Iron Diagnosis & Removal

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RESINTECH® INC.
INNOVATIONS IN ION EXCHANGE

ResinTech, Inc.

An industry-leader for over 30 years, ResinTech® manufactures a broad range of ion **exchange resins**, **activated carbons** and **selective adsorbents** for water and wastewater treatment.

- WQA Gold Seal Certified products
- ISO 9001:2015 Certified by Perry Johnson Registrars

Iron in Potable Water

- EPA Secondary Regulation
  - Limit of 0.3 ppm
- Causes staining on clothing/fixtures
- Can cause metallic taste/odor to water
- Not considered a health risk, more of a nuisance

Types of Iron

- Sequestered Iron
- Organically Bound (Heme)
- Iron Bacteria
- Ferric – “Red Water”
- Ferrous – “Clear Water”

Sequestered Iron

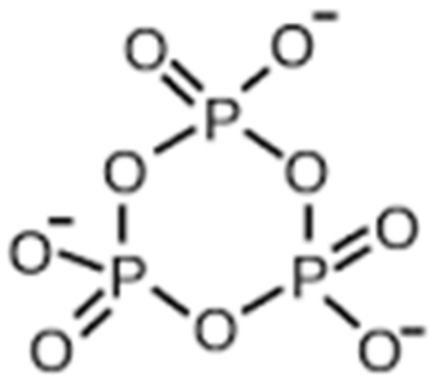
se·ques·ter /səˈkwestər/

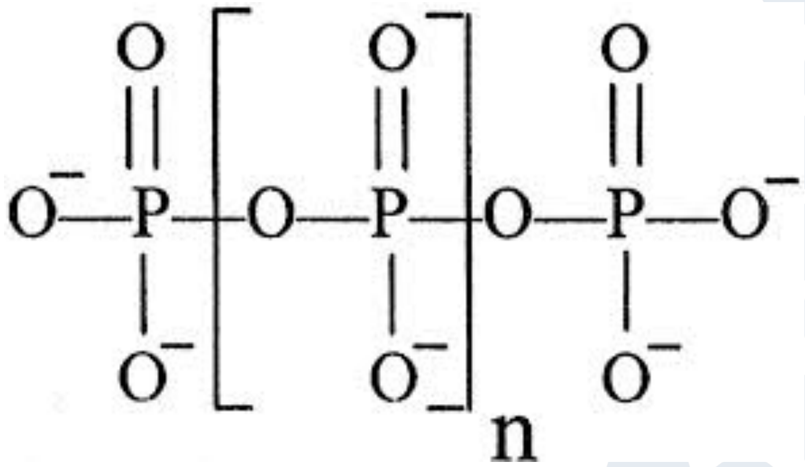
verb. “To isolate or hide away”

- In water, a chemical agent that keeps iron dissolved in solution
- Most common sequestering agents are phosphates
    - poly-, hexameta-,

Sequestered Iron

- Typical testing will show iron
- Conventional treatment won’t remove it





Sequestered Iron

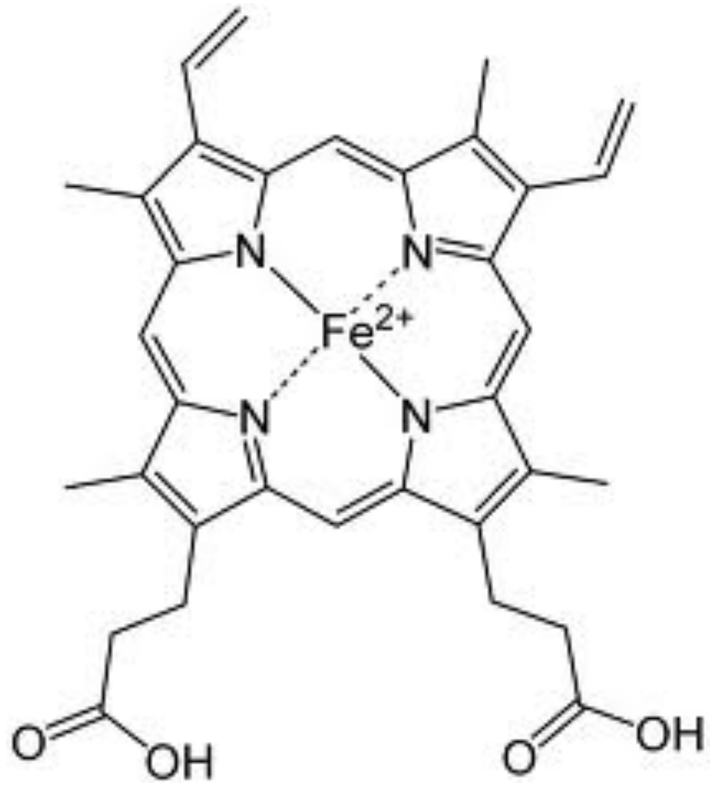
- Bond can be broken down by heat.
- Use of anion/tannin resins can remove it.
- Verify presence by testing for phosphates.

“Heme Iron”

- Iron bound in organic structure
- Typically found in “Tannins”
  - Humic, Fulvic, Tannic Acids
- Surface Water or Shallow Well
- Yellow/Brown tint to water

“Heme Iron”

- Structure is “anionic” in nature



“Heme Iron”

- Can be removed directly by anion/tannin resins.
- Oxidation by chlorine to destroy structure.
    - Follow oxidation by filtration

“Heme Iron”

- When using anion/tannin resins, capacity is calculated based on Sulfate (SO_4) concentrations.
- Frequent regeneration aids in the prevention of organically fouling the resin.

Iron Bacteria

- Microorganism that uses iron for metabolic process.
  - Iron deposits on cell walls
  - Reddish, slimy, odor
  - Wells & surface waters

Iron Bacteria

- Best managed by chlorination
  - “Shock” chlorination
  - Continuous chlorination
- Filtration post oxidation to remove iron.

Ferric Iron (Fe+3)

- “Red Water” Iron
- Latin “ferrum” = iron
- Most stable form of iron
- Red in color
- Rust

Ferric Iron (Fe^{+3})

- Insoluble at near neutral pH
- Forms reddish/yellow precipitant.
- Ferric Hydroxide ($FeOH_3$)

Ferric Iron (Fe^{+3})

- Removed as a suspended solid
  - Filtration
    - Backwashable
    - Cartridge
- Settling
  - Clarification

Ferrous Iron (Fe^{+2})

- “Clear Water” Iron
- Dissolved in water
- Colorless
- Soluble in water as Ferrous Bicarbonate
  - $Fe(HCO_3)_2$

Ferrous Iron (Fe^{+2})

- If left untreated, can oxidize and precipitate to cause staining.

Ferrous Iron (Fe^{+2})

- Removal Options:
  - Oxidation/Precipitation
  - Water Softening

Ferrous Iron (Fe^{+2})

- Oxidation/Precipitation
  - Conversion of Fe^{+2} to Fe^{+3}
  - Can be accomplished by:
    - Oxygen- O_2 (Air)
    - Chlorine- HOCl
    - Ozone- O_3
    - Permanganate- $KMn0_4$

Ferrous Iron (Fe^{+2})

- Oxidizing filters
  - Catalytic oxidation of iron
- Manganese Greensand
- Manganese Dioxide
- Various others

Ferrous Iron (Fe^{+2})

- Once iron is oxidized, the iron precipitates.
- Proper maintenance of filtration method is critical

Ferrous Iron (Fe^{+2})

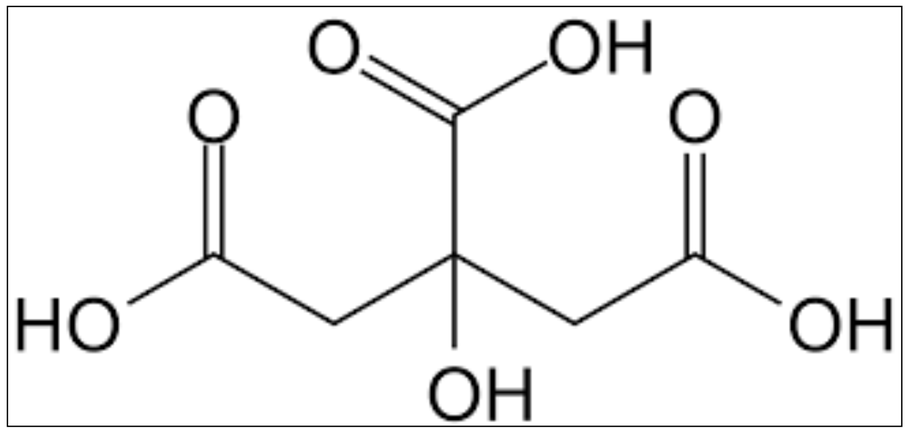
- Water Softeners remove Fe^{+2} readily.
- Exchanges on the resin just like hardness ions (Ca^{+2}/Mg^{+2})
- No limit to how much it can load
  - WHAT?

Ferrous Iron (Fe^{+2})

- Under anaerobic condition Fe^{+2} is stable.
- Under low pH conditions $Fe^{+2 \text{ or } +3}$ is stable.
- Under these conditions the Fe^{+2} elutes from the resin like hardness.

Ferrous Iron (Fe^{+2})

- Regeneration Aids
  - Sodium Bisulfite ($NaHSO_3$)
  - Sodium Hydrosulfite ($Na_2S_2O_4$)
  - Hydrochloric Acid (HCl)
  - Phosphoric Acid (H_3PO_4)
  - Citric Acid



Ferrous Iron (Fe^{+2})

- Limit loading on resin
- 400 to 600 grains/Cuft recommended.
- Prevents over elution of iron that leads to fouling.

Ferrous Iron (Fe^{+2})

- ppm as Fe X 1.79 = ppm as $CaCO_3$
- ppm as $CaCO_3$ / 17.1 = GPG Iron
- 400 – 600 grains / GPG Iron = gallons/Cuft
- Perform hardness capacity calculation
- Whichever is less is your capacity

Ferrous Iron (Fe^{+2})

- Equipment set-up can also help minimize fouling.
  - Countercurrent regeneration
  - Fine Mesh Resin
  - Frequent regenerations

Ferrous Iron (Fe^{+2})

- Key to all of this is the prevention of Fe^{+2} to Fe^{+3} oxidation during the regeneration cycle IN the water softener.
- Why and how does this occur?
  - O_2 dissolved in brine
  - 8-10 ppm is typical

Multiple Barriers

- More than one of these iron species can be present in any given water.
- Use of multiple techniques may be required to remove them.

Type of Iron

- Sequestered Iron
  - Heat, Anion Exchange
- Organically Bound (Heme)
  - Oxidation/Filtration, Anion Exchange
- Iron Bacteria
  - Disinfection/Filtration

Type of Iron

- Ferric – “Red Water”
  - Filtration, Clarification
- Ferrous – “Clear Water”
  - Oxidation/Filtration, Water Softener

THANK YOU

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