

# Arsenic Treatment Technologies & ETV Perspectives

Arsenic Technology Workshop  
August 2003

EPA

ETV ✓



# Acknowledgements

- Arsenic Water Technology Partnership (AWWA Research Foundation, Sandia National Laboratories & WERC)
- Environmental Protection Agency, Office of Research and Development, Environmental Technology Verification (ETV) Program
- NSF International

EPA

ETV ✓



# ETV DWS Center

## Arsenic Technology Testing Status

- Reverse osmosis.
- Chemical coagulation with rapid filtration skid mounted package plants.
- Adsorptive media.
- Oxidation with rapid filtration of iron laden source waters.

EPA

ETV ✓



# Arsenic Treatment Technologies – Reverse Osmosis

- Koch Membrane Systems TFC<sup>®</sup> - ULP4 Reverse Osmosis Membrane Module
- Hydranautics ESPA2-4040 Reverse Osmosis Membrane Element
- Small system equipment: 5 – 10 gpm
- Pilot units easily scaled for medium to larger systems

EPA

ET✓



# *ETV Test Plan for As Reduction by RO*

- Minimum of 1 month of continuous operation.
- Daily sampling for As, Fe, Mn, TDS, etc.
- Determine Arsenic species (III & V).
- Total and dissolved Arsenic.
- Operation parameters water production (specific flux).
- Fouling and cleaning.







**EPA**

**ETV** ✓



# *Results*

## **Arsenic Reduction by RO**

- Park City, Utah - Spiro Tunnel Water Filtration Plant (groundwater from silver mine)
- Total As feed: mean=65 g/L, range=49-77 g/L
- 32 days of testing in March & April 2000
- Product A reduced mean As to < 0.5 g/L, & Product B to < 0.9 g/L
- Mean As in waste stream: Product A (60 g/L) & Product B (62 g/L)

**EPA**

**ET** 



# *Results*

## **O&M by RO**

- Water recovery : ~ 13-15% in both products tested
- Specific flux decreased for one but not for the other throughout test
- Some accumulation of As and Fe on membranes but no significant fouling observed
- Requires power & skilled operator for O&M, but simple to operate

**EPA**

**ET** ✓



# Arsenic Treatment Technologies – Chemical Coagulation Package Plants

- Chemical Coagulation Package Plants (CCPP) are skid mounted ready-to-install
- Kinetico Inc. Model CPS100CPT (uses synthetic filtration media – ceramic)
- Watermark Technologies, LLC eVox® Model 5 (uses sand filtration)
- Small system equipment: < 10 gpm

EPA

ET ✓



# *ETV Test Plan for As Reduction by CCPP*

- Minimum of two weeks to establish operations.
- Intense sampling, every 6 hours for 48 hours.
- Daily sampling for As, Fe, Mn, TDS, etc.
- Determine Arsenic species (III & V).
- Total and dissolved Arsenic.
- Chemical and electrical consumption.




**EPA**

**ETV** ✓



## *Results*

# Arsenic Reduction by CCPP

- Park City, Utah - Spiro Tunnel Water Filtration Plant (groundwater from silver mine)
- Total Arsenic in feed water ranged 60.9-146 g/L
- Testing occurred in April 2000
- Product A: each Arsenic species reduced to average of < 4.7 g/L
- Product B: each Arsenic species reduced to average of < 3.0 g/L
- Waste produced: Solids

EPA

ET 



# *Results*

## O&M by CCPP

- Power: A (359 kWh) & B (516 kWh)
- CCPP requires some technical sophistication
- Chemical usage for
  - Product A: 5.48 mg FeCl<sub>3</sub> / L at 1.1 gpm
  - Product B: 8.63 mg FeCl<sub>3</sub> / L at 5 gpm

EPA

ET ✓



# Future ETV Technology Tests- Adsorptive Media

- Three small communities in Pennsylvania
- Three technologies
  - ADI (a regenerative media)
  - Kinetico Alcan iron treated activated alumina
  - TBD
- Protocol
  - 2 week system integrity
  - Weekly sampling until estimated breakthrough
  - Daily sampling close to breakthrough
  - Arsenic speciation, interfering & confounding chemicals

EPA

ETV ✓



# Future ETV Technology Tests- Oxidation, Co-precipitation and Filtration

- Small community in Anchorage, Alaska.
- Technology is ozone followed by a cartridge filter.
  - Ozone for rapid oxidation.
  - Simplistic cartridge filter = disposable.
- Protocol.
  - Same as chemical coagulation, however operation until cartridge change required.
  - Some additional testing of ozone production.
  - TCLP & Cal WET tests of solids.
  - Arsenic speciation and iron sampling.

EPA

ETV ✓



# ETV DWS Center Stakeholder Needs

- Highly credible performance test data by an independent third party.
  - Skepticism of vendor claims.
  - QC documented and check of data.
- Commercially ready technologies.
- Operation and Maintenance information, e.g. water production (recovery).
- Cost factors quantified, e.g. chemical & electrical consumption.

EPA

ETV ✓



# ETV DWS Center Lessons Learned

- States must be involved in development of protocols and test plans.
- O&M a major consideration for small systems = must be affordable.
- QA – take nothing for granted.
  - PE samples of speciation resins.
  - Data transfer and transposition errors.
- Pragmatic test designs: trade off of cost versus sufficient data for decision makers.

EPA

ETV ✓

