United States
Environmental Protection
Agency

Evaluating Arsenic Treatment Providers

An iron-based adsorptive media arsenic removal system in Rimrock, Arizona.

A Guide for Public Water Systems

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Pressure filter tanks for an arsenic removal system.

Introduction

On January 22, 2001 EPA revised the arsenic standard to 10 parts per billion (ppb). All public water systems must comply with this 10 ppb maximum contaminant level (MCL) by January 23, 2006. Some systems will have to install treatment for arsenic removal in order to meet the revised MCL. For more compliance information, please visit http://www.epa.gov/safewater/arsenic.

There are a number of technologies to choose from, and numerous engineering firms and treatment vendors who can help you with treatment selection, installation, and operation. Choosing the right technology and firm for your system can be a confusing and time-consuming process. The information in this brochure will help you navigate through the process of selecting the most appropriate treatment for your system
This guide will provide you with:

- An overview on the long-term, chronic health effects linked to drinking water that contains arsenic.
- Basic information on available treatment technologies for arsenic removal.
- Important questions to ask engineering firms and vendors when looking for the best treatment for your system and the best firm to design and install the technology.
- Information on estimating treatment installation and operation costs and sources of additional information on arsenic and arsenic removal.

By working through the handouts in this brochure and by reading the questions and answers, you will be able to more confidently choose an engineer or a vendor that you trust to help you make the best choices for your system.

Health Effects & Risk Communication

The revised arsenic standard will protect consumers against these effects of long-term, chronic exposure to arsenic in drinking water. Long-term exposure to arsenic has been linked to bladder, lung, skin, kidney, nasal passage, liver, and kidney cancer. Ingesting arsenic through drinking water may also cause cardiovascular, pulmonary, immunological, neurological, and endocrine problems (e.g., diabetes). Short-term exposure to high doses (greater than 50 parts per billion) of arsenic can have other negative health effects.

If you will be making a significant investment in treatment or non-treatment options to remove arsenic from your drinking water, it is important that you inform your customers of why you are making this investment and how it will benefit them now and in the future.

Information for Vendors & Engineers

To navigate through the increasingly complex and confusing arena of options available for you to remove arsenic from your drinking water, you will have to work with an engineer or an equipment vendor. Before you initiate contact, you will need to gather basic information on each water source that needs to be treated. Fill out the handout on the following page. Systems with multiple sources should photocopy the form and fill it out for each water source.

For information on current treatment capacity, review historical records to determine your average and maximum flow rates. If you are using wells, it is important to know the flow throughout the pumping cycle as it will change with differing system pressures. If records are not available, conduct flow monitoring prior to entering into any agreement with a vendor or obligating the water system to any specific treatment technology.

Fill out the handout on the following page and have it on hand for engineers and vendors who you could potentially work with.

You will also need information on the treatment currently in place at your system. If you are already chlorinating the water, you could be converting the arsenic to a treatable form (i.e., to arsenate). If you are conducting iron or manganese removal, you may already be removing arsenic and it may be possible to optimize your system (rather than installing new treatment) to remove enough arsenic to meet the revised MCL.

Water System Information Summary Form

Contact Information			
Utility Name		Phone Number	
Site Location		E-mail	
Operator Name		Address	
Main Contact			
Other Key Information			

Site Location Parameters	
System Type (e.g., municipal, school, etc.)	
Population Served	
Service Connections	
Design Flow[1] (max.. design flow rate, in GPM)	
Average Flow (typical demand, in GPM)	
Average Gallons Per Day	
Estimated Usage (gallons per year)	

Disinfection, Storage, and Discharge	
Describe Existing Pretreatment	
Describe Existing Disinfection	
Disinfection Injection Point	
Pump Operation and Pressure (in psi)	
Electrical Power Available?	
Storage Tank Size, Type (i.e., gravity, hydropneumatic), and Location	
Discharge Options (e.g., sanitary sewer, evaporation pond, etc.)	

[1] The treatment plant will have to be able to produce enough water to meet the system's maximum daily demand (i.e., the maximum amount of water used by the system over a 24-hour period).

Water System Information Summary Form (continued)

Source Water Parameters (enter all known averages)			
pH		Antimony	mg/L
Total Arsenic	mg/L	Chromium	mg/L
As(III)	mg/L	Lead	mg/L
Sulfides	mg/L	Molybdenum	mg/L
Hardness ($CaCO_3$)	mg/L	Selenium	mg/L
Silica	mg/L	Suspended Solids	mg/L
Manganese	mg/L	Iron	mg/L
Sulfate	mg/L	Vanadium	mg/L
Phosphate	mg/L	Dissolved Solids	mg/L
Chloride	mg/L	Turbidity	NTU
Fluoride	mg/L		
Other Key Information:			

Treatment Technology Briefs

These brief descriptions of the available treatment and non-treatment options provide an overview of process characteristics as well as key considerations for selecting the option. They are designed to function as a basic reference for beginners and a quick guide to supplement additional investigation.

Non-Treatment Options	Brief Description	Considerations
Develop a New Source	The installation or procurement of a new low arsenic source of supply.	▸ Simple. ▸ Most realistic with multiple water sources where at least one source can be relied upon to produce water with arsenic below the MCL. ▸ Constraints include inadequate capacity or water rights.
Seasonal or Peaking Use	System switches high arsenic source to seasonal or peaking use only.	▸ Not an option for systems with only one source. ▸ State requirements may preclude this option.
Blending	Operating low arsenic source in conjunction with the high arsenic sources.	▸ Must have more than one source. ▸ Wells with low arsenic levels must be continuously reliable and have a common header to allow for mixing with high arsenic source water.

Treatment Options	Brief Description	Considerations
Iron-based sorbents	Iron-based granular materials are placed in a pressure vessel and water is passed through the vessel. Dissolved As(V) is adsorbed onto the iron medium. After the medium is exhausted, it must be disposed of and replaced.	▸ Optimal performance is obtained at lower pH values. ▸ Recommend an empty bed contact time (EBCT) of 5 minutes and a hydraulic loading rate of 5 gpm/sft. ▸ Phosphate and silica have been shown to compete aggressively with As(V) for adsorption sites. ▸ Has not exceeded Resource Conservation and Recovery Act (RCRA) toxicity characteristics.
Activated Alumina (AA)	AA is a sorption process that uses porous, aluminum-based granular material with ion exchange properties.	▸ Effected by constituent(s) interference with adsorption process, selectivity sequence, preoxidation of As(III) to As(V), and presence of suspended solids. ▸ Capacity for removal is pH dependent with best removal occurring between the pH of 5 and 6. ▸ Will produce liquid and solid waste (if using a throw-away media)

Treatment Technology Briefs (continued)

Treatment Option	Brief Description	Considerations
Ion exchange (IX)	A physical-chemical process in which ions are swapped between a solution phase and solid resin phase. After the resin becomes exhausted, it can be regenerated with a brine solution.	▸ Efficiency depends on the concentration of other anions, most notably sulfates and nitrates. ▸ High levels of total dissolved solids (TDS) can adversely affect the performance of an IX system. ▸ Pre-filtration is recommended if the source water turbidity exceeds 0.3 NTU. ▸ Chromatographic peaking and resin fouling may occur. ▸ Spent regenerant may need to be treated before disposal. ▸ Spent IX resins tend not to exceed regulatory toxicity concentrations.
Enhanced Coagulation/Filtration	A precipitative process using coagulants including aluminum and ferric salts, which hydrolyze to form aluminum and iron hydroxide particulates, respectively. As(V) is adsorbed onto the metal hydroxide floc particles and is removed by filtration (either be granular media or membranes).	▸ Efficiency is contingent upon the type and dosage of coagulant, mixing intensity, and pH. ▸ Removal performance of aluminum-based coagulants drops at pH > 7. ▸ Pre-oxidation is typically necessary. ▸ Realistic possibility for new installations.
Coagulation-assisted Micro-filtration (CMF)		▸ Realistic possibility for new installations. ▸ Filter membrane must be periodically backwashed to dislodge solids and restore hydraulic capacity. ▸ Reject water is generally high in TDS.
Oxidation/Filtration	A precipitative process involving the oxidation of soluble iron to insoluble forms and then removal by filtration.	▸ Removal efficiency is strongly dependent on the initial iron and arsenic concentrations. ▸ Fe:As mass ratio should be at least 20:1, which assumes 1 mg/Fe removes 50 ug/As. ▸ Arsenic removals decrease with increasing pH. ▸ High levels of natural organic matter (NOM), orthophosophates, and silicates lessen efficiency. ▸ Greensand media must be regenerated with permanganate or chlorine.
Point-of-use (POU) and point-of-entry (POE)	POU treatment units treat the water at a single faucet. POE treatment devices treat all of the water coming into a building.	▸ Must be owned, controlled, and maintained by the utility or by an agency under contract with the utility. ▸ Reduces capital costs but increases administrative and monitoring costs. ▸ Economically viable alternative to centralized treatment for systems serving roughly 50-500 people. ▸ State requirements may preclude this option.
Additional information about these treatment technologies can be found at www.arsenictradeshow.com.		

Information from Engineers

You can gather a good deal of information from prospective engineering firms by giving them the handout that follows. It will provide you with a summary of the firm's and its staff's experience with installing arsenic technologies at systems like yours, and contact information from these systems. Review the engineering firm's experience and contact its references and former clients to see whether the firm is a good fit for your system. Include your contact information in the designated spot at the bottom of the form.

Have prospective engineering firms fill out the handout on the following page and use it to review the each firm's experience and contact its references.

Engineering Firm Information Summary

Company Name		Key Contact Name	
Phone Number		Key Contant E-mail	
E-mail		Key Contact Phone	
Address			

Relevant Past Experience

In the space provided below, please describe your firm's experience with installing or modifying arsenic treatment technologies, including the systems at which the treatment was installed, the type of treatment, and a description of the treatment unit.

System Name & Location	Contact Info (Name/Phone)	System Size (pop., service connections, design flow)	Describe Treatment Installed (including dates of installation)

Staff Experience

In the space provided below, please list the qualifications and experience of staff members familiar with all aspects of arsenic treatment technology installation and operation.

Name	Phone/E-mail	Qualifications/License(s)	Describe Relevant Experience

Selecting an Engineering Firm

If you hire an engineer to help design and install the treatment, consider the following questions when contacting prospective engineering firms and when working with the engineers to choose the most appropriate treatment technology. If the engineer cannot answer these questions, he or she should work with the vendor to get you the information you need to make informed decisions.

Background Information

Questions	Reason for Question or What to Look for in the Answer
Are you a registered Professional Engineer in this state?	Some states require that a licensed professional engineer create any plans and specifications for system construction or modification.
What experience do you have designing treatment facilities and arsenic removal technologies for small public water systems? Can you provide references?	Hiring an experienced engineer provides a certain level of comfort. If the engineer has little or no relevant experience, determine how they will overcome that obstacle. Talking with another system about their experiences with the engineer can also be extremely valuable.
What kinds of treatment facilities have you designed? Can you provide references?	An engineer with a broad base of knowledge can better assist you in choosing the best technology for your system. This person should also be familiar with the State's permitting process.
How much experience have you had getting water treatment facilities approved in our state? Can you provide references?	Design is the first step; getting the state to approve the design is the next hurdle. You want an engineer who is familiar with the often lengthy approval process.
Who in your firm is best qualified in the area of arsenic removal technologies?	An engineering firm is only as good as the person(s) that will actually be doing the work. Get a commitment on the names and qualifications of the staff that will be working for you, and the amount of time that they can devote to your project.

Additional Questions

- **How will the technology affect corrosion control?**
- **Do you have a good understanding of all the current and future drinking water regulations that affect my system?**
- **How will the treatment affect compliance with other Rules?**
- **How will the arsenic treatment process be incorporated into the bigger regulatory picture?**

Adsorptive media treatment system for ion exchange waste brine.

Working with Vendors

Questions	Reason for Question or What to Look for in the Answer
How do you deal with vendors that provide proprietary technologies?	You want an engineer that protects your interest by evaluating all technologies carefully, and not just relying on the vendors' recommendations or past experience with a single technology.
Have you worked with specific vendors in the past?	Call former clients to learn how the engineer has dealt with vendors in the past.
How do you ensure the success of a proprietary technology?	Ask the engineer for a protocol they have used before in evaluating treatment technologies (e.g., pilot testing, bench scale evaluations, etc.).

Funding

Questions	Reason for Question or What to Look for in the Answer
Are there sources of funding available to help cover the costs of treatment, and do you have experience helping systems obtain funding?	The engineer should be able to offer assistance and advice in this area. You can also contact your primacy agency to find out what funding your system is eligible for or see http://www.epa.gov/safewater/arsenic for information on the Drinking Water State Revolving Loan Fund and other funding sources. Ask if raising rates and self-funding is a better option. The engineer may be able to offer valuable advice and guidance on the process of obtaining funds.

Technology Impact and Monitoring

Questions	Reason for Question or What to Look for in the Answer
What preliminary water quality monitoring will I have to complete?	Your engineer should know what water quality monitoring is necessary for process selection and design. Get a list of parameters and frequency of the testing that needs to be done, and get a cost estimate from the engineer. Make sure you understand the time required to get adequate monitoring data, and factor it into your compliance time-line.
Will a full-time, on-site operator be required?	You have to know the operational requirement, both in terms of time and expertise, in order to determine costs. Have the engineer estimate the level of operator attention the treatment plant will require and make sure the estimation is approved by the state. Some treatment technologies are more expensive to install but require less time to operate. Have your engineer look at various levels of automation.

Impact on Water Quality and Current Facilities

Questions	Reason for Question or What to Look for in the Answer
Will the proposed treatment resolve or cause other problems?	Most technologies will remove other constituents besides arsenic. This can positively or negatively affect treated water quality. You may be able to select a technology that will resolve other problems (e.g., remove both iron and arsenic), but you should also be aware of the potential "side effects" of the technology.
Will other utilities be needed at the treatment site (e.g., improved power, standby power, sewer, gas, telephone, radio)?	Providing these services will be a major expense-be aware of all the additional costs associated with treatment installation.
What permits will we need (NPDES, building, electrical, construction, etc.)?	You may need numerous permits to construct the building, each of which has their own set of requirements. Make sure that your engineer will develop a schedule for obtaining the necessary permits.
Will I have to provide treatment at all my sources? Are there non-treatment options that I can apply to some sources?	You will need to know the regulatory requirements and discuss all compliance options with the engineer. You may even want to consider purchasing treated water from, or consolidating with, another system. Your engineer should be able to help you address these issues.
Will I have to provide treatment on a continuous basis?	You must know if you have to use the well all the time or only during periods of high use. Also, you need to know if intermittent operation can cause problems. Your engineer should be able to answer these questions.

Bag filters for initial sediment removal.

Impact on Water Quality and Current Facilities (cont.)

Questions	Reason for Question or What to Look for in the Answer
Will we be able to add additional capacity or treatment processes at the new facility at a later date?	You need to have the ability to provide additional capacity to the system if there is a potential to expand your water system. Understand the growth potential of your system and consider installation of treatment technology that will meet that need, or phased construction that will provide for future growth.
Will we have pressure and capacity through the new facility that will have to be compensated for with pump change-out?	Almost all treatment processes will have pressure losses through the treatment plant. Your engineer must determine what the losses might be, and how you can minimize them. If the headlosses are high enough to cause a significant loss of flow, or pumping efficiency, your engineer should consider changing out, or modifying, the pump.
Will we have water losses through the new facility that will have to be compensated for by additional wells?	You will need to understand the production losses of each of the treatment technologies you consider. In many cases, the water loss can be reduced significantly (e.g., recycle of backwash water). In all cases, you must ensure the production is adequate to meet your maximum day demand.
Are there increased process monitoring sampling requirements for the treatment process?	For proper operation, the treatment system will require some process monitoring that is in addition to the regulatory sampling. The specific process control monitoring requirements may be system-specific, and will be established by your primacy agency. Be sure you understand what those requirements are. Ask the engineer to identify sampling sites and testing methods and explain State requirements. There are less expensive methods for process monitoring than for regulatory monitoring-understand the difference between them.

Information from Vendors

You can gather a good deal of information from prospective vendors by giving them the handout that follows. It will provide you with a summary of the firm's and its staff's experience and the types of treatment technology it offers. Review their experience and contact their references and former clients to see whether they and the technologies they provide are a good fit for your system. Include your contact information in the designated spot at the bottom of the form.

Have prospective vendors fill out the handout on the following page and use it to review the each firm's experience and the types of treatment technology it offers.

Vendor Information Form

Company Name		Key Contact Name	
Phone Number		Key Contant E-mail	
E-mail		Key Contact Phone	
Address			

Arsenic Treatment Technologies

In the space provided, describe the arsenic treatment technologies that your firm provides. List NSF certifications, expertise required to operate the unit, and the type of residual produced.

Treatment Description	NSF Certification	Operator Expertise Required	Residuals Generated

Units Currently in Place

In the space below, provide examples of arsenic treatment units that you have installed, if any. Briefly describe the type and size of the unit and the size and type of system at which the unit was installed. Please also provide system contact information.

Water System	Contact Info (Name/Phone)	System Size (pop., service connections, design flow)	Describe Treatment Installed (including dates of installation)

Do you pilot test units prior to installation?
Do you provide start-up services and technical assistance?
Do you provide a maintenance contract?

Please return this form to:

Selecting a Vendor

There are several approaches to working with vendors. If you hire an engineer, he or she may be the one contacting, selecting, and working with the vendor. Some water systems choose to work with vendors directly (make sure this is an acceptable practice in your state), because some vendors will provide a package that includes the design and installation of a treatment system. When contacting and selecting a vendor, you and your engineer should keep in mind the questions listed below.

General Information on Technology

Questions	Reason for Question or What to Look for in the Answer
Do you have installations in place for arsenic removal? Can you provide details on the treatment and contact information for these systems?	It is critical that you determine the vendor's experience in arsenic drinking water treatment. Ask system operators about their experience with the vendor's equipment including, treatment efficiency, water quality issues, water loss, customer assistance, guarantees, and ease of operation.
What are the technology's water quality limitations?	Some raw water constituents can limit treatment run times, media life, and costs. Reputable vendors should be able to tell you what constituents challenge their technology.
What level of treatment can the technology achieve?	You need to ensure that the technology will enable you to meet the arsenic MCL given your water quality and system characteristics.
Are coatings and contact surfaces NSF certified? Can I see the certification?	All components should have NSF Standard 61 certifications. If you are contemplating use of POU devices, ask the vendor if the unit has NSF Standard 53 or 58 certification. (Also check the NSF Web site for their listing: http://www.nsf.org/business/drinking_water_systems_center/index)
For adsorptive media: Is the medium NSF certified? Can I see the certification?	Drinking water system components must have NSF Standard 61 certification.
What are the typical design criteria for your technology (Empty Bed Contact Time [EBCT] and surface loading rate)?	Many proprietary systems have specific design criteria to ensure the technology works. Your final design will have to meet those criteria in order to get the vendor to accept responsibility for ensuring compliance. EBCT, for example, determines the size of the treatment vessels needed (which determines the building size). For coagulation/filtration plants, the same is true of the surface loading rates on the filters. Make sure that the information provided meets state design standards.

Chemical feed tank for an ion exchange system.

General Information on Technology (cont.)

Questions	Reason for Question or What to Look for in the Answer
What chemicals will I have to add? What is their cost and availability? Do they require special handling? Are they all NSF certified?	Each treatment technology is somewhat different. With some, you may have to add certain chemicals to adjust pH, oxidize the raw water, or regenerate the media. You need to know what chemicals, if any, will be needed; their costs, availability and handling/safety requirements. Any chemical that is added to the drinking water must have NSF 60 certification.
What waste streams does the technology produce and what is the approximate quantity of the wastes?	The wastes produced by the technology can sometimes be very difficult to handle and dispose of. This information could be a major determining factor in your treatment selection. You should be sure that you have a means through which to dispose of the waste.
Would the waste streams be characterized as hazardous?	Though most of the waste streams will not be hazardous, ask for certification that the waste will pass the Toxicity Characteristic Leaching Procedure test (or Waste Extraction Test, for systems in California). Have the vendor identify any contaminants that treatment will remove that may cause the waste to be characterized as hazardous. Disposal of hazardous waste is more difficult and costly.
What is the typical range of water loss (in percent of total raw water flow) when using your technology? Identify each point where water loss occurs and indicate what operating conditions increase water losses.	All treatment systems produce some water loss. Determine the degree of water loss and consider this information when choosing a technology.
What is the size of the system's footprint and the required building height and square footage?	The building needed to house the treatment plant can be a considerable expense. This is particularly important if space and land availability are at a premium in your location.
Do I have to provide pretreatment? If so, what type? Can the pretreatment cause any water quality or operational problems?	You need to know all treatment requirements at the outset. Pretreatment is typically required to oxidize the arsenic to a more treatable form. Sometimes filtration is required to minimize media fouling. Also ask your state for their pretreatment requirements.
Does the technology remove arsenic (III) and arsenic (V)? Can it remove both with equal efficiency?	Arsenic (III) is not efficiently removed by most treatment technologies. If the vendor contends that the technology will remove both species of arsenic efficiently, ask for long-term documentation.
If the system is a custom unit (i.e., the media and equipment are purchased from two different suppliers) who do you consider responsible for making the system work?	Custom designing a system can be a liability nightmare if the treatment technology does not work. Identify the criteria that must be met by each party and have performance testing as a part of full payment.
Do you have a local representative who can provide timely assistances?	There is nothing better than having local service. The vendor needs to be available to provide technical assistance in a timely manner.

Costs

Questions	Reason for Question or What to Look for in the Answer
If adsorbents are used, what is cost of the media in dollars/ft^3 and how often will the media need to be replaced?	Replacing and disposing of media can be very expensive. Find out if the vendor will dispose of the spent media and get an estimate of the associated costs. Ask for a full disclosure of capital and operation and maintenance costs including testing for hazardous waste characteristics.
What types of guarantees do you provide for treatment equipment? Life of capital components? Life and capacity of media? Finished water quality?	Guarantees are only as good as the company that provides them. Ask for performance bonds for unit processes and establish performance testing Ask for a life expectancy of media, replacement costs, and disposal. Make sure that the finished water quality meets state and federal requirements and that the performance bond ensures that you will be able to meet those lets.
Do you offer a leasing option or lease/purchase option?	Some vendors will let you lease the equipment with a discounted purchase price at the end of the lease. Make sure that you have the legal right to lease equipment.
Are installation costs included?	In some cases, installation costs will be almost as much as the capital equipment costs. You need to know this prior to purchasing the technology.

Start-up

Questions	Reason for Question or What to Look for in the Answer
Is conditioning of the new treatment plant or media necessary?	Some media needs to be conditioned on-site; ask whether this is part of the initial media cost. Some conditioning processes require large volumes of water, which have to be disposed of.
How is the equipment delivered? Who is responsible for the equipment on-site until it is installed?	You should know how the equipment will be delivered and what to do if equipment arrives damaged. Inspect the equipment thoroughly when it is delivered. Do not accept damaged equipment or agree to have damaged equipment repaired until you have decided who is responsible for the repair cost.
Who will install the system? Do you provide on-site technical assistance and troubleshooting during installation, startup, and beyond?	Knowing who will install the system and ensuring that they have the proper training and experience is important. Having technical assistance during start-up is very important. Build a start-up plan into the purchase agreement that identifies a schedule, amount of assistance provided, and availability for assistance after start-up.
Do you offer extended service agreements? What are the terms and cost?	Many vendors will provide extended agreements beyond the typical warranty period.

Operations

Questions	Reason for Question or What to Look for in the Answer
What is the ease of operation? What level of operator expertise is necessary?	Get a detailed description of how the system operates and a list of existing plants in operation that you can contact for more information.
Can the facility be automated? Will I have to provide special monitoring and communication equipment? How much time will operation and maintenance require?	Some treatment technologies can be easily automated. Ask whether you can add automation in the future at a reasonable cost.
Will there be headlosses through the system that are likely to require a change-out or modification of the well's pump? If so, how much?	Some systems have significant head loss through the treatment plant. Determine if the source water pump is capable of meeting the head loss and providing adequate system pressure and flow.
Can the technology be easily updated to increase capacity or to use another media? Can it remove other contaminants?	If the equipment is adaptable you will not be tied to one supplier. For example, if the vessel has a typical EBCT, then the replacement media can be from any supplier that can provide the treatment with the same EBCT. Also, with some modification, adsorptive media treatment systems could be adapted to coagulation/filtration.
Will you pilot your technology at my site? How much will that cost?	Some suppliers have a database available such that they do not need to pilot test their technology at your site. Some vendors will pilot test their technology if you provide their research center with enough water. If they will not conduct a pilot test, ask for performance certifications and guarantees.

A row of ion exchange tanks in parallel.

A bag filter set up outdoors.

POU/POE

Questions	Reason for Question or What to Look for in the Answer
Are the units NSF/ANSI certified? Can I see the certification?	Ask the vendor if their units meet NSF Standard 53 or Standard 58 if it is a reverse osmosis system. (You can also check the NSF Web site for their listing at http://www.nsf.org/business/drinking_water_systems_center/index.)
Is the unit equipped with a warning or shutoff device to alert the customer that the unit is malfunctioning or in need of service?	A warning device will be required on all POU systems. Some states do not allow the shutoff device; contact your state regarding these requirements. Determine how the device operates (e.g., is it based on time or water quality?)
What are some of the water quality limitations of this technology?	Provide the vendor with your system's water quality data. Ask if there are any limiting constituents in the water that would impact the use of their treatment technology.
Based on my water quality, what is the necessary frequency of service?	All treatment technologies react to specific water quality and use characteristics; these will impact the mandatory maintenance schedule. Extensive site testing may be necessary to get state approval for the technology and the monitoring plan.
Can you pilot your units on a limited number of homes? At what cost?	Also contact your state to see if pilot testing is required.
Is it necessary to oxidize the source water to convert arsenic (III) to arsenic (V)?	Nearly all treatment technologies are more effective at removing arsenic (III) oxidized to arsenic (V). If the vendor indicates this is not necessary, ask for documentation and make sure your state does not require pre-oxidation.
Is any other pre-treatment necessary?	Many systems require pretreatment such as filtration and dechlorination to protect either membranes or media.
Is chromatographic peaking a potential risk? If so, how can it be avoided?	Concentrating contaminants and driving them into the system can occur with some technologies (specifically ion exchange).

Sources of Cost Information

If you have chosen, or are still deciding on, an appropriate treatment technology, you will want to get a feel for the cost of implementing the technology. There are many sources for cost information, including cost models developed by EPA and other public and private organizations; cost information based on other treatment systems that have been constructed; site-specific cost estimates developed for your system by an engineer; and estimates developed by vendor and equipment suppliers.

EPA has developed numerous cost estimating tools:

- The *Arsenic Treatment Technology Evaluation Handbook for Small Systems* (see http://www.epa.gov/safewater/smallsys/arsenic_treatment_handbook_lo.pdf) has cost curves (in 1998 dollars) that can be used to estimate capital and operating costs for each of the common technologies.

- EPA's Office of Research and Development (ORD) has created an Excel-based cost-estimating model for adsorptive media and ion exchange technologies. This program is free of charge and available at http://www.epa.gov/ORD/NRMRL/arsenic/ARCE.xls. The costs generated by this model are in 2003 dollars. This and other models typically have an accuracy of ± 30 percent.

ORD has also published cost information on the first round of EPA's full-scale, long-term, on-site arsenic demonstration projects (see http://www.epa.gov/ORD/NRMRL/pubs/600r04201/600r04201.htm), which offers a general sense of the capital equipment and building costs for these projects. Compare the system size and technology type to your system (though note that some of these costs may reflect a discounted price for equipment or may seem high due to differing specifications, e.g., level of automation).

There are other cost-estimating models available or under development by other entities such as states and the American Water Works Association.

Remember!

The best costing information will come from your engineer or vendor and other systems that have constructed similar facilities. (Ask your engineer, vendor, or state for system contact information.) Use the information and tools in this brochure and on the EPA Web site to provide the engineer or vendor the information necessary to get a good cost estimate.

Sources of Additional Information

http://www.epa.gov/safewater/arsenic
http://www.epa.gov/ORD/NRMRL/arsenic/
http://www.arsenictradeshow.com

Part of a coagulation/filtration treatment system in Billings, Montana.