking septic systems are a big problem, the main culprits are **Phosphorus** and **Nitrogen** which are injected into the environment via fertilizers and ammonia that isn't being removed by wastewater treatment plants. Fertilizers are applied to the land by the commercial agricultural industry but also homeowners, municipalities, golf courses, and many more. The chemical components of these fertilizers percolate down through the soil and end up in our ground water, or they wash off the land and into our canal systems during storm events. Florida cannot reduce toxic or environmentally harmful blooms without removing the chemicals that feed them, Phosphorus and Nitrogen.

In addition to fertilizers, Florida's water is also suffering from the release of ammonia nitrogen that is not being properly removed from domestic wastewater treatment facilities. **Ammonia nitrogen** is most likely the biggest contributor to toxic bacteria and blue green algae blooms in Florida.

While bio-filtration (grasses, oysters, impoundment) has been heavily considered and occasionally implemented as a solution, the reality is that they can only go so far in helping Florida's water woes.

Only Phosphorus can be removed via biological processes in an impoundment, but its removal by impoundment is an uncontrolled (biological) process whose efficiency can only be estimated. The current practice of "impoundment" has no theoretically verifiable positive effect unless biomass is continually harvested. Also, water impoundment removes productive land from farming, and excavation costs are significant.

Cost calculations show that the same amount of water that would be impounded in an excavated plot of 10,000 acres in a process that would cost well over $400 million, could be treated safely and efficiently with Ferrate, for pennies on the dollar.

When flowing water is treated with Ferrate, it binds to Phosphorus which is then precipitated out, and can be recycled back onto fields if desired. Nitrogen is converted to a gas and removed from water. No known technology today can quantifiably remove Nitrogen from water or wastewater. Until now.

Ferrate is safe for the environment as it treats water in a closed system before releasing clean water back into streams and lakes.

Important FAQs About Nutrient Contamination and Destroying Blue Green Algae

Is Ferrate poured directly into streams and rivers?

No. Ferrate is used in a controlled manner within a "pump & treat" process. Water from a lake, canal or river is pumped out and ferrate is added.

Can Ferrate clean up large bodies of water like Lake Okeechobee?

Yes. Ferrate systems can be scaled up to large flows because it is a simple chemical treatment. Hundreds of millions of gallons of water per day can be treated with a modest size system capable of removing thousands of TONS of phosphorus + nitrogen + cyanobacteria.

Is Ferrate safe for fish and wildlife?

Ferrate is never in contact with any wildlife, including fish. It is added during a pump & treat process, and the treated water (returned to the environment) is the same as before treatment (minus the nutrients and the suspended materials including algae and bacteria).

Is there any danger to the environment when Nitrogen is converted to a gas?

Ferrate is the only chemical in the world that can convert nitrogen (which has been discharged to the water from wastewater treatment plants or fertilizers) to a harmless nitrogen gas. This gas leaves the water and goes into the atmosphere (our air is already 70% nitrogen) and its volume is insignificant compared to the nitrogen already present.

What happens if there is a chemical spill?

Ferrate is produced by mixing together common commercial chemicals (ferric iron, caustic, and bleach). These are the only chemicals that could "spill", as the produced ferrate is injected into the water as soon as it is generated. These feedstock chemicals are used at most every water and wastewater plant in the world and required spill "prevention" measures are already in place.

What does Ferrate do to the salinity or pH of the water, and is there any concern about the change in either of these to the environment?

There is no change in pH of the treated water due to Ferrate treatment. Some minor amounts of salt (chloride) will be added during the treatment, but this is small and will be diluted when the treated effluent is added back to the environment.

Can I use Ferrate in my house or in my sprinkler system?

No. Ferrate is intended for large-scale use.

Once Ferrate is added to water, how long will it take to kill algae and bacteria?

Oxidation and disinfection (killing) reactions are rapid. Contact time to inactivate bacteria and algae will be approximately five minutes.

How come nobody has talked about Ferrate as a solution, before?

People have talked about Ferrate's remarkable treatment abilities for over 40 years (20,000+ open literature publications). The reason it has not be utilized is that the chemical was not available on a commercial scale. It now is … because we have figured out how to make it inexpensively from common feed-stock chemicals.

Will there be any smell related to Ferrate treatment?

No. In fact Ferrate has been used to deodorize wastewater sludge so that it can be land-applied.