LIVINGWATERS™
ENGINEERED WATER TREATMENT SOLUTIONS

The AdVantEdge™ Medallion Series from Adedge Technologies

Packaged Residential Arsenic Adsorption Systems

Adedge's new POE *Medallion Series™* treatment systems offer a new level of quality and convenience. These packaged residential and light commercial systems, specifically designed for arsenic and other heavy metal treatment are the culmination of years of experience. The systems can utilize one of several AdEdge adsorption medias, for reliable, simple, and cost-effective treatment. No other technology can compare to its simplicity and ease of use. The media can operate over a wide range of water quality and utilize no regeneration chemicals, salt or additives. Only periodic backwashing is required. The spent media, upon exhaustion, is easily disposed as non-hazardous waste.

Some Features and Benefits include:

- *Complete pre-packaged, pre-designed modular system for ease of use*
- *High performance adsorption media for arsenic and heavy metals*
- *Reduces Up to 99% reduction of Arsenic (V) and (III) without chemicals*
- *other heavy metals such as lead, zinc, chrome, copper*
- *Automatic controls with LCD display / readout*
- *Proven, reliable treatment without hassle of chemicals or brine*
- *Long product life for economical performance*

Adedge offers three sizes of systems to accommodate home, light commercial and low flow remediation applications, The POE-5-1252, POE-7-1354, and the POE-10-1465 are sized for 5-gpm, 7-gpm, and 10-gpm flows respectively. The following table highlights the basic system specifications.

Model Specifications

Specifications	Model # POE-5-1252	Model # POE-7-1354	Model # POE-10-1465
Dimensions	12"W x 52"H, fiberglass	13"W x 54"H, fiberglass	14"W x 65"H, fiberglass
Quantity of AdEdge Media	2 cubic feet	3 cubic feet	4 cubic feet
Media Type	AD33, or other AdEdge AD series Media	AD33, or other AdEdge AD series Media	AD33, or other AdEdge AD series Media
Normal service flow	4-6 gpm	6-8 gpm	8-10 gpm
Peak flow Rate	6 gpm	8 gpm	10 gpm
Backwash max flow	5 gpm	7 gpm	10 gpm
Backwash cycles	Automatic preprogrammed	Automatic, preprogrammed	Automatic, preprogrammed
Inlet / Outlet	1" dia MPT PVC	1" dia MPT PVC	1" dia MPT PVC
Drain	1/2" connection	1/2" connection	1/2" connection
Underbed material	Gravel / stone	Gravel / stone	Gravel / stone
Shipping weight unit	60 lbs	75 lbs	90 lbs
Temperature Range	33 °F – 100 °F	33 °F – 100 °F	33 °F – 100 °F

Recommended Water Quality

Q: What is the recommended incoming water quality for best performance?

Parameter	All Models
Arsenic and heavy metal concentration Range	5 – 500 ppb [1, 2]
Typical treatment goal	< 10 ppb total arsenic [3]
Arsenic types reduced	As (V) and As (III)
Removal efficiency	90-99% typical
Estimated media life	water quality and usage dependent [4]
Spent media disposal	Non-hazardous waste landfill [5]
Recommended incoming water quality for best results:	pH range: 5.5 – 8.5 Arsenic: 5 - 100 ppb Iron: < 0.5 mg/L Manganese: < 0.05 mg/L Sulfides: < 0.1 mg/L Silica: < 30 mg/L Phosphate: < 0.5 mg/L Sulfate: < 100 mg/L Fluoride: < 1.0 mg/L Hardness: < 300 mg/L Sediment: use pre-filter Tannins: consult Adedge
Use with water conditioner unit:	Not required, but if utilized, place softener unit prior to AdEdge adsorption system

Notes:
1. Above table is guideline only; AdEdge dealer responsible for completing site specific profile for prescribing appropriate system with AdEdge technical support
2. Systems can reduce higher arsenic concentrations; consult AdEdge for details
3. Treatment goal reflects current EPA MCL of 10 ppb arsenic
4. Media life projections can be provided by AdEdge upon review of water profile and projected use information.
5. Spent media passes EPA Toxic Characteristic Leaching Procedure

Q: What are some of the valve / microprocessor features?

- Built-in flow controls
- Flow totalizer for tracking gallons treated for media changeout
- Built-in sample ports
- LCD readout
- Variable sequencing backwashing capability

Q: Does the system reduce other contaminants in addition to arsenic?

A: Yes. Heavy metals such as lead, copper, zinc, selenium, antimony, chromium, and others are reduced with the AD33 technology

Q: How does the technology compare to other treatment alternatives?

Comparison of Point of Entry Treatment Alternatives

Feature	Anion Exchange	Reverse Osmosis	Medallion Series AD33 Adsorption System
Type of arsenic treated	As (V)	As (V)	As (V) and (III)
Pre-oxidation step required for Arsenic removal	Yes	Yes	No
Chemical Use	Yes, Salt	Membrane cleaning	None
Loss (waste) of water	5%	25-75%	< 1%
Frequency of Regeneration	Approx. every 2000-4,000 gallons	Not Applicable	Non regenerable; disposable media
Hazardous waste generation	Yes	Concentrated arsenic reject	None
Off-taste potential	Yes	No	No
Maintenance	High	High	Low
Arsenic "dumping" when capacity of media reached	Possible	N/A	No
Changes in water chemistry	Lowers pH	Removes TDS	Negligible
Relative cost	Moderate	High	Moderate

Technology Overview

Bayoxide® E-33 Adsorption Media

The Adedge Technologies treatment approach for arsenic utilizes Bayoxide® E33 adsorption media. This media is packaged into Adedge integrated systems for arsenic treatment, which is a proven adsorption process designed specifically for drinking water applications. It was developed in the United Kingdom and has been proven successful in lowering arsenic levels to less than 3 ppb (µg/L) using a unique and proprietary adsorbent media that has a high, selective capacity for arsenic (As) removal from drinking water. Over a half million people around the world are currently using this technology to remove arsenic, and by the end of this year that number will surpass 1 million people and possibly as many as 2 million. The technology is currently installed in approximately a dozen municipal water systems, several hundred POE and POU applications and numerous industrial wastewater clean up sites.

This arsenic removal process for small systems employs a fixed bed adsorption system using the AD-33 granular ferric oxide media (adsorbent) for the adsorption of dissolved arsenic onto the ferric oxide. Groundwater or surface water is simply pumped in a down-flow mode through a single or multiple fixed bed vessel(s) containing the media where the arsenic removal occurs.

With the media, both As (III) and As (V) oxyanions are removed from water via a combination of adsorption, occlusion (adhesion) or solid solution formation by reaction with ferric oxide ions. This is rather unique feature since many conventional processes poorly adsorb As (III) and require pre-oxidation before effective arsenic reduction is achieved. Above pH 7, the primary mechanism is adsorption of the oxyanions to the surface hydroxyl groups of ferric oxide or hydroxide as indicated below:

$$(HO)_2Fe\ O\cdots H\cdots O_4AsH_n^{-(3-n)}$$

Adsorption is a continuous process conducted at a specific flow rate or velocity downward through a fixed bed adsorber. In addition to velocity, the other key process parameter is empty bed contact time (EBCT), which dictates the amount of water residence within the bed required to effect complete arsenic adsorption.

Unlike other adsorbents, AD-33 will adsorb both As (V) and As (III). The arsenite form is nonionic at normal water pHs and, therefore, will not be as quickly adsorbed as an anion. Adsorption kinetics for As (III) are slower than that of As (V).

Once every 3-4 weeks or another frequency dictated by specific applications, the adsorber is taken off-line for a very brief period of time for backwashing to remove media fines that have built up and to "fluff up" or reclassify the compacted bed. This intermittent step will also minimize ΔP through the bed. The residual consists of approximately 10 bed volumes of backwash water containing only innocuous iron oxide fines. Based on site specific backwash water data, *no soluble arsenic is discharged as a result of this process step*. Aside from backwashing, there are no other steps required until the end of the adsorbent's capacity when it becomes exhausted.

For small system applications, media life typically ranges from 6 months to two years, depending upon:

- The influent water's arsenic concentration
- The water's pH
- Concentrations of other ions in the water that could shorten the media's arsenic adsorption capacity

What about Interferents?

It has been reported that the iron oxide media will also adsorb other ions that may be present in the water. Adsorption tests on AD-33 have shown that it will adsorb antimony, cadmium, chromate, lead, molybdenum, selenium, vanadium, and zinc, most of which are considered water contaminants and must be removed to meet EPA drinking water standards. Many of these parameters would not be considered interferents, but rather ions that are also adsorbed to some extent on the media. All media have interferents or competing ions that compete with arsenic for adsorption sites. However, the AD-33 Systems will adsorb arsenic in preference to these other ions. Most of these tend to be found in very low concentrations in natural waters and appear in many cases to be negligible. Under high pH conditions, high levels of phosphate (PO_4 of greater than 1.0 mg/L) and silica (SiO_2 of greater than 40 mg/L) can present interference and reduce the media's adsorption capacity for arsenic.

pH Effects

Metal oxides act as anion exchangers up to a certain pH level (their respective zero point of charge), where the oxide no longer has a high capacity to act as an anion exchanger). They will adsorb arsenic and other interferents more effectively at lower pHs within the 6.0 to 9.0 range and less effectively at the upper end of this range, since the media maintains more positive charge at the relatively lower pH range.

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About Arsenic

Health Effects of Arsenic

Throughout history, arsenic has been used as a poison. One of the earliest documented cases of arsenic poisoning was Nero's poisoning of Brittannicus to secure the Roman throne in 55 A.D. French scientists believe that French and British conspirators poisoned Napoleon with arsenic. In the winter of 1609-1610, more than 90 percent of the Jamestown colony perished. Many scientists believe the deaths were the result of arsenic poisoning at the hands of the Spanish government intent on getting rid of the English colony.

Today, arsenic continues to poison millions of Americans. The element occurs naturally in the soil and enters the water supply throughout the U.S., especially in the west, mid-west and New England. After more than 20 years of debate, a new arsenic standard was signed into law in late 2001, reducing the allowable level for the contaminant in drinking water by more than 80%. The law impacts 4,100 public water systems that serve 13 million people. An additional 40 million Americans obtain their water from private wells, which are not protected by the new standard and may have high levels of arsenic. Even at the new level of 10 parts per billion (ppb), three in 1,000 people exposed will die from cancer. For the past two decades, the EPA's maximum acceptable level of risk for all other drinking water contaminants has been one in 10,000.

Potential short-term health effects associated with arsenic exposure include:

Stomach pain	Difficulty Swallowing
Vomiting	Low blood pressure
Skin lesions	Convulsions
Pigmentation	Gastrointestinal problems

Potential long-term health effects associated with arsenic exposure include:

Bladder cancer	Gangrene	Immunological disorders
Skin cancer	Limb loss	Endocrine disorders
Kidney cancer	Keratosis	Hematological disorders
Liver cancer	Neurological effects	Reproductive problems
Prostate cancer	Cardiovascular disease	Developmental problems
Lung cancer	Pulmonary disease	

References

The EPA's Office of Research and Development may have also discovered a link to DNA damage caused by arsenic compounds. The research shows arsenic inducing a reaction between itself and DNA, causing certain genetic alterations in the DNA that result in breakage.

The following links are references to some current research projects on the health effects of arsenic:
www.epa.gov/safewater/arsenic.html http://socrates.berkeley.edu/~asrg/

The following references are papers presented on the health effects of arsenic exposure that can be accessed at a library:

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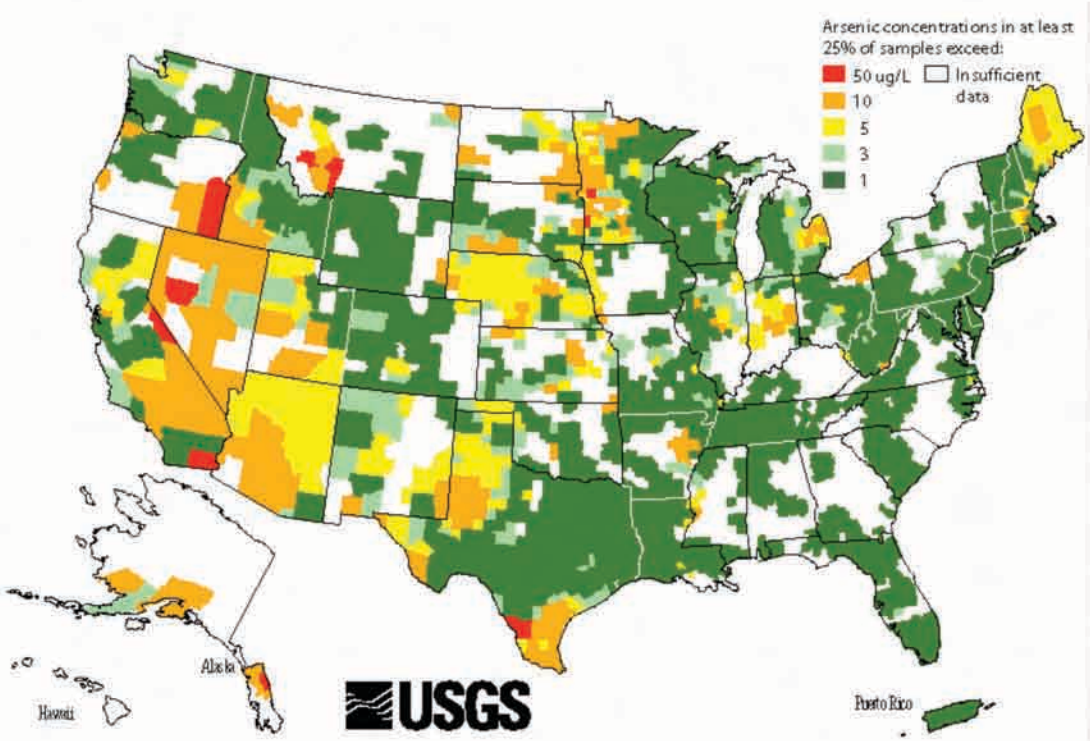
About Arsenic

Arsenic Occurrence in the United States

The United States Geological Survey has compiled the following map of arsenic in drinking water in the United States.



The History of Arsenic Regulation

Arsenic Legislatve Timeline

Date	Action
1942	The drinking water standard was set at 50 parts per billion (ppb) by the U.S Public Health Service.
1975	This standard was adopted by the U.S Environmental Protection Agency (EPA) as a result of the passage of the Safe Drinking Water Act.
1989	COntroversy around health effects studies caused postponement of final rule until November, 1992
November 1992	The EPA, citing the need to further to evaluate health effects, postponed the final rule until September 1994
September 1994	Due to a delay in the EPA studies, the final rule was postponed until November 1995.
November 1995	Due to Congressional concerns, including cost of implementing a solution, the final rule was postponed until January 2000,
June 2000	New rule proposal isued with final rule date of Jun22, 2001
January 2001	The EPA posted a final rule in the Federal Register, five months ahead of schedule, lowering the standard from 50 to 10 ppb. The EPA also established a health-based, non-enforceable Maximum Contaminant Level Goal (MCLG) for arsenic of 0 ppb.