Private Water Supplies

Copper – Guidance for Local Authorities

Description and Background

Copper is a red metal that is relatively common in nature. It often occurs in sulphide or carbonate form, sometimes in association with other metals such as iron and arsenic[1].

Copper has many uses in industry, including electronics and as an ingredient in pesticides and fungicides. It is also commonly used in water pipes and fittings.

Affected Areas

Naturally Occuring

In the UK, BGS and SEPA have undertaken stream sediment studies” to determine the extent of trace contaminants. Copper levels are generally low but groundwater in areas of granite have higher concentrations.

Contamination Sources

If present in drinking water at significant concentrations, the most likely source of copper is dissolution from pipework and plumbing fittings, and this source should be considered initially. High concentrations of copper in drinking waters as supplied are rare, but concentrations of several milligrams per litre are achievable within properties where copper pipework is present and conditions are favourable to dissolution. A survey published by Health Canada found that treated water concentrations across the country did not exceed 100µg/l, but maximum concentrations up to 560µg/l were detected at consumer taps due to the influence of household pipework[3]. Dissolution of copper fittings and pipework is especially likely in waters where either pH is low or pH is high and low in alkalinity.

Health Significance

Copper is an essential human nutrient. The acute effects of excessive copper are primarily gastrointestinal. Chronic health effects are less well defined.

Aesthetically, copper will impart a metallic taste to the water at concentrations. In studies, the taste threshold has been documented as 2.4-2.6µg/l[4]. Blue green staining of water and sanitary ware can occur. Under certain circumstances even hair may take on a blue / green tinge. At higher concentrations, water itself can take on a blue appearance. If any of these are noted, the presence of copper should be strongly suspected and further investigated through sampling.

The WHO has set 2mg/l as the health based guideline value. The EU Drinking Water Directive also sets the standard at 2mg/l for copper.

Risk Assessment and Monitoring

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

Studies by the British Geological Survey (BGS) into metal concentrations in stream sediments may be helpful in determining the risk from copper in a particular area[2]. Copper is also more soluble under acidic conditions.

What if it fails?

Check the following:

- What is the pH of the water and what are the plumbing materials made of?
- Is it likely that copper is naturally occurring, based on other sample data from supplies in the area and BGS data?

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

Options for resolving at source

Although less likely than corrosion of plumbing, the possibility that copper could be present in the source water should at least be considered. This is especially the case where sources of industrial pollution are likely to be present or in mining areas and where natural copper deposits are known.

Unless very localised, it is likely that removal or remediation of industrial and mining contamination at source will be expensive and difficult, and the identification of an alternative source of water is likely to be preferable. Where multiple sources of water exist, each should be sampled to establish whether one is significantly more contaminated and could be abandoned, reducing overall copper concentrations to within acceptable limits.

Treatment

Treatment for copper is likely to be focussed around conditioning water to inhibit corrosion of copper pipework. Theoretically at least, reverse osmosis could be used to reduce copper concentrations in incoming water, however this approach should be a last resort after all catchment options have been considered.

Conditioning of water is best achieved where the water enters the property, unless significant amounts of copper pipework exist upstream. The aim is to change the water chemistry to enable a thin carbonate or oxide film to form on pipework, preventing further corrosion. This is usually achieved by increasing the pH and alkalinity of the water using a filter containing alkaline media such as limestone or calcite chips, or by dosing a carefully controlled quantity of sodium carbonate or sodium bicarbonate. This is an effective approach but clearly should only be used where installation and ongoing monitoring and maintenance are likely to be sufficient – a poorly operated dosing installation risks being ineffective at best and overdosing chemicals causing health risks at worst. The dosing of sodium hydroxide solution could also prove effective, however some sources consider the risks associated with handling and controlling dosing of this chemical to be too great for a water supply run without professional expertise[5].

Polyphosphate dosing is another option for corrosion control – this substance also forms a coating on pipework to inhibit corrosion. Once again, careful control of dosing is required. The protective coating may take time to form and may quickly re-dissolve should dosing be interrupted for some reason.
With all of the systems involving chemical doing mentioned above, professional advice should be sought.

If copper removal at a single tap is required, point of use reverse osmosis may be an option. Where water is hard, some form of pre-treatment may be required to prevent excessive scaling of the membrane. If the majority of copper pick-up is occurring within the property, flushing of taps prior to use may be a simple way of significantly reducing copper concentrations.

References / Further reading

[1]WHO. 2004. Copper in Drinking Water.
Background document for development of WHO Guidelines for Drinking Water Quality
WHO/SDE/WSH/03.04/88

[2]Shand, P, Edmunds, W M, Lawrence, A R, Smedley, P L, and Burke, S. 2007.
The natural (baseline) quality of groundwater in England and Wales.
British Geological Survey & Environment Agency, RR/07/06 & NC/99/74/24
USEPA 2003

[3] Health Canada.. 1992. Copper.
Health Canada website

[4] Zacariad I. *et.al*. 2001. *Determination of the Taste Threshold of Copper in Water*.
Chemical Senses 26 (1): 85-89.

[5] Dvorak, B.I. *et.al*. 2013. Drinking Water: Copper.
University of Nebraska-Lincoln.

FAQ Fact Sheet for Owners and Users

To be developed if necessary