Managing High Iron Levels While Removing 1,4-Dioxane from Groundwater

Background/Design Basis
- Site is located in St. Petersburg, FL
- Contaminated groundwater remediation; 100 to 175 gpm
- 1,4-dioxane = 2,535 ppb
- Total Organics = 17,450 ppb
- Iron = 6 to 30 ppm
- negative ORP, < -100mV
- Treated water discharged to city POTW

Approach
- Full-scale system design incorporated iron pretreatment, followed by AMBERSORB™ 560 (AMBERSORB) vessels
- Iron pretreatment included oxidant feed, catalytic media filtration, solids conditioning with polymer, and sludge dewatering
- AMBERSORB media was installed to remove the 1,4-dioxane, CVOCs and other organic contaminants
- Superheated steam is used to regenerate the media in-place

Challenge
- Iron pretreatment = half the battle
- Results in high O&M cost and production of hazardous waste sludge

Oxidation State Matters
- Influent iron is in the soluble, reduced form
- AMBERSORB vessels have zero headspace
- POTW is required to remove phosphorus
- Iron is effective at removing phosphorus from solution via precipitation and coagulation
- Project team convinced City to allow a trial in which iron pretreatment system was bypassed

Objectives
- Long-term plume control
- Compliance with 1,4-dioxane permit limit = 3.2 ppb
- Compliance with total iron limit = 1.0 ppm
- Compliance with TVOC limit = 1.0 ppb
- Consistent, reliable treatment under changing influent flow rates and concentrations

Results
- Iron passes through AMBERSORB system in dissolved state
- Successful trial led to full-scale implementation
- Effluent 1,4-dioxane is consistently < 0.04 ppb
- Effluent TVOC is consistently < 1.0 ppb
- No iron fouling or buildup of solids in system

Summary/Conclusions/Lessons Learned
- In groundwater, high iron concentrations result from reduced (negative ORP) conditions
- Reduced (ferrous) iron is soluble and clear
- Zero-headspace treatment systems can take advantage of this:
  - Reduced hazardous sludge generation
  - Reduced O&M costs
  - Enhanced phosphorus removal at the POTW
  - No iron fouling of the vessels, pipes, etc.
- Don’t be afraid to question traditional (institutional) thinking:
  - Why was the Fe limit 1 mg/l?
  - Why were we adding oxidant to a zero-headspace system?
- Don’t make iron sludge unless you have to!
- AMBERSORB works:
  - Treated over 50 million gallons, so far
  > > 99% up-time

Iron Pretreatment

1,4-Dioxane Removal

Iron Sludge

Plats and Frame Filter Press

AMBERSORB Column Test

Zero-Headspace System

AMBERSORB™ 560 (AMBERSORB) vessels

Iron Sludge

Ferric Iron, Fe3+

Ferrous Iron, Fe2+

Influent and Effluent Iron

Influent and Effluent 1,4-Dioxane

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Site Layout

Iron Pretreatment
1,4-Dioxane Removal
Iron Sludge
Plats and Frame Filter Press
Iron Sludge
Ferric Iron, Fe3+
Ferrous Iron, Fe2+
Influent and Effluent Iron
Influent and Effluent 1,4-Dioxane