

ADVANCED METALS REMOVAL SYSTEM WITH FERROLOCK™ ZERO VALENT IRON MEDIA

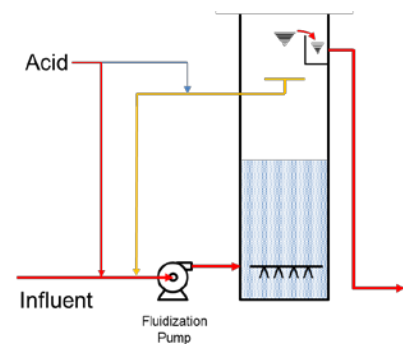
Envirogen has developed a proprietary active water treatment system called the Advanced Metals Removal System (AMRS) that utilizes Envirogen's FerroLock™ Zero Valent Iron (ZVI) media to remove selenate, arsenate, chromate and other oxyanion contaminants. This unique system is engineered to operate optimally regardless of media size and density. You are never locked into a single media. The AMRS can utilize Envirogen's specially formulated FerroLock™ ZVI or other iron-based media to deliver high removal efficiencies allowing customers to comply with stringent wastewater discharge permit limits.

ADVANCED METALS REMOVAL SYSTEM

The AMRS is an active water treatment system that allows use of multiple ZVI formulations to accomplish metals removal. Compared to conventional ZVI system designs, the AMRS design is up to 50% lower in capital cost and provides the fluidization flow flexibility needed to utilize multiple types and grades of ZVI formulations. It is also unlike the in-situ approach more commonly employed with ZVI for metals removal from water, and offers a number of advantages.

- Reduced physical footprint
- Ability to effectively operate over a range of conditions and contaminant concentrations
- Automatic pH adjustment to optimize removal efficiency
- Pilot validation available and recommended
- Achieve permit compliance consistently
- Treated water can be safely discharged with no toxicity impact

AMRS Column



FERROLOCK™ MEDIA

Envirogen's FerroLock™ ZVI media reacts with the contaminants, effectively neutralizing and adsorbing them, without generating toxic byproducts.

Envirogen does not believe there is a "one size fits all" approach to ZVI treatment. Waters containing high concentrations of certain salts can quickly dissolve the iron from some ZVIs.

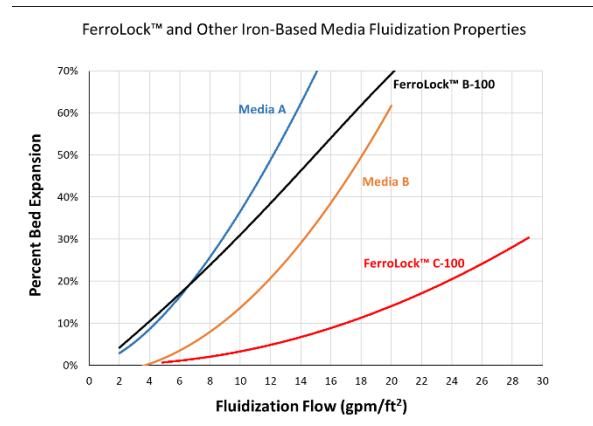
Sulfate affects some ZVI formulations more than others. It is therefore important to balance longevity and performance when choosing the optimal ZVI for a given application.

With Envirogen's approach, the characteristics of each wastewater will dictate the best FerroLock™ ZVI to use from an overall performance, longevity, and life cycle cost standpoint. The ability of Envirogen's AMRS to utilize different ZVIs that range in size, reactivity and cost is a unique benefit for you to consider.



FerroLock™ Media Characteristics:

- High surface area
- Mechanisms employed are adsorption and chemical reduction
- Insoluble metals and iron-metal complexes remain on the media
- Insoluble metals are not released
- More effective on some metals than other chemical reduction processes with no chemicals to handle



APPLICATIONS

Envirogen's Advanced Metals Removal System (AMRS) can be employed for water treatment applications with very low effluent limits for difficult-to-remove metals such as selenium, chromium, arsenic and more. It is employed primarily for groundwater and wastewater remediation.

Envirogen Engineers will assess your particular application and contaminant mixture and specify the best FerroLock™ ZVI formulation for your water treatment needs.

Pilot and/or lab scale testing will be employed to determine:

- Performance vs. contact time (full-scale system size)
- Media regeneration frequency
- Iron solubilization rate and post-treatment requirements

EXPERIENCE

Pilot testing has shown that an Envirogen designed multi-step system can accomplish broad spectrum metals removal, with ZVI polishing steps to remove the more difficult contaminants such as the selenate form of selenium.

Envirogen Mobile Pilot Trailer



The Table below illustrates how Envirogen applied our water treatment expertise to address a complex mixture of contaminants for one power plant client with contaminated ash pond water.

| Average Concentrations for Duration of Pilot | | | | | | | |
|--|--------------|--------------|--------------|-------------|------------|------------|------------|
| Concentrations (µg/L) | SP-1 | SP-2 | SP-3 | SP-4 | SP-5 | SP-6 | SP-7 |
| Aluminum | 387.5 | 68.3 | 19.1 | 25.1 | 55.6 | 9.2 | 13.8 |
| Antimony | 9.5 | 4.1 | 2.8 | 1.3 | 1.3 | 0.8 | 0.8 |
| Arsenic (Spiked) | 992.7 | 218.3 | 19.8 | 1.8 | 0.8 | 0.4 | 0.4 |
| Barium | 229.2 | 197.5 | 207.5 | 180.9 | 196.3 | 191.5 | 114.5 |
| Cadmium | 0.2 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| Chromium | 2.8 | 2.1 | 1.3 | 2.0 | 7.7 | 0.5 | 0.8 |
| Copper | 2.5 | 1.6 | 4.8 | 13.5 | 37.3 | 1.5 | 2.1 |
| Lead | 0.7 | 0.3 | 0.2 | 0.1 | 0.1 | 0.1 | 0.8 |
| Molybdenum | 106.3 | 58.2 | 41.9 | 20.5 | 16.5 | 7.5 | 2.3 |
| Nickel | 10.9 | 9.6 | 9.5 | 7.7 | 17.9 | 1.6 | 2.6 |
| Selenium (Spiked) | 227.8 | 217.6 | 109.6 | 42.4 | 2.1 | 0.7 | 0.6 |
| Silver | 0.8 | 0.8 | 0.8 | 1.0 | 0.8 | 0.8 | 0.8 |
| Thallium | 1.1 | 0.9 | 0.9 | 1.0 | 0.8 | 0.8 | 0.8 |
| Vanadium | 33.9 | 4.0 | 0.8 | 1.2 | 2.4 | 0.7 | 0.7 |
| Zinc | 16.2 | 8.9 | 11.3 | 6.0 | 5.7 | 5.2 | 6.7 |
| Iron, mg/L | 0.5 | 1.7 | 6.6 | 11.3 | 22.7 | 4.5 | 0.1 |
| Chloride, mg/L | 175.1 | 216.6 | No Data | No Data | No Data | No Data | 217.2 |
| TSS, mg/L | 5.9 | 5.5 | No Data | No Data | No Data | No Data | 0.8 |

Table Key:

- | | | | |
|------|---------------------------------|------|---------------------------------|
| SP-1 | System Influent | SP-5 | ZVI Polishing Column 2 Effluent |
| SP-2 | Clarifier Effluent | SP-6 | 0.45 Micron Filter Effluent |
| SP-3 | 0.45 Micron Filter Effluent | SP-7 | Final System Effluent |
| SP-4 | ZVI Polishing Column 1 Effluent | | |

[Contact Us to Discuss Further!](#)



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