Manage the elements

Arsenic Treatment Solutions for Small Drinking and Process Water Systems

Packaged Treatment Systems Using Granular Ferric Oxide Adsorption Technology

Process Description and Qualifications

AdEdge Technologies, Inc.
5152 Belle Wood Ct Ste A
Buford, GA 30518
678-835-0052
678-835-0057 (fax)
www.adedgetechnologies.com

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I. Executive Summary

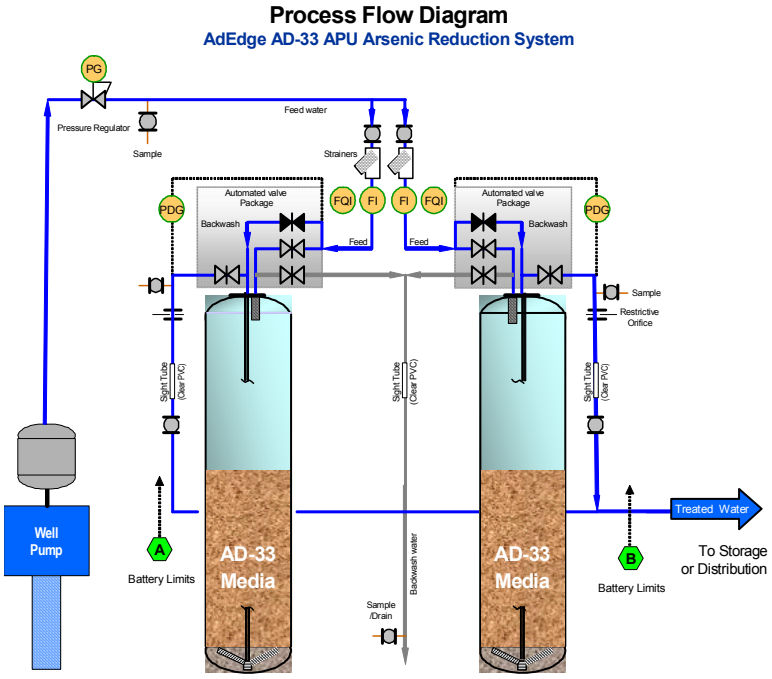
AdEdge's Arsenic Package Unit (APU) is a commercially available product specifically designed for arsenic removal for small systems at the wellhead. The APU products are standard packaged systems engineered for arsenic removal in the flow range of 5 gpm to 300 gpm. A central component of AdEdge Technologies' integrated APU systems is the Bayoxide® E33 iron-based adsorption media developed by Bayer AG specifically for the removal of arsenic from drinking water. For AdEdge Technologies small water system applications (typically <100 gpm), this system is branded and referred to as AD33. The granular ferric oxide media exhibits a high capacity for arsenic and, unlike other iron-based media, is delivered in a dry crystalline form. The AD33 media is robust and easy to handle, is stored and shipped dry and has NSF 61 approval for use in drinking water. Equally important, it is currently available in large quantities of more than 10,000 tons per year so the SWS can rely on supply irrespective of future market demands.

Water from the source well is pumped through a vessel or series of vessels containing the media. As the water passes through the fixed bed of media, the arsenic is reduced to below 10 ppb (the new MCL) until the media reaches its capacity. The spent media, which will pass the EPA's TCLP test for toxicity, is then removed and disposed as non-hazardous waste. Unlike several other BAT technologies, there is no chemical regeneration or flocculation, making the process simple and reliable and minimizing labor. The media's high capacity for arsenic enables long operating life (typically 9 to 36 months between media change-out), thus minimizing operational attention requirements.

Outside of simplicity and reliability, most other considerations can be translated to cost. The AdEdge process:

- Minimizes waste as no hazardous waste is generated
- Is efficient as less than 0.1% of water is wasted
- Requires a low level of operational attention

All these features result in low operational costs. When compared with the BAT technologies over the range of populations considered SWS (less than 10,000), the capital and operating costs for the AdEdge Technologies APU systems are dramatically lower.



II. Technology Description

The AdEdge Technologies treatment approach utilizes Bayoxide® E33, branded and utilized as AD33. This media is packaged into AdEdge integrated systems for arsenic treatment, which is a proven adsorption process designed specifically for drinking water applications. Our partner, Severn Trent, has successfully deployed a similar process known as the SORB 33™ process. 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. The adsorbent media, a granular ferric oxide adsorbent, is manufactured by Bayer AG provides a simple, economical solution for drinking water purification. The AD33 media is designed to specifically meet the adsorption challenges posed by the new MCL for public drinking water systems.

This arsenic removal process employs a fixed bed adsorption system using the 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 pressure vessels 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:

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

Adsorption is a continuous process conducted at a specific flow rate or velocity downward through the fixed bed adsorber for periods of six months to two years. 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. (The normal design value is four to five minutes.)

Pressure drop of water through the adsorbent bed is a key variable to monitor. The granular media can be crushed if subjected to a high pressure differential (ΔP). Solids removal from the water and routine backwashing will minimize ΔP through the bed.

The media adsorbs As (V) with rapid kinetics. ***Unlike other adsorbents, it will also adsorb 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 a month – or on 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 process maintenance step is the only one that generates a residual stream. The residual consists of approximately 10 to 15 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.

Media life ranges from typically one to three 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

pH

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 5.5 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.

Waters with pH values above the 8.0 to 8.5 range would be candidates for pH adjustment in order to maintain the media's high adsorption capacity. This can be done with either an acid (hydrochloric [HCl] or sulfuric [H_2SO_4]) or with carbon dioxide (CO_2).

Water Chemistry and Competing Ions

As water passes through the media, the overall water chemistry remains virtually unchanged. All adsorption media products have interferents or competing ions that compete with arsenic for adsorption sites. However, the granular ferric oxide media will adsorb arsenic in preference to these other ions. The granular ferric oxide media can also have secondary benefits of removing certain other cations and anions to some extent that may be present in the water. Adsorption tests on the media have shown that it will adsorb antimony, cadmium, chromate, lead, zinc, molybdenum, selenium and vanadium, most of which are considered water contaminants and must be removed to meet EPA drinking water standards. 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. Additionally, secondary aesthetic-related contaminants such as ferrous iron and manganese should be removed prior to adsorption for best results.

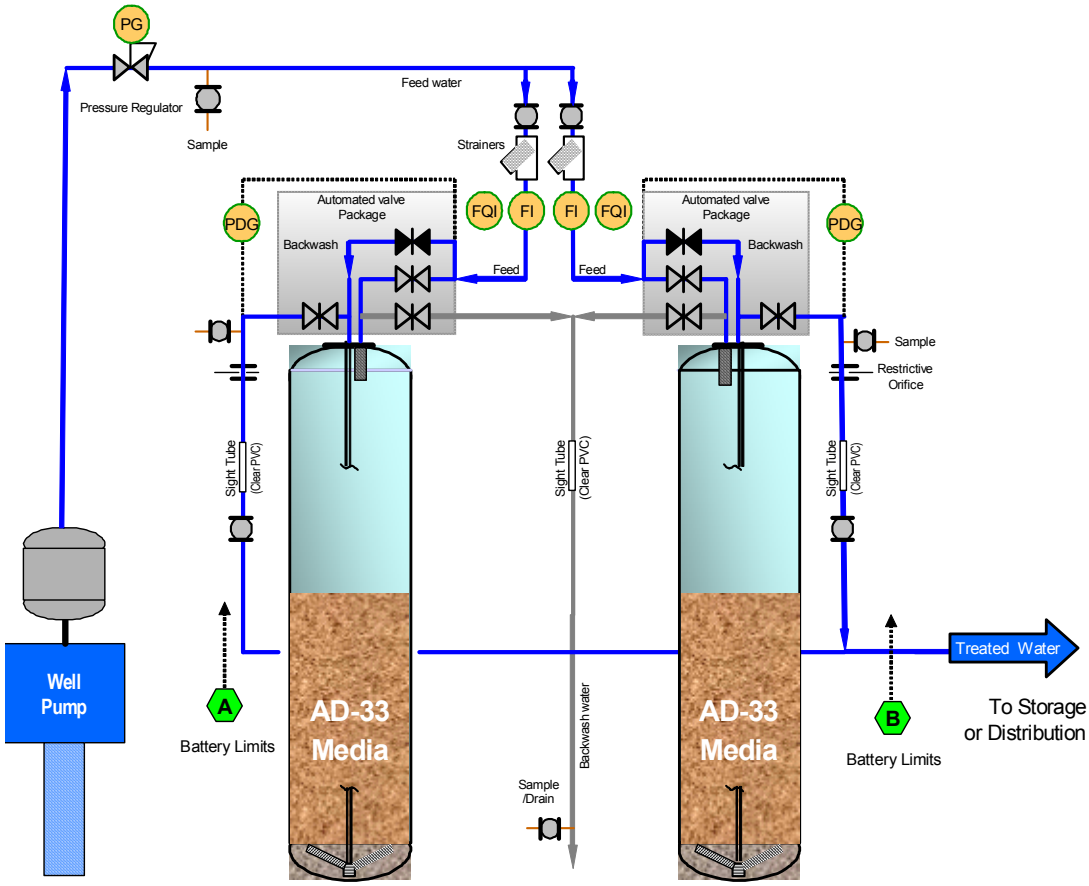
III. Process Flow Diagram

The typical APU consists of one or more adsorption vessels, piping, an automated valve assembly mounted at the top of each vessel, instrumentation, sample ports, GFO media, tank internals and underbed material for a complete integrated system. This figure in the example below is a AD33 Model APU-100 adsorption system. Water from the well is distributed between two pressure vessels operating in parallel flow configuration. Flow is downward through the packed GFO media bed. Flow to each is measured and totalized to record the volume of water treated. Pressure differential through each vessel is also monitored.

Once a month (based upon a set time or pressure differential setpoint), the vessels are alternated or taken off line one at a time to backwash (or fluff) the media bed. Vessels that are not in backwash mode remain in adsorption service while the other is backwashed. Well water is used for backwashing and spent backwash water, containing only a very small amount of media fines, can be discharged to a sewer if available or drainage ditch. Treated water from each adsorber is then fed to storage or distribution. The system can be placed before or after disinfection.

Process Flow Diagram

AdEdge AD-33 APU Arsenic Reduction System



IV. Technology Development and Experience

Development History for Small Water Systems

The genesis of this media product began with a development program undertaken in 1994 with testing that included a comprehensive evaluation of the technologies available at the time including coagulation microfiltration, reverse osmosis, granular activated carbon, ion exchange, activated alumina and iron adsorption.

The conclusion of the study and extensive economic analysis was that adsorption would be the most desirable technology to pursue further because the process:

- Is simple
- Has a small footprint
- Is significantly less expensive than current alternatives

Concurrently with this development program, a need was identified for a more consistent media product and a reliable supply to meet needs in the UK, as well as the market needs in the U.S. and throughout the world. (At that time, the projected need for the UK was approximately 500 tons per year and the worldwide need to be in the range of 10,000 to 30,000 tons per year while, in 1996, suppliers of iron adsorption media could produce only 100 to 200 tons per year and the quality was highly variable.) Severn Trent initiated collaboration in 1996 with Bayer AG, the world's largest technical oxide producer, to develop a superior iron oxide adsorbent for arsenic removal. The specific criteria defined for this development was a media that:

- Had high arsenic capacity
- Had robust mechanical properties
- Was a dry media
- Was easy to handle, store and ship
- Had reproducible performance characteristics from batch to batch

An unexpected benefit has been the media to remove or reduce other contaminants such as lead, copper, chromium, antimony, molybdenum, vanadium and others.

As the U.S. market started to develop in 1999 and 2000, the need to scale down and address the concerns of small water systems (particularly those serving fewer than 10,000 people) was recognized. The scale-down process was straightforward since pilot work had been performed at smaller scales and full scale work had been performed on large municipal systems.

In July 2002, AdEdge Technologies began bringing this adsorption technology into the small systems, remediation and industrial wastewater markets, expanding opportunities into markets not previously addressed. The AdEdge portfolio and personnel brought a depth of understanding and experience to the small system market and remediation applications.

The platform for delivering this adsorption technology to small water systems was the development of the AD33 APUs. They consist of pre-engineered, pre-packaged (optionally skid-mounted) systems that incorporate years of extensive treatment design experience. The systems are designed with key features of simplicity and ease of use. AdEdge introduced its APU

product line in mid 2002, with a focus on small utilities, schools, mobile home parks, subdivisions and other small public water systems. To date, public water systems with AD33 arsenic treatment have been installed in Alaska, Arizona, Michigan, New Hampshire, New Mexico, Oregon and Washington. In June, 2002 Bayer AG received NSF Standard 61 approval for Bayoxide® E33. The media is also Drinking Water Inspectorate (DWI) approved for use in the UK.

Point-of-Use and Point-of-Entry Products

POU/POE products (cartridges and systems) utilizing the AD33 ferric oxide technology were also launched in 2002. Several hundred POU installations and more than 70 small scale 5-10 gpm size POE (whole-house) treatment systems have been installed and are currently operating in residential applications with a wide range of water quality profiles. These applications include water quality with arsenic levels up to 500 ppb, As (III), As (V), high competing ions and many other conditions. A whole house system referred to as the Medallion Series has been launched to provide whole-house treatment. Recently, the AdEdge AD33 technology has also been formulated successfully to produce the first carbon block-based POU cartridge for arsenic reduction and multiple other claims. The product is the first of its kind to receive NSF 53 certification in accordance with the new standard for arsenic reduction. To date Adedge has shipped product in 34 states and 6 countries for POU or POE applications.

U.S. Pilot and Full Scale Experience

Our arsenic removal program is built upon a strong technical base. This section summarizes a sample of development activities performed by AdEdge and its partner Severn Trent Services. AdEdge Technologies has implemented more than 200 small residential and four commercial systems with the media. One of the most thorough pilot tests conducted to date has been with the State of New Jersey, where testing has been ongoing with the NJGS for the past year. As a result of this program, the State of New Jersey has determined that granular ferric oxide adsorption is the most preferred arsenic technology for Point-of-Entry home treatment.

Between AdEdge and its partner Severn Trent, there are approximately 30 pilots completed or ongoing in the U.S. Individually, these pilots are intended to provide a given utility with specific performance and economic data on their water. Together, these pilots are beginning to provide a second matrix of data from which we can predict full scale performance. A partial list of water assays that have been or are in the process of being tested are shown in Table 1. This table illustrates the range of pilot scale data and several key parameters including pH, arsenic, silica, phosphate and sulfate completed or in process in seven states.

Table 1 – Pilot Test Site Matrix

		Units	Standard	NM	AZ	CA	UT	UT	TX	MT	CA	CA	AZ	OH	CA	AZ
pH				8.8	8.9	7.5	8.0	8.1	8.8	7.5	8.2	8.1	7.9	7.4	8.5	7.2
Alkalinity	$CaCO_3$	mg/L	N/A	116		140	125	166	72		90	130		127	67	404
Fluoride	F	mg/L			1.0	0.3	0.1	<0.1	0.9	0.9	0.2	0.2	0.6			
Nitrate	N	mg/L		1.5	1.5	2.1	0.2	0.3	0.3				0.7	<1		
Phosphate, Ortho	P	mg/L		<0.1		<0.1			0.03			0.40	<0.10	0.08	ND	
Silica	SiO_2	mg/L		21.5	22.5	48.0			32.1	23.0	19.0	63.0	39.0	6.3	43.0	14.8
Sulfide	S	mg/L		ND		<1.0							<0.50	<0.03		
Sulfate	SO_4	mg/L		77.0	26.0	15.0	47.0	9.0	93.4	63.0	21.0	5.0		<1	34.3	9.9
Suspended Solids		mg/L		<1		ND	2.0	3.0			0.2	0.2	0.2			
Total Dissolved Solids		mg/L					256	220	346							
Hardness (Ca & Mg)	$CaCO_3$	mg/L		7.2		120.0	174.0	170.0	29.9	116.0	72.0	54.0		75.0	75.0	342.0
Metals																
Antimony	Sb	µg/L	6	<1		<1	16.5	9.7					<1.0	<25	ND	<5
Arsenic	As	µg/L	50	49.2	45.0	19.0	4.3	8.5	27.7	24.0		19.0	31.0	64.0	7.0	54.0
Cadmium	Cd	µg/L	5	<1	<1	<1	4.0	1.1	0.1	<0.3	ND	ND	<1.0	<5	ND	<5
Chromium	Cr	µg/L	100	12.0	46.0	<10	<2	<2		<0.3	ND	ND		<6	<100	<10
Copper	Cu	µg/L	1,000	<50	<10	<50	30.0	2.0	18.0					<3		
Iron	Fe	µg/L	300	<50	<20	<100			16.0	15.0	ND	10.0		1,298.0	<100	<10
Lead	Pb	µg/L	15	<3	<10	<5	2.4	5.2	5.0				<1.0		<5	
Manganese	Mn	µg/L	50	<15	<10	12.0	20.0	<10		7.0	ND	95.0		173.0	<30	<50
Mercury	Hg	µg/L	2	<.2		<1	<0.2	0.2	0.3				<0.2			
Molybdenum	Mo	µg/L		<100	<10	<10							<1.0			
Nickel	Ni	µg/L	100	<40	<10	<10							<5	<15		
Selenium	Se	µg/L	50	<5	<20	<5	1.1	<0.5			ND	ND				4.0
Vanadium	V	µg/L		78.0	72.0	30.0						ND	14.0			
Zinc	Zn	µg/L	5,000	<20	<10	<50	670.0	150.0						41.0		

Residential System Data

AdEdge began deploying multiple 5-10 gpm systems with the AD33 process in mid 2002 based on the body of data developed in the laboratory and pilot programs. Table 2 shows a broad spectrum of water profiles that the AD33 has been exposed to. In many cases, the arsenic levels have been typically less than 50 ppb but, in several cases, we have evaluated the technology at levels significantly above 50 ppb and, in one case, up to 2 ppm. The wide variety of arsenic levels is typical of our experiences with residential applications for homeowners on private wells. Since the water is not exposed to any treatment, the arsenic levels are considerably higher than public water systems and the arsenic often exists as As (III).

Table 2
Variations in Water Quality Assay Range

Assay	Range
pH	5.9 - 8.8
Alkalinity	5 - 185 mg/L
Hardness	5 - 345 mg/L
Fluoride	<0.1 – 3.5 mg/L
Silica	1 – 60 mg/L
Sulfate	4 – 150 mg/L
Total dissolved solids	60 – 600 mg/L
Metals:	
Arsenic	**17 – 2000 µg/L**
Iron	<10 – 5000 µg/L

It is important to note that all the installed systems are reducing the level of arsenic to below detection levels and are still operating on their first charge of media. Monitoring continues in order to get a better understanding of predicting media life over diverse water profiles.

Environmental Remediation

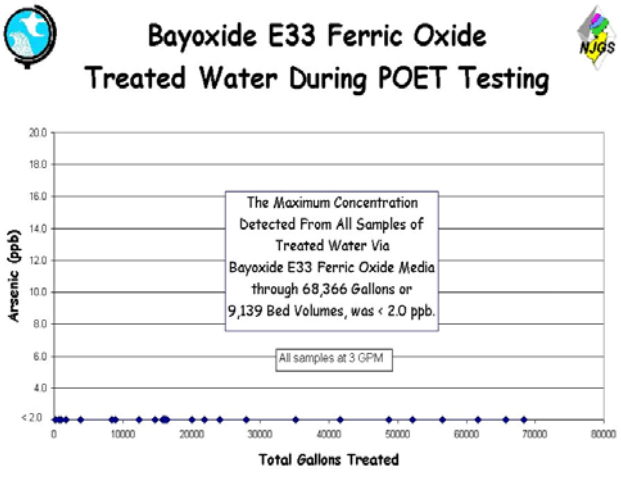
AdEdge has applied this technology into both process water and groundwater remediation applications. As mentioned above, multiple heavy metals can be effectively reduced with the granular ferric oxide technology. AdEdge, working in cooperation with some industrial customers, has demonstrated the technologies' effectiveness for removing chromium, molybdenum, zinc, lead, uranium, phosphate, selenium, and others. AdEdge is actively involved in utilizing the technology for metal finishing and process water treatment for meeting lower discharge limits. One such category for broad application is to meet EPA's proposed effluent guidelines and standards for the Metal Products and Machinery (MP&M) Point Source Category. These facilities generate wastewater as a result of processing metal parts, machinery, and metal-based products. This adsorption technology is ideally suited for effluent polishing compared to other chemical/filtration methods which are inefficient and costly to achieve the desired goals.

Other field applications where the technology is being applied is for groundwater remediation of dissolved contaminants such as arsenic, chromium, copper, and others. AdEdge is working with various engineering / consulting firms on former wood treating and other commercial sites contaminated by arsenic and heavy metals. Compared to other alternatives, the simplicity and cost advantages for remediation projects are obvious. A successful pilot program has been undertaken at a private cleanup site in Florida for remediating high concentrations of arsenic. A full scale system is planned for 2003.

Public Water System Data

As mentioned earlier, dozens of small residential systems (5-10 gpm) have been successfully deployed by AdEdge through its dealer network for treating arsenic. Of particular note is a pilot program undertaken by the state of New Jersey that has been testing the AD33 product in a comparative POE testing program for the past year.

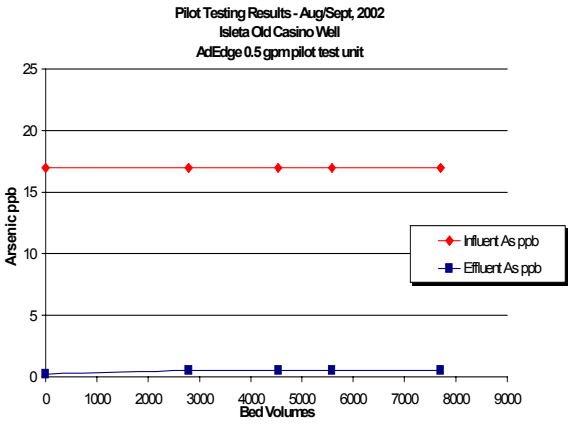
The AD33 is being tested on two incoming waters in a 1-cubic-foot system at a flow rate of 2 gpm. Both feed waters have total arsenic around 50 ppb, one with nearly 100% As (III) and one with predominantly As (V). The chart to the right is preliminary performance data provided by the NJGS for the As (V) site out to 100,000 gallons utilizing the AD33.



A pilot program for the Isleta Pueblo in New Mexico was initiated in August 2002 for a 100-gpm well requiring arsenic treatment. A 30-day proof of technology pilot test was highly successful reducing arsenic to below detection for approximately 10,000 bed volumes treated. A full-scale system is planned to be installed in the second quarter of 2003.

AdEdge Pilot Results – Albuquerque, NM

- Startup August 6, 2002
- Utilized 0.5 gpm pilot unit
- AD-33 Adsorption media
- 30 day continuous test run
- As = 17 ppb pH 7.8, Si = 32 mg/l
- Treated approx 10,000 bed volumes; arsenic below detection
- Full-scale system to be provided



AdEdge began implementing the AD33 technology in two public water systems in mid 2002 in Yakatat, Alaska and Bumblebee, Arizona. The Alaska site was the first installation of its kind for commercial small public water system (airport terminal) in that state. The system had a design flow of 25 gpm with a total arsenic level of 80 ppb. The system has been successfully treating arsenic below 10 ppb for the past year. The system was placed after an iron/manganese oxidation and filtration pre-treatment.

AD-33 Arsenic Adsorption System

- Commercial System
- Location: Yakatat, Alaska
- Arsenic: 80 ppb
- 25 gpm System serving regional airport
- Installed May, 2002
- 20 cubic feet AD-33 Adsorption Media
- Ozone pretreatment for Fe, Mn
- Effluent arsenic - Non detect

A 10-gpm AD33 system for a public recreational facility was installed in Arizona in mid 2002 to treat high levels of arsenic up to 170 ppb. The effluent has been periodically sampled and monitored since installation and analyzed at a certified lab. Results to date have shown treatment effectiveness to below 5 ppb. The inserted figure shows the system and summarizes the results.

AD-33 Arsenic Adsorption System

- Commercial System
- Location: Arizona
- Arsenic: 170 ppb
- 10 gpm system serving recreation facility
- 8 cubic feet AD-33 Adsorption Media
- Installed May, 2002
- Effluent < 5 ppb As

In May, 2003, an AdEdge APU-40, 40-gpm system was installed for an elementary school in Michigan serving 600 students. Arsenic levels in the feed water ranged historically at the site from 37-50 ppb. The water contains relatively high hardness and Iron levels from 0.5 to 1 ppm. The arsenic adsorption system was preceded with a water conditioner for hardness and dissolved iron reduction. The system is successfully treating the water below the detection limit for arsenic.

- Elementary School
- Location: Oakland County, Michigan
- AdEdge APU-40 Adsorption system w/ GFO media
- Influent Arsenic: 37-50 ppb
- 40 gpm design flow
- Installation May, 2003
- Effluent < 1 ppb arsenic

V. About AdEdge Technologies

AdEdge Technologies, Inc. is a privately-owned provider and developer of specialty adsorbents, products and integrated solutions for the removal of contaminants from process or aqueous streams in a variety of industries and applications. These include, but are not limited to, drinking water, chemical, pharmaceutical, environmental and wastewater applications. Headquartered near Atlanta, Georgia, the company was formed in 2002. Its founders have been pioneers in developing and implementing adsorption-based arsenic treatment technology in the US, Canada India, and Bangladesh.

Collectively AdEdge has more than 60 years of experience in adsorption technology and unparalleled experience in the realm of arsenic treatment. The AdEdge team has developed, successfully commercialized and marketed multiple products and systems for arsenic treatment throughout the U.S and internationally since 1998. In 2001, one of the AdEdge team members received the prestigious R&D 100 Award – which honors the top technology innovations of the year – for its arsenic treatment system developed for remote villages of India/Bangladesh (which has the worst naturally occurring arsenic problem in the world). In addition to its commercialization and field experience, AdEdge remains very proactive in arsenic issues, training seminars, NSF standards development, field testing, university collaborations and EPA programs to promote new technology.

One of AdEdge's key objectives is to offer the most cost-effective metal reduction solutions in the marketplace for small water system compliance. In addition to its focus on the small centralized public systems market, AdEdge is also a leader in providing AD33 based arsenic treatment products and integrated solutions for residential whole house treatment as well as point-of-use (POE/POU) markets.

VI. Management Team

Rich Cavagnaro, President. Mr. Cavagnaro has nearly 20 years of international business experience in strategic marketing, business development, product development and commercialization of new products and services in a broad spectrum of industries. His experience spans such industries as catalysts, adsorbents, drinking water, process separations, paint & coatings, adhesive & sealants, pharmaceuticals and others. From 1999 to 2002 he was Senior Vice President of Sales and Marketing for Apyron Technologies, Inc, where he grew the company to be internationally renowned as the experts in arsenic removal and added over 20 years of industry-based management and sales expertise to the company. Prior to that experience, Mr. Cavagnaro was the Global Director of Alumina Sales and Marketing for LaRoche Industries.

Previously, he served 8 years with Degussa Corporation in various positions including Manager of Accounts, Products and Markets for the Chemical Catalyst division. Mr. Cavagnaro is a driving force behind the Company's aggressive marketing plan and is responsible for directing key business development and strategic partnership initiatives. Mr. Cavagnaro brings to the AdEdge team extensive experience in building sales forces and spearheading specialty new product development. A graduate of Shepherd College where he obtained his Chemistry degree in 1983, Mr. Cavagnaro continued his education with various management courses in sales and marketing at Syracuse University and the University of Chicago.

Greg Gilles, Vice President – Small Water Systems. Mr. Gilles has over 20 years of treatment technology, industrial, regulatory, engineering, and management experience. His most recent position was as Vice President of Technical Sales for Apyron Technologies where he directed the company's initiatives on arsenic removal and new adsorbent applications both from a sales and technical service capacity. Mr. Gilles has written many publications and received awards for his accomplishments in the removal of arsenic from drinking water. In 2001, Mr. Gilles was presented the prestigious R&D100 Award recognizing the top 100 innovations of 2001, and the Innovative Technology Award from the Water Environment Federation for the development of its arsenic removal systems.

In 1998, Mr. Gilles worked for OHM Remediation Services Corp. from 1993 to 1998 where he was Regional Technical Services Manager and was responsible for all engineering and technical support services to the remediation operations, project development and sales/marketing groups. Prior to OHM, Mr. Gilles worked for Chemical Waste Management from 1989 to 1993 where he was the Engineering and Technology Manager for the Midwest Region and from 1984 to 1988 he worked for General Motors Corporation as a Project Engineer. Mr. Gilles is a Certified Hazardous Materials Manager, has authored several technical publications and holds a U.S. patent in soil washing technology and another pending patent for Apyron's Arsenic Treatment Unit for rural communities. Mr. Gilles received an M.S. in Environmental Science/Engineering in 1984 and a B.A. in Biology/Chemistry from Indiana University in 1982.

Dr. Ley Hathcock, Vice President - Residential Systems. Dr. Hathcock has over 15 years of experience in commercial product and process development, international business management and industrial analytical chemistry. He was previously Director of New Business Development for Apyron Technologies and Director of Business Operations for Scientific Adsorbents, Inc. (SAI), a subsidiary of Apyron Technologies specializing in process and chromatographic

separation media. During his tenure at SAI, Dr. Hathcock was responsible for doubling the profitability of the business.

Prior to SAI, Dr. Hathcock was Director and General Manager of the Chemical Sensing Division of Marconi Applied Technologies, where he headed Sales and Marketing and established U.S. operations for the division. Previously, Dr. Hathcock was a member of the global management team of Neotronics Scientific, Inc. and Neotronics Scientific Ltd., where he held several executive roles. He established North American operations for the company (Neotronics Scientific, Inc.) and as North American General Manager and Director of Global Research and Development, he led the successful development and commercialization of new metal-oxide, polymer and acoustic chemical sensor technologies for process monitoring in scientific, medical food & beverage and industrial markets. Dr. Hathcock began his industrial career with Philip Morris U.S.A. where his responsibilities included environmental chemistry, filtration modeling and development and application of internal process monitoring technologies throughout Philip Morris companies. Dr. Hathcock has authored a number of technical articles, holds several international patents and has regularly served as an editorial reviewer for an international chromatographic journal. Dr. Hathcock holds a Ph.D. in Analytical Chemistry from the University of Alabama, concentrating in chromatographic and adsorbent research.

VII. Getting Started with a Small System Application

Whether the system is a small or large application, certain site-specific information is needed from the end user or engineer to properly prescribe the arsenic treatment solution and predict capital and operating costs. The form below is an example of the prequalification and profile form used by AdEdge Technologies. These forms can be obtained by contacting AdEdge or accessing our website at www.adedgetechnologies.com and completing the profile on-line. Once some basic facility information and water characteristics is made available, system design and cost information can be provided.

AdEdge Technologies, Inc.
AD33 Adsorption System
System Sizing and Budget Estimate Form

adedge

Arsenic Reduction - Small Water Systems
Application - Site Profile Form

Customer Confidential

Contact Information

Customer / Utility:		**Date (mm/dd/yy) :**	
Site or Well Location:		**Main Contact :**	
Local Engineer / Firm:		**Phone:**	
Operator:		**Fax:**	
		Email:	
Other Pertinent Notes:			

System Parameters / Site Specific Info

System Type / Application:		(municipal / utility, school, recreational, trailer park, subdivision, other)
Population Served:		
Number of Connections:		
Design Flow (GPM):		(Max design flow rate)
Ave Flow (GPM):		(Typical demand)
Gallons per day:		(Ave throughput per day)
Est. Usage (Gals / Year):		(Best estimate)
Existing Pretreatment In Place:	Describe:	
Existing Disinfection:	Yes / No If Yes, Type: Cl_2 gas / HOCl / ClO_2 / Chloramine / Ozone / Other	
Disinfection Injection Point:	Pump Shaft / Storage Tank / Downstream	
Pump Operation:	Constant / Intermittant / Other	
Pump Discharge Pressure (psi):		
Electrical Power Availability:		
Storage Tank Present at the site:	Yes / No If Yes, Size and location:	
Hydropneumatic Tank Present:	Yes / No If Yes, Size and location:	
Building present:	Yes / No If Yes, Available space in existing building:	
Any additives ie, phosphates, fluoride:	Yes / No If Yes, Specify type and injection point:	
Discharge Options:	Sanitary Sewer (POTW) / Drainage Ditch / Evap. Pond / Other	

Water Analysis

(enter all available)
**** denotes priority parameters**

pH **			**Antimony**		mg/L Sb
Total As **		mg/L As	**Sulfides****		mg/L
As(III)		mg/L	**Chromium**		mg/L Cr
Alkalinity		mg/L @ CaCO3	**Fluoride**		mg/L F
Hardness **		mg/L @ CaCO3	**Lead**		mg/L Pb
Silica **		mg/L SiO2	**Vanadium ****		mg/L Va
Phosphate **		mg/L P04	**Molybdenum**		mg/L Mo
Sulfate **		mg/L SO4	**Selenium**		mg/L Se
Iron **		mg/L Fe	**Turbidity**		NTU
Manganese **		mg/L Mn	**Suspended Solids**		mg/L

Please complete and fax to: 678-835-0057 **Form can be completed online at www.adedgetechnologies.com**

AdEdge Technologies, Inc. 3560 Financial Center Way, Suite 5 Buford, GA 30519 * Phone: 678-835-0052 * www.adedgetechnologies.com