Private Water Supplies

Manganese – Guidance for Local Authorities

Description and Background

Manganese is the 12th most abundant element in the Earth's crust. It is often found in combination with iron, and in many minerals, common minerals of manganese being pyrolusite, psilomelane, hausmannite, braunite, rhodochrosite and manganblende.

Manganese and its compounds are widely used in various production areas. About 90% to 95% of manganese is used in the steel industry, and 5% to 10% of manganese is used in other areas such as the chemical industry, light industry, building materials industry, defence industry and electronics industry.

Manganese exists in several different states ranging from -3 to +7. The most stable oxidation state for manganese is +2 and many manganese(II) compounds are known, such as manganese(II) sulfate ($MnSO_4$) and manganese(II) chloride ($MnCl_2$).

Manganese can be a problem in private water supplies, especially in the South and West of Scotland. It can be leached from soil, especially during activities which disturb the ground such as forestry. Loch supplies can also be affected if a cold, anoxic layer of water forms at the bottom of the loch. This layer can allow significant concentrations of manganese to dissolve within it, and this can enter the private water supply if this layer is brought to the surface due to seasonal turnover of the lake water.

The presence of manganese in water supplies often manifests itself by black staining of fittings in contact with the water – this can be a problem for sanitaryware , and especially for UV systems where lamps may be rendered ineffective due to becoming coated with a layer of manganese.

Manganese may build up as a layer of fine sediment in pipes and tanks, which may be disturbed by changes in flows leading to discoloured water.

Health Significance

Manganese is an important trace metal for human health. Nevertheless, excessive exposure or intake may lead to a condition known as manganism, a neurodegenerative disorder. Some recent research has linked elevated manganese concentrations with developmental disorders of the nervous system.

Manganese precipitation gives water a brown-black colour when exposed to air, and can make water aesthetically unacceptable. Manganese can give water a metallic taste.

Risk Assessment and Monitoring

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

What if it fails?
Manganese failures are not uncommon, and usually there will be visible evidence of high concentrations of manganese around tanks and sanitary ware. Manganese is usually naturally occurring but may very seasonally, so may not be present all year round.

Check the following:

- Resample from several points in the supply (pre- and post- treatment, at taps where water is consumed) to determine the amount of manganese in the raw water, the effectiveness of any treatment process and whether historic deposits of manganese sediment are being re-suspended into the supply.
- Are there visible deposits of manganese sediment in any tanks?
- Has there been any activity in the catchment that may have disturbed soils and caused an increase in dissolved manganese in the supply?

Options for resolving at source
It may be possible to reduce concentrations of manganese in source waters by reducing opportunities for dissolution and leaching. Strategies such as soil stabilisation and lake mixing may assist with this, although naturally occurring manganese is unlikely to be eliminated entirely. Reviewing the position and depth of lake abstraction points may provide some improvement.

Treatment
There are a series of treatment processes aimed at manganese removal such as oxidation, filtration, bio-filtration and adsorption, etc. Among these processes, oxidation including chemical oxidation and biological oxidation is a classical technology which can be used in the industrial scale water treatment engineering and scaled for smaller applications.

Aeration alone is unlikely to be sufficient to achieve complete oxidation of any soluble manganese. Chemical oxidation employing chlorine, ferrate or permanganate may be economic and convenient for small scale water treatment plants where significant concentrations of soluble manganese are present.

For many private water supplies with low to medium concentrations of manganese, a simple catalytic filter may be sufficient. This is a basic loose media filter containing catalytic media such as greensand or manganese dioxide. Any manganese present in the water precipitates out onto the media

Ion exchange and nanofiltration would appear reliable solutions for manganese treatment at the point of use, though they are costly compared with other methods.

Historic Deposits of Manganese in Supply Systems
Even if manganese is no longer present at high concentrations in the raw water, or new manganese removal treatment is effective, historic deposits may be present in

tanks and pipework. If this is the case, the system should be cleaned to remove them – flushing of pipes may help if sufficient velocities can be achieved to re-suspend the manganese, but manganese can be difficult to shift, especially from some pipe materials such as asbestos cement. In some circumstances, replacement of the problem pipework may be the most effective option.

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