By Jane Wilson, NSF International

ARSENIC

Addressing Arsenic Contamination Through Residential Drinking Water Treatment

On June 22, 2000, the U.S. Environmental Protection Agency (EPA) announced a proposed rule that would lower the current national primary drinking water standard for arsenic. The current maximum contaminant level (MCL) for arsenic is 0.05 mg/L; the proposed rule would lower this limit to a new MCL of 0.005 mg/L based on arsenic's ability to cause cancer in humans, with alternate values of 0.01 mg/L and 0.02 mg/L also being considered. While publication of the final rule initially was scheduled for January 2001, recent legislative action revised the EPA deadline to June 22, 2001, to allow sufficient time to review and respond to the public comments received on the proposed rule.

NSF International (NSF) is in the process of developing changes to two of its residential drinking water treatment unit standards in order to meet the anticipated need from the drinking water treatment industry for having a means to verify the arsenic removal performance of various treatment technologies. EPA also has proposed that municipalities meeting certain criteria may be allowed to use residential treatment devices as a means of meeting the new regulation.

Arsenic Types

Arsenic may exist in both organic and inorganic forms in water, and the inorganic forms generally are considered more toxic. The inorganic forms commonly occur as either trivalent arsenic (As III or arsenate) or pentavalent arsenic (As V or arsenite). In general, arsenic in water that has been exposed to air such as surface water or to oxidizing agents such as chlorine is found as As V. Municipally treated water generally contains only As V, since most disinfection processes will oxidize As III to As V. Several established treatment technologies such as reverse osmosis are able to remove As V, because it is a charged (ionic) species at typical drinking water pH levels. As III is more difficult to remove since it usually occurs as an uncharged species in the typical drinking water pH range. Technologies designed to remove As III must either remove the As III species directly or oxidize the As III to As V and remove it by established technologies.

Stakeholder Involvement

NSF has formed a task group consisting of interested stakeholders from the drinking water treatment industry as well as state and federal regulatory agencies to develop an arsenic removal performance test for ANSI/NSF 53 Drinking Water Treatment Units—Health Effects. This group also is working to revise the current arsenic reduction protocol in ANSI/NSF 58 Reverse Osmosis Technologies. Although an arsenic removal protocol was reinstated in ANSI/ NSF 58 in September 1999, the performance claim that can be made under this standard is limited to reverse osmosis (RO) technologies used on water systems that have a detectable chlorine residual. Recommendations from the task group will form the basis of the proposed arsenic challenge tests that will be balloted by the NSF Joint Committee on Drinking Water Treatment Units for inclusion in the standards.

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Setting of Influent Challenge, Effluent Concentrations

One of the initial challenges to the task group was to define the appropriate influent concentration for arsenic to use for the performance testing.

A significant number of water sources are expected to be below the current MCL of 0.05 mg/L, but in excess of the proposed MCL. Most of these will be municipal systems where the arsenic is most likely in the As V form due to disinfection practices. Also of concern are private water supplies in certain geographic areas that have very high concentrations of arsenic in the ground water. These supplies are more likely to contain significant amounts of As III in addition to As V.

The NSF task group is considering giving manufacturers the option of challenging the test unit with an arsenic concentration of either 0.05 mg/L or 0.3 mg/L. Review of U.S. Geological Survey (USGS) arsenic occurrence data showed 95 percent of source waters that contain arsenic and that are used for domestic purposes have arsenic concentrations of less than 0.05 mg/L. It is anticipated that homeowners with arsenic concentrations at or below 0.05 mg/L, but above the proposed MCL of 0.005 mg/L, will need to reduce arsenic but will not require a system designed to remove higher levels. Analysis of the USGS data also indicated that an upper tier challenge test of 0.3 mg/L will address the majority of the remaining source waters that had arsenic concentrations in excess of 0.05 mg/L. Manufacturers whose devices can effectively reduce even higher influent concentrations also will have the option of testing at challenge concentrations above 0.3 mg/L. A demand will exist for these high-performance units in the domestic and international markets.

In addition to the two challenge concentrations, the task group currently is proposing to have separate arsenic removal claims for municipally treated water sources (As V removal) and non-municipally treated water sources (As III and As V removal). A protocol also is being developed for performance evaluation of technologies that oxidize As III to As V.

Other Considerations

In addition to determining the concentration of arsenic to use in the challenge test, the task group also has defined other water quality parameters that need to be considered. Many commonly occurring ions in drinking water either may interfere with or enhance some arsenic removal technologies. The USGS data also were used to identify average occurrence levels for common ions such as Mg^{+}_{2}, Ca^{+}_{2} and SO^{+}_{2} that

will be included in the challenge water. Another water quality parameter that may influence the removal of arsenic is the pH value of the water. The challenge test for ANSI/NSF 53 will be performed at pH 6.5 and 8.5, as is done for other metal reduction tests. The current ANSI/NSF 58 arsenic removal test uses a pH of 7.5. The task group is evaluating whether a change to use pH 6.5 and 8.5 would be appropriate for the RO technologies as well.

Arsenic 101

Because of the complexity of arsenic chemistry and the many parameters that may affect its removal, the task group currently is proposing challenge testing that will allow performance claims for different types of arsenic removal at different influent concentrations. However, the task group is aware that having multiple performance claims for one contaminant likely is to be confusing to the average consumer wanting to purchase a device that will address his particular arsenic problem. For this reason, the task group is proposing that a fact sheet be available to consumers purchasing arsenic removal devices. The fact sheet is expected to contain the following.

- An explanation of the chemical difference between As V and As III and the importance of determining which forms are in the consumer's water.
- An explanation of how the arsenic removal efficiency of the device depends on source water characteristics.
- A description of the exact arsenic removal performance claim that has been verified for the device.

Current Activity

NSF currently is in the process of validating the As V removal tests for both ANSI/NSF 53 and 58. Additional research and validation work is anticipated in the establishment of the total arsenic (As III and As V) removal and arsenic oxidation test protocols. It is NSF's goal to have arsenic removal performance protocols for multiple technologies available to the drinking water treatment unit industry upon the finalization of the EPA MCL expected in June 2001. WQP

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