Water distribution WSP	**Corrosion and mains sediments** *Management/technical guidance*	

Information derived from:
- Feedback from water suppliers

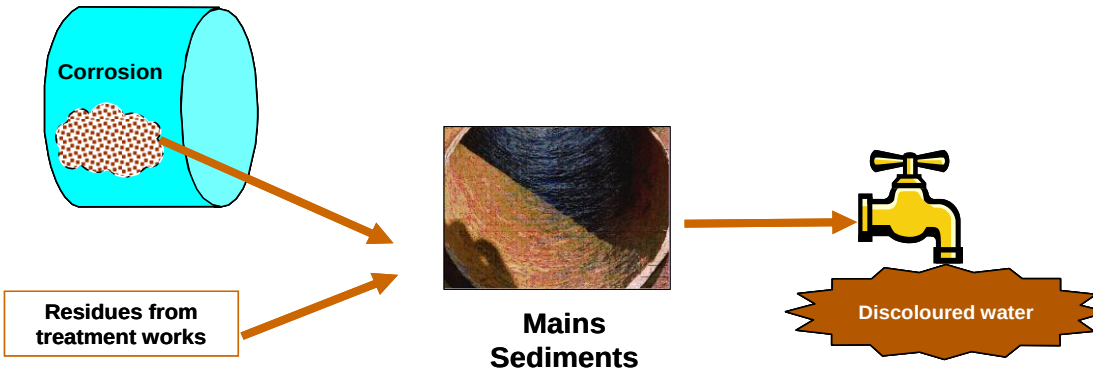
Related tools:
- Asset management
- Network modelling and design
- Treatment works design and operation
- Biofilm management
- Water mixing and source change

Important Notes to users:
This document provides information to support improved management of piped drinking water quality by water utilities and other stakeholders. It cannot however be definitive and users must ensure that they assess local factors and particularly take account of any national or regional legislative requirements before use. Where necessary this may also need close collaboration with others. The priority to be given to implementing controls to manage identified water quality risks will depend on a proper prioritisation process by each water supplier.

Summary
Over time, many distribution networks accumulate sediments and deposits. However the nature of the sediments and the rate of deposition vary considerably and the causative factors can be complex. If disturbed by change in flow velocity as a result of planned or unplanned activity such as bursts, increased demand or starting of booster pumps, the sediment can be discharged through consumer taps as discoloured water. This is unacceptable to consumers and can damage their overall trust in water quality. This document summarises the factors which can lead to discoloured water and ways that the risks can be mitigated.

Detailed information

Background
Over time, many distribution networks accumulate sediments and deposits. Depending on the density of the sediments they can be re-suspended by flow velocity change, arising from planned or unplanned activity including bursts, increased demand or starting of booster pumps. The softer the deposits the greater the likelihood of being easily disturbed thus giving rise to regular discolouration events at consumer's taps.



Water quality risks and potential causes
The causative factors leading to sediment deposition can be varied and complex. Typically they arise through a combination of one or more of the following:
- Residues from treatment works
  A variety of metal cations originate from treatment works. These can include iron or aluminium coagulants as well as naturally occurring iron, aluminium and manganese. For example even a well managed 100 Ml/d surface treatment works with iron residuals of 0.05mg/l will be putting

nearly 2 tonnes of iron a year into the network. In addition in some situations natural humic organic matter can co-precipitate with cations in the network to form complex organic/inorganic sediments

- Corrosion products
  Iron oxides and other debris from corrosion of iron pipes can accumulate over time
- Biofilm
  In some case where biofilm growths are significant, they can bind metal residues thus forming sediment comprising discoloured complex biological matrices.

Risk mitigation measures

Mitigation measures to minimise sediment formation, and thus the likelihood of discoloured water, will depend vary much on local circumstances. Many of the measures require significant resources but since sediment formation is typically a long term problem the measures should be part of a long term asset management plan phased over an appropriate timescale with priority given to those measures that:

- Deal with areas where the risks of discoloured water is highest
- Or will have the most cost effective long term outcome

Measures could include:

- *Waterworks residue management*
  Maintaining the lowest practical level of ex works residual levels of including iron, aluminium or manganese as well overall turbidity and levels of natural organic matter. This can be through improved operation and/or asset improvement.
- *Mains flushing programmes*
  There are a number of different techniques for this, but all incur some loss of water so need to be managed carefully particularly in areas of drought.
- *Network design*
  As far as practicable designing and operating networks to maintain a minimum velocity and minimise major flow surges. For example by minimising long mains with low demand, avoiding dead ends in the system, and managing booster pump arrangements.
- *Network rehabilitation programme*
  Having in place a long term mains rehabilitation/renewal programme to reduce the extent of any mains corrosion.
- *Managing water mixing*
  Where waters from different source types are mixed in the network chemical reactions can increase the formation of new sediments, or alter the nature of existing sediment. This can be a particular problem for example when mixing water of very different origins, such as soft upland water with hard groundwater, or river water with groundwater. In addition, corrosion products within distribution networks that have historically been served by a relatively hard groundwater source, can be de-stabilised if that water is replaced with much softer water, for example from an upland reservoir. This can in turn lead to major discolouration problems, as the existing deposits become softer and therefore more likely to become disturbed by velocity changes.
- *Biofilm management*
  In some situations high levels of biofilm can also influence the level and type of sediments. See separate tool for mitigation measures.

Mapping sediment risks and typical control points

The most effective control points will depend on an assessment of the most likely causes of sediment in the network. This can be greatly helped by mapping the extent and nature of existing sediments within the network using GIS or network models. This can include:

- Numbers of consumer complaints of discoloured water
- Chemical/microscopic analysis of sediments to determine the potential sources
- Visual inspection of the internal levels of sediment and extent of any corrosion when mains are opened for repair or other reason

Based on this assessment control points could include:

- Levels of key parameters leaving treatment works e.g. iron, aluminium, manganese, turbidity
- Regularity of agreed mains flushing programmes
- Pressure/flow variability in the network
- Modelling water age

Reference for further detailed information:

- Relevant case studies

Typical resources needed:

Management of network sediments is a major activity with potentially significant long term resource requirements. Risk based prioritisation of work though a comprehensive asset management plan is most likely to be the best way forward.

Document creation:

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