

DATE: 27 May 2008

TO: Office of Drinking Water Staff

FROM: J. Wesley Kleene, Ph.D., P.E., Director

SUBJECT: Permits & Project Review - Procedures for Arsenic Removal Treatment Systems

### SUMMARY STATEMENT

Arsenic removal by adsorptive media is the preferred treatment method for groundwater systems in Virginia requiring treatment to comply with the new arsenic standard of 10 ppb. This memo addresses design features, process control and compliance monitoring, and permitting procedures for these systems.

### BACKGROUND

ODW identified 22 community and nontransient-noncommunity systems with historically high levels of arsenic, and conducted a special sampling program in 2005 to determine if they would meet the new arsenic standard of 10 ppb. The study indicated that six of these systems would need to install removal treatment in order to meet the new standard. These six systems all have groundwater sources, and contain arsenic levels only marginally higher than 10 ppb.

In addition to these six systems, at least two new systems have shown arsenic in their groundwater sources and have indicated a desire to install adsorption treatment processes for arsenic removal. ODW may encounter other systems with arsenic levels of concern in the future.

EPA has published several design references and is continuing to conduct Demonstration Projects throughout the country on arsenic removal processes. The best resources are EPA/600/R-03/019: Removal of Arsenic from Drinking Water by Adsorptive Media, and published Demonstration Project evaluation reports, which are available on EPA's website.

Additionally, there are iron-based adsorptive materials being marketed or in development which are proving effective in treating arsenic economically without the need for pH adjustment.

### DESIGN FEATURES

#### Media

Adsorption media for arsenic removal must be NSF Standard-61 certified. In order to select and size the adsorption media, the waterworks must provide the manufacturer with a current, complete characterization of the groundwater quality, including inorganic chemicals and metals. The manufacturer must provide performance data that clearly demonstrates to the review engineer an ability to remove arsenic from the system's groundwater source(s), with allowances for preferential adsorption by other competing constituents (such as silica, phosphate) if they exist in the source water.

### Process Design

For systems where the arsenic removal levels and system hydraulic capacities are low, the process should incorporate off-site disposal of spent media. (A service agreement for removal of spent media is recommended). To simplify operations, pH adjustment should be avoided.

At least two pressure vessels should be used, piped in series and operated in a downflow mode. Ideally the system should be designed for complete arsenic removal from the lead vessel. When the media is exhausted, the vessel is bypassed, and the spent media is removed, while the lag vessel becomes the lead treatment unit. Operational flexibility should be provided by configuring the piping to allow for bypassing either unit or blending of treated and untreated flows. Manual control of the system operation is recommended.

Empty bed contact times (EBCT) for the treatment beds should be recommended by the manufacturer. (EPA recommends no less than 5 minutes.) This parameter will affect the vessel sizing, operation life of the media and consequent media replacement frequency and cost.

If removal of suspended solids, hardness or organics is necessary or desired, these treatment processes should be installed *upstream* of the adsorption contactors.

Some manufacturers recommend periodic backwashing of the media to remove media fines and/or accumulated particles. Automation of the backwash function, via a timer or differential pressure measurement across the adsorption bed may be considered. Disposal of the backwash wastewater may require a discharge permit from DEQ.

### Sampling & Testing Provisions

Instrumentation for measuring flowrate and total flow upstream and downstream of the treatment beds, and pressure upstream and downstream of each vessel is required. Taps for sampling the applied water to and treated water from each vessel are also needed for testing pH, arsenic, and any other parameters of concern.

### Manufacturer's Guarantee

The manufacturer should certify that the treatment units will remove arsenic to meet the new drinking water standard, and that spent media will pass the Toxicity Characteristic Leaching Procedure test.

### APPROVAL PROCEDURES

1. A Preliminary Engineering Conference is required.
2. Submission of plans and specifications, issuance of a Construction Permit, receipt of the engineer's Statement of Completion, and final inspection by ODW shall follow standard procedures.
3. A performance evaluation study and report of the full scale installation is required. The goals of the study are to determine if the treatment units meet the arsenic removal requirements, to validate the design and operation parameters, including the EBCT, media life expectancy, backwash requirements (if any), and to produce an Operations & Maintenance Manual for the treatment units. This Manual should include the manufacturer's data as well as operational guidelines, procedures, and contract disposal

information. A minimum study period of 90 days is recommended, and should include all of the operational testing described below.

4. The Operation Permit will be issued with process monitoring requirements incorporated into Engineering Description Sheet for the permit.

#### OPERATOR REQUIREMENTS

The operation of an adsorption treatment process without regeneration or pH adjustment is comparable to an ion exchange softener. Consequently a minimum Operator Class IV will be required.

#### MONITORING AND REPORTING

Operational testing, at a minimum frequency of twice/week, should include:

1. Arsenic levels in the applied and treated water from each adsorption bed,
2. pH of the raw water (or applied water if additional treatment occurs upstream of the adsorption beds),
3. total water treated,
4. pressure at the influent and discharge of each bed (to determine pressure loss through the contactor)

Test kits may be used for operational control monitoring. Refer to the arsenic test kits that have been evaluated under the EPA Environmental Technology Verification (ETV) program; they may be found at <http://epa.gov/etv/verifications/vcenter1-21.html>. Additionally, Lamotte makes an arsenic kit sensitive to 2 ppb using test strips (<http://lamotte.com/pages/common/newprod/4053.html>). There are also portable bench models such as the HACH DR 2800 Portable Spectrophotometer that are significantly more expensive, but which can also be used for many other parameters (such as Cl-, Fe, Mn, etc.).

Compliance testing shall meet the requirements of the Arsenic Rule.

#### REFERENCES

[www.epa.gov/safewater/arsenic/compliance.html](http://www.epa.gov/safewater/arsenic/compliance.html)