Point of Use Devices for Removal of Arsenic from Drinking Water
Implementation Point

CT: Centralized Treatment Plant

- Well
- Point of treatment
- Consumer
- Distribution line
Implementation Point

WH: Well Head or Point of Extraction

- well
- point of treatment
- consumer
- distribution line
Implementation Point

POE: Point of Entry (to residence)

- well
- point of treatment
- consumer
- distribution line
Implementation Point

POU: Point of Use (in residence)
POU Arsenic Removal

1. Adsorption (Single Use Media) Processes

2. Reverse Osmosis (Membrane) Processes
Single Use Media

Activated Alumina (Alcan)

Iron-Based Media

Granular Ferric Hydroxide, GFH (U.S. Filter)
Bayoxide Sorb 33, E-33 (Severn Trent)
Iron Amended Activated Alumina, Fe-AA (Alcan, Inc)
Iron Amended Resin, ArsenX\textsuperscript{np} (Solmetex, Purolite)
Other (AdEdge GFO, Engelhard ARM-200, etc.)

Zirconium Oxides (Isolux, Elektron)

Titanium Oxides (MetSorb, Hydroglobe)

Lanthanum-Coated Diatomaceous Earth (EaglePicher)

Many Others at Commercial, Pilot or Bench-Scale
Single Use Operation

- Source Water
- Shut-off Valve
- Media Column
- Pre-filter
- Downflow During Sorption
- Upflow During Backwash
- Product Water
- Shut-off Valve
- Source Water
- Backwash Reservoir
Adsorption: Considerations

- **pH** *(Capacity decreases as pH increases > 7.0)*
- **Sulfate** *(Electrostatic competition > 100 mg/L)*
- **Sulfide** *(scaling > 0.03 mg/L)*
- **NOM** *(Electrostatic & specific competition, fouling > 2 mg/L)*
- **Silica** *(Specific competition, fouling > 20 mg/L)*
- **Iron & Manganese** *(clogging > 2.0 mg/L or 0.05 mg/L)*
- **TDS** *(Electrostatic competition > 400 mg/L)*
- **Solid Residuals** *(May leach arsenic unless appropriately managed)*
- **Co-contaminants** *(Fluoride (2mg/L) , nitrate (10mg/L) , radium, perchlorate, radon, VOCs, microbial)*
Single Use Media

1 Pre-filter
2 As Media
3 GAC filter

Thanks to M. Spear and SPWTAC, 2006
Membranes: RO

- Allows passage of water, but not ions.
Membranes: Concerns

Chlorine (Membranes degrade with free chlorine)
Cost (Capital and O&M are high)
Fouling (Water must be pre-filtered)
Scaling (TDS > 400, Ba > 1 mg/L, Ca > 100 mg/L, SO4 > 150 mg/L)
Water Loss (Maximum recovery 20 – 90%)
Concentrate Disposal (High TDS and arsenic)
Co-contaminants (Removes organics and inorganics)
POU: RO

Under-counter Reverse Osmosis POU

1. Particle Pre-filter
2. R.O. Unit
3. Pressurized, Treated Water Storage
4. Activated Carbon Filter
5. Separate Treated Water Tap
Cost of POU versus CT

From AwwaRF, 2004
Considerations Beyond Cost

- Ability to gain access residences and businesses*
- Additional sampling and record keeping
- Installation and maintenance workload
- Water wastage (RO up to 85%)
- Authority to require participation*
- Home damage liability*
- Willingness of consumers to comply & participate*
- Community growth

*education and outreach are critical
Federal & Arizona Law

Federal (EPA)
1. Owned, controlled, maintained by PWS or PWS contractor
2. Devices equipped with mechanical warning of malfunction (PID, performance indication device)
4. Can’t be used for microbial contaminants

Arizona Department of Environmental Quality
1. Submit and follow written monitoring plan (9 year cycle; 33% each 3 yr; 23% by test strips and 10% by lab)
2. ADEQ approval of device design
3. Cover 100% of consumers in PWS
4. Consumer rights/responsibilities convey with title for property sale
5. Operators must have appropriate certification
Steps to POU Compliance

1. Communicate with ADEQ
   Develop and Submit:
   POU application form, manufacturer device certification, PID description, customer participation description, installation schedule, monitoring plan, education and outreach plan

2. Pilot test candidate devices under site-specific conditions

3. Conduct education and outreach activities

4. Develop agreements and ordinances for access & compliance

5. Negotiate vendor service, installation, purchase/lease agreements

6. Train operators

From ADEQ, “Arizona Point of Use Compliance Program”, 2005
Questions and Comments