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Keeping a Watchful Eye

on arsenic

Maintaining compliant arsenic levels in drinking water with regular testing of POE and POU treated water

Arsenic concentrations in U.S. groundwater are generally low, less than 1 parts per billion (ppb), but levels higher than 10 ppb—the current U.S. Environmental Protection Agency (EPA) maximum contaminant level (MCL) for arsenic—are prevalent in some regions, such as New England and the desert southwest. It has been known for more than a century that inorganic arsenic is a human carcinogen. Long-term exposure to even low levels of arsenic via drinking water consumption has been linked to an increased risk of skin, prostate, lung and bladder cancer.

There is currently no federal requirement to monitor arsenic levels in private wells, which means that the owners are responsible for the quality and safety of their well water. The npXtra Arsenic Assurance Program provides simple point-of-entry (POE) and point-of-use (POU) systems for removing arsenic from drinking water. These systems come with a complete service cycle, which includes arsenic testing of the water to ensure that the system is always efficiently operating.

How Long does it Last?

A prediction of how long the lead column of the npXtra POE system will last can be made based on water chemistry and the average household water use. The reported average U.S. water use for people living in single-family homes was about 101 gal per person per day in 1995. Assuming a single-family home is inhabited by two to three people, an average use of 300 gal of water per day (i.e., 109,500 gal annually) has been used in sizing the npXtra POE column for the whole household to give an average minimum life of 1.5 years in optimal conditions.

However, if water usage is well below 300 gpd, the actual effective operating life of the POE columns may be longer than predicted. Conversely, the operating life may be shorter in waters with high arsenic concentrations (>150 ppb), high pH (pH >8.5), a presence of competing components (e.g., phosphate and silica) and prevalence of the uncharged form of arsenic.

Arsenic exists in two major chemical forms in water, arsenate (As(V)) and arsenite (As(III)). The form of arsenic depends on the water chemistry, pH and the oxygen level in the water. Due to its typically chargeless nature, As(III) is more difficult to treat than As(V) by most arsenic removal technologies.

Testing is Important

Regular testing of any POE and POU system is essential to ensure that the device is operating as designed and that the treated water is free of arsenic. As part of the POE or POU system under the npXtra Program, sampling and laboratory testing service is provided. At installation, the installer or homeowner takes a water sample of the raw water, the water after passing through the lead column and the treated water after the two columns of the POE system.

In the case of the POU system, water is taken from the treated faucet and raw water from any other faucet in the household. The samples are then shipped in the provided bottles to the laboratory in a preaddressed and labeled package.

The approximate pH of the raw water is also determined by the homeowner using pH strips and a color reference chart. Based on the initial determination of the raw water arsenic concentration and the pH, an appropriate testing frequency is set for each customer. The follow-up sample kit will automatically be sent out to the POE well site after nine months and after six months for POU systems.

If arsenic concentration or pH of the water is high, these times may be shorter. When arsenic is detected at or above 10 ppb after the lead column of a POE system, a recommendation is sent out to the customer to replace the lead column with the current lag column and

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TABLE 1. Performance of npXtra POE lead column in various customer waters. Arsenic level after the lag column was 0 ppb in all cases.

Influent As (ppb)	Treated water (gallons)	Time in use (months)	As bleed after lead column (ppb)
11	131,000	18	0
15	94,150	10	0
20	166,300	15	0
25	72,900	21	7
21	42,600	10	17[1]
34	58,300	7	2.6[2]
50	71,600	10a	26
130	149,000	17	107
173	96,100	12	6
233	80,000	11	210[3]
288	35,600	12	5

[1] 87% of arsenic in influent water was As(III)
[2] pH of influent water was 8.3
[3] Arsenic in the treated water after the lag column POE was 13 ppb

to place a new column in the lag position. This type of program ensures that the customers continuously get water that meets the level of compliance.

The first of the npXtra arsenic treatment systems became operational in November 2005 and as of Jan. 23, 2008, a total of 333 POE and 69 POU systems have been registered in the testing program.

The raw water from all the system sites was sampled at start-up, and 96 POEs and 23 POUs have since been resampled, some multiple times.

In most waters where arsenic concentration is less than 50 ppb, which was the U.S. EPA MCL for arsenic until January 2006, the lead column of the POE system would be expected to last for a minimum of 1.5 years before column replacement is required. Seventy-seven percent of the tested well sites have arsenic concentrations less than 50 ppb. However, the actual life of the POE and POU column will depend on the volume of processed water and the water chemistry—arsenic speciation, silica, phosphate and pH.

Periodic arsenic analyses of the customer samples have shown that the npXtra POE and POU systems operate as predicted and meet the needs of the customers in terms of arsenic removal and ease of operation. Some of the first installed systems have begun to show arsenic breakthrough after the lead column due to variable water conditions.

It is important to sample the water regularly to catch a premature breakthrough. Table 1 presents some examples where water testing of the system has proven crucial for ensuring that the quality of the customer's drinking water continues to be within safe limits regarding arsenic concentration. Optimally timed replacement of the lead column will also give the homeowner the best value for his or her money because the columns will not be changed out unnecessarily.

Eight out of the 69 installed POU devices have shown levels higher than 1 ppb in the treated water. Although arsenic bleed has been detected, these units are still working effectively because all levels are below 10 ppb. However, it is important to regularly test the water from these systems to be able to recommend column replacement once the system is approaching exhaustion.

Simple, low-maintenance POE and POU systems are very effective in maintaining arsenic concentrations below the MCL. Combined with a regular water-testing program, the homeowner can be assured that the arsenic level in the water never exceeds the regulated levels. *wqp*

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