

ECOWATER SYSTEMS ARSENIC REDUCING FILTERS

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For Residential and Commercial Arsenic Remediation

# Arsenic Remediation Application Guide

ECOWATER SYSTEMS, LLC

# Arsenic Reducing Filter Application Guide

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This guide provides general information on the use of EcoWater equipment and filter media for arsenic remediation. Equipment and media performance will vary depending on the condition and quality of the water supply. A thorough analysis of water supply and water usage is required to properly specify a water treatment solution. This equipment is intended for use on a microbiologically safe water supply.

Arsenic ingestion is a health risk. Be sure you have a complete understanding of equipment and media performance before providing equipment, installation, and/or service for arsenic remediation. EcoWater offers training for dealers interested in learning more.

MetSorb™ HMRG meets NSF 61 and is approved for use in drinking water systems. The equipment and media described in this guide have not been performance tested by NSF for arsenic reduction and are not for sale in California to reduce arsenic.

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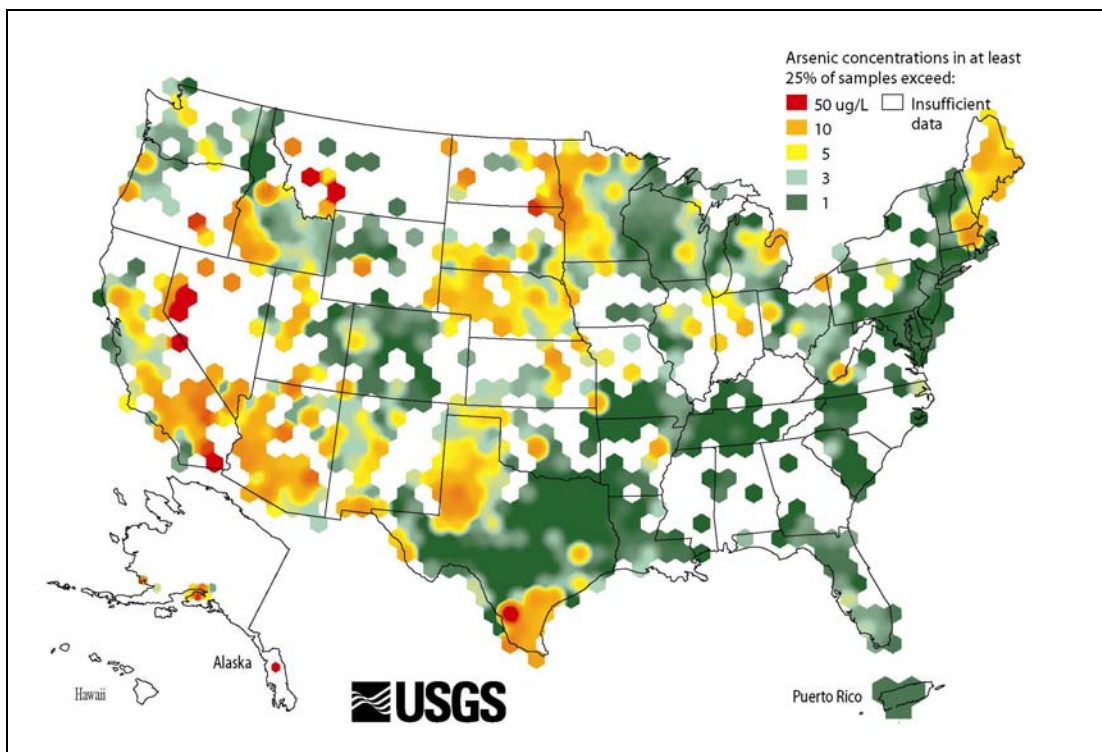
# About Arsenic

*Arsenic is a naturally occurring metal. Arsenic is dissolved into ground water as it percolates through earth that contains arsenic.*

Like other minerals, arsenic is in the earth. Also like other minerals, deposits are usually found in pockets. Some regions of the United States are more prone to have arsenic in ground water. The northeast, midwest, southwest and northwest regions contain large areas with high arsenic levels. Concentrations vary within these regions. Some wells will be arsenic free and wells outside these regions can hit arsenic.

The EPA has set the maximum limit for arsenic in drinking water at 10 ppb (parts per billion). This was reduced from 50 ppb in January 2006 due to concerns that long-term exposure at that level may have negative health impacts. Most large municipal supplies meet the new, lower limit. Smaller scale water providers have lagged behind, and existing private wells are generally not monitored. Digging a new well or selling a property often necessitate arsenic testing and, if required, remediation.

Arsenic levels at a well can vary with time. Ground water flow patterns are affected by many factors including precipitation, temperature, and water usage. Variation in flow patterns can affect how much arsenic the water dissolves as it flows through the earth. Arsenic levels can vary significantly, sometimes changing by as much as 100 ppb or more within a few weeks.



# Arsenic Adsorbing Media

*Media used in EcoWater arsenic reducing filters permanently adsorbs arsenic*

EcoWater uses MetSorb™ HMRG media from HydroGlobe. The active ingredient in this media is titanium dioxide. Arsenic binds to the surface of the titanium particles (adsorption). Titanium dioxide is a white powder. Since powder is not suited for use in a filter bed, it is processed with a binding agent to form grains (agglomeration). Arsenic levels are reduced as water flows through the media bed.

MetSorb™ HMRG is not regenerable. It has a large, but finite capacity to adsorb arsenic and eventually needs to be replaced. The life of the media bed depends on several factors including arsenic level, water usage, and water chemistry. This media tolerates chlorine at levels typically used for sanitization.

Similar to other metal oxide media, MetSorb™ reduces arsenic by permanently adsorbing it. Adsorption efficiently reduces arsenic in a wide variety of water conditions. Since the arsenic is permanently adsorbed, spent media is landfill safe. To verify safe disposal, spent media has passed TCLP (Toxicity Characteristic Leaching Procedure) testing. Check local disposal codes to see if there are any special requirements.

MetSorb™ HMRG meets NSF 61 requirements for use in drinking water applications.

## Adsorption Process Description

Arsenic adsorption is the process of arsenic ions bonding to the surface of the media particles. Arsenic is adsorbed on the media when dissolved arsenic ions come close to the surface of a media particle. Dissolved arsenic ions are mixed throughout the water, so arsenic reduction is not instant. It takes time for the ions to come in close contact with the surface of a media particle. The longer the water is in contact with the media, the more opportunity there is for arsenic to be adsorbed by the media.

In an application, this time is expressed as Empty Bed Contact Time (EBCT). It is defined by the amount of time it would take water to flow through the media bed if the tank were empty. Higher flow rates result in lower contact time. A larger media bed results in higher contact time.

A minimum EBCT of 90 seconds is recommended for efficient arsenic reduction. This equates to a maximum flow rate of 5 GPM/ 1 ft<sup>3</sup> of media. Rated system flow may be lower if pressure drop across the system would exceed 15 psi. Excessive pressure drop across the media bed can damage the media resulting in the generation of fines and the loss of media in backwash and/or supply water.

\* Landfill disposal requires TCLP testing to verify that arsenic is retained. The media used by EcoWater has passed this test. TCLP results are available upon request. Local landfill requirements may vary and require additional testing.

# Sales Planning

## Finding Leads

Existing home sales

Well drillers

New home construction

Commercial

Water Testing Lab

Water Quality/Health Agencies (local, state, federal)

## Water Testing

Kits for on-site arsenic testing are available for less than \$1 and may be a valuable tool for a sales demo. They take about 20 minutes and are suitable for simple detection of arsenic. Design of an appropriate arsenic remediation system requires more in depth water analysis such as:

- Total arsenic - accurate within  $\pm 2.0$  ppb (typically lab tested)
- Arsenic III – accurate within  $\pm 2.0$  ppb (typically lab tested)
- pH – accurate to  $\pm 0.05$  (\$100-200 for a good meter)
- Silica – accurate within  $\pm 5.0$  ppm (typically lab tested)
- Sulfate – accurate within  $\pm 5.0$  ppm (typically lab tested)
- Nitrate – accurate within  $\pm 1.0$  ppm
- Manganese – accurate within  $\pm 0.05$  ppm
- Iron content – accurate within  $\pm 0.25$  ppm
- Hardness – accurate within  $\pm 2$  grains
- Hydrogen Sulfide – accurate within  $\pm 0.5$  ppm

## Company Background – EcoWater Systems, LLC

- 80-year history of water treatment
- All products made in USA
- Local service, national brand
- R&D laboratory in Minnesota
- Residential and commercial remediation
- Commercial grade products
- Experience treating problem water

## Equipment Features

- No regenerant chemicals
- Arsenic levels are reduced in backwash water; wastewater is septic safe
- Flow restrictor to prevent equipment/media damage due to over run
- Flow totalizer to track water usage and calculate remaining capacity
- MetSorb™ media meets NSF 61 for use in drinking water applications
- Spent media can be disposed of in landfill (passes TCLP)

## Program Features

- Water chemistry analysis to verify proper remediation system design
- Performance monitoring (water testing, etc.) to verify system performance
- Complete solution to ensure the best water quality
- Ongoing service may be well suited to monthly billing
- Media life is difficult to accurately predict without service history and may best be billed separately

# Equipment Sizing and Specification

*Several factors must be considered when specifying equipment for arsenic remediation.*

1. Understand local codes. Is lead-lag required? Certification requirements? Water testing or performance verification requirements? Media disposal requirements? Contact your state department of health for this information.
2. Get the water usage information. What are the average daily water usage and maximum flow rates?
3. Perform on site water testing to get basic information on water treatment needs. (pH, hardness, iron, arsenic detection)
4. Get install site information. Is there a drain sufficient for backwash water? How much space is available? Is AC power available? What other equipment is in line (pumps, storage tanks, softeners, etc.)?
5. Get the water supply tested to determine all treatment needs. Quoting a job without this information may result in a system that doesn't get the job done. Contact a state certified laboratory for testing information and water sampling procedure. Measure the following:
  - a. Levels of arsenic III and arsenic V
  - b. Silica
  - c. Manganese
  - d. pH (may be tested on site with accurate meter)
  - e. Dissolved iron (may be tested on site with accurate equipment)

6. Specify arsenic remediation system, including pretreatment if required.

Excessive service flow rates will reduce bed life and can damage the media bed. Maximum service flow must be restricted to rated flow for the equipment.

### **Arsenic Filter Specifications**

Media	Tank	Backwash	Fast Rinse	Quartz	Sand
1 ft <sup>3</sup>	10" x 47"	3.0 GPM	3.0 GPM	17 lb	10 lb
2 ft <sup>3</sup>	12" x 54"	4.0 GPM	4.0 GPM	29 lb	20 lb
3 ft <sup>3</sup>	17" x 58"	7.0 GPM	7.0 GPM	50 lb *	50 lb
4 ft <sup>3</sup>	17" x 58"	7.0 GPM	7.0 GPM	50 lb *	50 lb
6 ft <sup>3</sup>	24" x 72"	12.0 GPM	12.0 GPM	100 lb **	100 lb
8 ft <sup>3</sup>	24" x 72"	12.0 GPM	12.0 GPM	100 lb **	100 lb
10 ft <sup>3</sup>	24" x 72"	12.0 GPM	12.0 GPM	100 lb **	100 lb

### **Equipment Sizing Guidelines**

Media	Tank	Valve	Service Flow	Daily Water	Contact Time
1 ft <sup>3</sup>	10" x 47"	1" dual	5 GPM	500 GPD	90 sec
2 ft <sup>3</sup>	12" x 54"	1" dual	8 GPM	1000 GPD	112 sec
3 ft <sup>3</sup>	17" x 58"	1" dual	15 GPM	1500 GPD	90 sec
4 ft <sup>3</sup>	17" x 58"	1" dual	15 GPM	2000 GPD	120 sec
6 ft <sup>3</sup>	24" x 72"	2" dual	30 GPM	3000 GPD	90 sec
8 ft <sup>3</sup>	24" x 72"	2" dual	30 GPM	4000 GPD	120 sec
10 ft <sup>3</sup>	24" x 72"	2" dual	30 GPM	5000 GPD	150 sec

\* 17" tank also requires 100 lb of gravel,

\*\* 24" tank also requires 150 lb of gravel

Note: Temperature variations can affect backwash operation. In general, colder water requires lower flow rates and warmer water requires higher flow rates.

7. Specify arsenic remediation equipment – Systems include electronic flow totalizer. Mechanical flow totalizers are required in some cases.
- a. Residential – ETF2100 AS10 & AS12  
Complete units available for purchase, flow restrictor is included
  - b. Commercial – size equipment as required, underbed with quartz and filter sand  
Flow restrictor appropriate to system size is required

# Affects of Water Chemistry

*Arsenic reduction and media life are affected by water chemistry.*

- Arsenic III vs. Arsenic V
  - Arsenic III is more difficult to adsorb than arsenic V
  - Arsenic III is more toxic than arsenic V
  - A higher ratio of arsenic III to arsenic V will reduce media life
  - Oxidizing agents can transform arsenic III to arsenic V
  - Reverse osmosis filtration will reduce arsenic V but not arsenic III
  - Samples to be analyzed for arsenic speciation (III vs. V) require special handling as Arsenic III will gradually oxidize to arsenic V when water is exposed to air.
- Iron
  - Clear iron can reduce arsenic capacity if it oxidizes and fouls the media bed.
  - Clear iron below 0.3ppm is typically not a concern. Clear iron up to 5 ppm is reduced by a water softener, depending on water chemistry.
  - Particulate red iron can foul the media bed.
  - Clear iron will gradually oxidize to red iron when water is exposed to air
  - Arsenic has an affinity to red iron and, if present, will concentrate in red iron particulate. Oxidizing iron filters can reduce arsenic by 50-75%. Backwash water in this type of system will contain concentrated arsenic, which may be considered hazardous waste.
- Manganese
  - Manganese can reduce arsenic capacity if present above 0.05ppm as it can oxidize and foul the media bed.
  - Manganese up to 0.5 ppm is reduced by a softener, depending on water chemistry.
- pH
  - Lower pH water (more acidic) is more favorable to arsenic reduction

- Water pH above 7.5 will significantly reduce media life
- Water pH above 8.0 may require pH adjustment to 7.0 or less for effective arsenic reduction
- Silica
  - Silica interferes with arsenic adsorption and can reduce media life
  - Silica is difficult to treat and is usually left untreated
- Phosphates
  - Phosphates severely inhibit arsenic reduction based on iron
  - Phosphate typically does not affect MetSorb™ HMRG, depending on water chemistry. However, it may significantly reduce the effectivity of pretreatment.
  - Phosphates are extremely difficult to treat
- Hardness
  - For best results, arsenic remediation equipment should be fed soft water

# Installation

Arsenic remediation is critical to water consumers. There are potential health risks if the equipment does not function properly. It is important that all stages of remediation are thoroughly documented. Keep a file for each arsenic remediation site. In it, keep records including initial water test results, plumbing diagrams, water usage history, ongoing water test results, EASE reports, and service history. Having these records for review will allow you to provide efficient, quality service when visiting a job site.

- When filling a new media bed with water, fill the tank slowly (less than 1 GPM) in the fast rinse cycle. This will fill the bed from the top down and promote better purging of air.
- Treated water from a new media bed may be cloudy with air bubbles for the first few days.
- Arsenic remediation systems should always be fed with zero soft water. Include a water softener (conditioner) in front of the arsenic-reducing filter if necessary.
- If other water treatment equipment is being installed, the arsenic-reducing filter should be the last in line. This will maximize arsenic reduction and media life.
- A flow restrictor is included with pre-assembled arsenic reducing filters. It is required to prevent system flow rate overrun. Exceeding the maximum flow rate can damage the media and result in the shedding of media fines in the product and/or backwash water. Loss of fines will cause cloudy water and erode the bed. Resulting media loss can significantly reduce system performance.
- Ongoing service will require periodic collection of water samples before and after the arsenic reducing filter(s). To simplify sample collection, plumb a water sampling port at the inlet to each arsenic-reducing filter.
- The media bed in an arsenic-reducing filter will eventually need to be replaced. Install a bypass for each filter to simplify media replacement.

Once installed, the arsenic-reducing filter should be backwashed 2-3 times (until the fast rinse water runs clear) to rinse out any fines.

# Service

*Arsenic remediation requires ongoing service to ensure proper operation of equipment.*

## Water Testing Schedule

Initial water quality analysis – full characterization of feed water

Post-installation – total arsenic inlet and outlet

One month check-up – total arsenic inlet and outlet

Scheduled water testing, typically every 6-12 months – total arsenic inlet and outlet

## Service Procedure

Check total flow and maximum flow rate

Document water usage and condition of equipment

Ask customer for feedback

Send EASE report

Collect water samples

## How to collect water samples

Talk to testing lab to identify sampling procedure

Use new, clean containers or containers provided by lab

Run water at 50% rated flow minimum for sufficient time to purge line

Collect inlet and outlet water samples

Collect at least 500ml of water per sample, or as instructed by testing lab

## Water Testing

Use state approved laboratory

On site tests should only be used to identify presence of arsenic. System design and performance monitoring require laboratory analysis of water.

Test water as soon as possible after collection

Test for total arsenic

Significant changes in inlet water arsenic levels require in-depth water testing to be repeated. Arsenic levels at a well can change by 100ppb or more within a matter of weeks.

## Media replacement

As media capacity nears exhaustion, arsenic bypass will gradually increase

If arsenic above 5 ppb is detected in the product water, test more frequently (monthly) until media replacement is required. Also discuss media replacement plan with customer.

Remove media, sand, and gravel from tank and dispose of. Replace with new gravel, sand, and media. It may be easiest to replace tank on site and rebed in shop.

Load new media into system. Be sure no media goes in riser tube. New media is dusty, so a filter mask is recommended.

When filling a new media bed with water, first add water slowly (about 1 GPM) in the fast rinse cycle for about 3 minutes. This will fill the bed from the top down and saturate the media bed with water. Next, put the unit in bypass to keep the air in the tank from being pressurized. Cycle the valve to backwash and put the bypass back in service position. Backwash the bed to remove air and media fines. Run backwash until the drain water runs clear. This could take up to 60 minutes. The final step is to fast rinse for 5 minutes. The unit is then ready for service.

## Media disposal

Spent media can be disposed of as regular waste.

Spent media has passed TCLP testing.

Check local codes for any special requirements.

# Glossary of Terms

MCL – Maximum Contaminant Level, maximum level of contaminant allowed in drinking water

ppm – parts per million

ppb – parts per billion

µg/liter – parts per billion

mg/liter – parts per million

POE – point of entry, whole home water treatment

POU – point of use, drinking water treatment

TCLP – Toxic Characteristic Leaching Protocol, a test to determine if landfill disposal will contain or release contaminants

NSF53 – Testing standard for removal of particular compounds from drinking water

NSF61 – Protocol to verify that materials are safe for use in drinking water systems and do not release unsafe chemicals into the water supply

Friability – a measure of how easily a particle can be crumbled into powder

Speciation – determining the levels of arsenic III and arsenic V in the total arsenic concentration

Agglomeration – gathering small particles or powder to form a larger particle

Oxidation – increasing the positive charge of ions by taking away electrons

Bed volume – the amount of space taken up by the media bed

Hydraulic loading – the pressure developed across the media bed under flow

Coagulation – grouping dissolved molecules together to form solid particles

Flocculation – grouping together fine particles or solutes into a solid form that can be easily filtered

Solute – a substance (arsenic) dissolved into another substance (water)