Private Water Supplies

Selenium – Guidance for Local Authorities

Description and Background

Selenium is a relatively uncommon trace element, often found associated with other metal ores. It has a number of industrial uses, primarily in electronics and photography. It has also sometimes been added to fertilisers and can accumulate in soils in this way. Parts of the US and Canada have significant concentrations of naturally occurring selenium. Significant concentrations of selenium in drinking water have also been documented from China[1].

Affected Areas

Contamination Sources

Industrial pollution can cause selenium to be present from mining wastes, metal refining and combustion products of coal and petroleum[2].

Health Significance

At low concentrations Selenium is an essential element, however it does exhibit toxic properties when present in larger quantities. The main health effects comprise long term circulatory damage resulting in effects at the periphery of the body, such as hair and fingernail loss and impairments to the peripheral nervous system[2]. A wide variety of other impacts have also been noted, including respiratory, cardiovascular and gastrointestinal effects.

Aesthetic impacts of high selenium concentrations in drinking water are likely to be limited, although some selenium compounds have a characteristic garlic odour and the odour has been reported on the breath of individuals who have consumed a significant quantity of selenium.

The WHO has set a guideline value for Selenium of 10µg/l. This has been replicated in many national standards including the EU Drinking Water Directive.

Risk Assessment and Monitoring

The Private Water Supply regulations require regular monitoring for selenium where it is present at more than 75% of the PCV.

What if it fails?

If a water sample fails for selenium it would be prudent to gather additional samples to verify the failure and determine the variability of the concentration of selenium in

water. If there are multiple sources, it would be worth sampling each one to determine whether one source has greater levels of contamination than the others.

Check the following:

- Is it likely that selenium is naturally occurring, based on other sample data from supplies in the area and BGS data?
- Is there any history of industrial processes that could have used selenium?
- If multiple sources, are concentrations of selenium consistent across these?

Any failure of the selenium PCV will also exceed the WHO health-based guideline value. Health advice should be sought.

Options for resolving at source

Catchment management options for selenium are likely to be limited. Where it is naturally occurring, it is likely to be fairly ubiquitous, although alternative water sources could be sought.

Where selenium is not known to occur naturally, industrial pollution should be suspected, especially if there is evidence of mining, smelting or manufacturing activities in the catchment. Remediation of contaminated land may be possible, but it is likely to be significantly cheaper and easier to abandon the source.

Treatment

Selenium in its oxidised Se (VI) form, such as selenite, is most difficult to remove. Other forms are likely to be relatively easily removed from drinking water. WHO reports that adsorptive technologies using iron or aluminium oxides are successful. Ion exchange technologies have also been used with good results, as has reverse osmosis[3]. Base anion exchange systems have been shown to perform effectively on a large scale and it is likely that this is one of the most practical treatment solutions for small water supplies. Due to the chemical similarities between selenium and sulphur, it is suggested that sulphate will also be removed by the resin, making the process less economic for high sulphate waters[4].

The USEPA guidance on Selenium suggests that coagulation and filtration processes may be effective for selenium removal, although other sources contradict this. It is likely that the efficacy of this process depends strongly on the chemical form of the selenium. Coagulation is unlikely to be an appropriate solution for most small supplies in any case.

Point of use treatment is likely to be feasible, based on the technologies above. Filtration with activated alumina or iron oxide are likely to be simplest as they require minimal maintenance and no chemical regeneration, however a service contract or close monitoring to ensure timely media replacement would be advisable.
Point of use ion exchange and RO units are also available.

References / Further reading

[1] Yang, G., S. Yin, R. Zhou, et al. 1989a. *Studies of safe maximal daily dietary Se-intake in a seleniferous area in China. II. Relation between Se-intake and the manifestation of clinical signs and certain biochemical alterations in blood and urine* (published erratum appears in Jour. Trace Elem. Electroly. Health Dis 1989. 3:250). Jour Trace Elem. Electroly. Health Dis. 3: 123-130 (Cited from USDHHS 1994)

[2] US EPA Consumer Factsheet on: Selenium USEPA. http://www.epa.gov/ogwdw/pdfs/factsheets/ioc/selenium.pdf

[3]WHO 2011. *Selenium in Drinking-water. Background document for development of WHO Guidelines for Drinking-water Quality*. WHO/HSE/WSH/10.01/14

[4] Smith et. al. 2005*. Evaluation of Treatment Techniques for Selenium Removal.* IWC Paper 09-05.

FAQ Fact Sheet for Owners and Users
To be developed if necessary