
FERRATE
SOLUTIONS

# History

## World's Oldest "Breakthrough" Technology

Oxo compounds of iron (Ferrates) were first synthesized 1715 in Germany, and since that time high valence (Fe4+ through Fe7+) 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 FeO42-. 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.

## 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.

**Learn more at Ferrate-Solutions.com**

# Capabilities

## Ferrate is capable of removing almost any unwanted chemical from water & wastewater.

From nutrient and fertilizer pollution to pharmaceuticals and radioactive material, Ferrate works.

- Ferrate disinfects and coagulates drinking water and wastewater.
- Ferrate removes organic matter and toxic metals.
- Ferrate removes endocrine disrupting chemicals (EDCs), pharmaceuticals and personal care products (PPCPs).
- Ferrate improves finished water quality when treating Disinfection Byproduct (DBP) Formation from Chlorination.
- Ferrate destroys cyanide and thiocyanate.
- Ferrate removes phosphorus and coliforms from secondary effluent.
- Ferrate removes Radionuclides (americium and plutonium).

**Learn what ferrate is capable of at Ferrate-Solutions.com**

# Technology

## What are Ferrate Solutions Inc. Treatment Systems?

Ferrate Solutions Inc. provides its customers with the complete, on-site 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 break-through 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.

# Invest in a Clean Future

Ferrate Solutions Inc. is currently seeking investors who are interested in bringing this technology to the international market place.

For inquiries, please contact Geoffrey P. Wight.

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The International Commercialization of Ferrate

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