The control of legionellosis

in hot and cold water systems
MISC150

This is a supplement to *The control of legionellosis including legionnaire’s disease* ISBN 0 7176 0451 9

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WHY IS THIS GUIDANCE NEEDED?

1 This guidance has been produced as a supplement to *The control of legionellosis including legionnaires' disease* and focuses on the options for controlling legionella organisms in hot and cold water services.

2 Most guidance, both in Britain and worldwide, advocates the use of elevated water temperatures as a means of controlling legionella. Recent findings indicate that certain alternative methods can also be effective. Research on alternative control methods is ongoing and future revisions of guidance will take account of any new findings.

3 Where water temperatures above 43°C are used, scalding may be a significant risk, eg where the elderly or infirm are present. Guidance on how to control this risk can be found in *Health and safety in residential care homes* and the leaflet *Controlling legionella in nursing and residential homes*. NHS organisations and providers of health care to the NHS are also referred to the guidance contained in *The control of legionellae in health care premises*, *Hot and cold water supply, storage and mains services* and *‘Safe’ hot water and surface temperatures*.

HOW DO I REDUCE THE RISK?

4 To reduce the risk of legionellosis, the main objective is to design, maintain and operate water services under conditions which prevent or minimise the proliferation of legionella. This can be achieved by the combination of approaches outlined in paragraphs 5-28.

Selection of materials

5 Materials and fittings selected for use in water systems should not encourage the growth of legionella. For non-metallic materials, compliance with BS 6920 is generally an indication of suitability. The *Water fittings and materials directory*, published by the Water Research Centre, lists fittings and materials that are acceptable, according to byelaws for connection to the mains water supply.

System design

6 Systems should be designed to eliminate or minimise conditions under which legionella can proliferate:

- Protect systems against external contamination, eg by providing lids to storage tanks.
- Avoid water stagnation by keeping pipe lengths as short as possible and tanks no larger than is necessary. Eliminate dead legs wherever possible.
- Maintain design temperatures in both hot and cold water systems by providing efficient heating for hot water systems and adequate insulation for all pipes and fittings.
- Keep systems clean. Tanks, calorifiers and other items need to be readily accessible for cleaning. Good design principles are described in BS 6700 and *Water supplies byelaws guide*.

System operation

7 Controls placed on the operation of a water system are designed to create an environment in which legionella are either killed, or their ability to multiply is significantly restricted. Certain features need to be considered in any control strategy (see box).

Control strategy features

- **Establish control level.** The effective level of the control parameters (such as temperature, concentration of biocide etc) will need to be identified.
- **Achieve control level.** The system should be capable of delivering and maintaining the effective level. (The rate of addition of some components may need to be varied as the rate of water usage changes).
- **Ensure control level.** There should be some means of measuring the parameter to ensure that it is being achieved throughout the system.
- **Records** need to be kept of the procedures/precautions.
Conventionally, a water temperature regime has been recommended and has generally proved to be effective when there has been appropriate attention to system parameters. However, it has sometimes been difficult to achieve and maintain the hot and cold water temperatures required, especially in some older buildings with complex water systems. The temperature control strategy may also require the provision of thermostatic mixing valves if scalding is assessed as a significant risk.

Recent research has shown that there are alternative water treatment technologies which can also be effective in controlling the growth of legionella in the water system of a building. However, these alternatives, like the water temperature regime, require meticulous control in system parameters if they are to be effective.

WHAT WATER TREATMENT CONTROL SYSTEMS ARE AVAILABLE?

Temperature regime

This is the traditional approach. It is recommended that hot water should be stored at 60°C and distributed so that, after one minute of running, a temperature of at least 50°C is attainable at outlets. Cold water storage and distribution should be at 20°C or below.

At water temperatures of 43°C and above there is a risk of scalding. Where a significant scalding risk has been identified the use of thermostatic mixing valves at baths and showers should be considered to reduce the water temperature. These need to be placed as close as possible to the point of use.

For most systems routine inspection and maintenance will usually be enough to ensure control if the following checks are made and appropriate remedial action taken when necessary:

- water temperature at calorifiers;
- condition of calorifiers;
- water temperatures at a representative number of outlets;
- condition of accessible pipework and insulation;
- condition of accessible pipework and insulation;
- operation of thermostatic mixing valves.

Ionisation

‘Ionisation’ is the term given to the electrolytic generation of copper and silver ions for use as a water treatment. The results of recent research have shown that where copper and silver ion concentrations can be maintained at 400 µg/l and 40 µg/l respectively, the technique can, if properly managed, be effective against planktonic legionella in both hot and cold water systems. This is provided that the application is properly assessed, designed and maintained as part of an overall water treatment programme.

The research also found that:

- For hard water systems, silver ion concentrations can be difficult to maintain due to:
  - the build-up of scale on electrodes;
  - the high concentration of dissolved solids precipitating the silver ions out of solution.
- For both hard and soft water, the ionisation process was pH sensitive and it became increasingly difficult to maintain silver ion concentrations above pH 7.6.
- The build-up of scale and concentration of dissolved solids need to be carefully controlled so that suitable ion levels are consistently maintained throughout the system.
- Additional water treatments such as scale control, filtration, pH control and water softening may therefore be necessary, particularly in hard water areas, to overcome these problems.
- Other work suggests silver ion concentrations between 30-20 µg/l can also be effective in softened water, when a minimum concentration of 20 µg/l is maintained. This suggested level of silver still requires copper ions to complete the synergy.
18 The Water Supply (Water Quality) Regulations and Private Supply Regulations, prescribe a maximum value for the level of copper and silver in potable water supplies. It is important that installers of ionisation systems are aware of the need to avoid any breach of these Regulations and maintain copper and silver levels below the maximum allowable concentration. The local water company may need to be consulted to check that the installation complies with the requirements of the byelaws.

19 Suppliers of commercial ionisation systems will need to have considered these problems. When choosing a system you need to satisfy yourself that all the above points have been addressed satisfactorily by the supplier.

20 For most systems routine inspection and maintenance will usually be sufficient to ensure control if the following areas are monitored at regular intervals and appropriate remedial action taken when necessary:

- the rate of release of copper and silver ions into the water supply;
- the measurement of silver ion concentrations at a representative number of outlets;
- the condition and cleanliness of the electrodes;
- the pH of the water supply;
- records of all actions taken.

21 As an alternative to manual monitoring, it may be possible to automatically monitor some parameters and feed outputs into a building management system fitted with suitable alarms.

Chlorine dioxide

22 Chlorine dioxide is an oxidising biocide capable of reacting with a wide range of organic substances. There are commercial systems available that release chlorine dioxide from a stabilised precursor solution into water systems. The Drinking Water Inspectorate prescribe a maximum value for total oxidants in potable water supplies. This value is the combined chlorine dioxide, chlorite and chlorate concentration and should not exceed 0.5 mg/l as chlorine dioxide. This may set an upper limit for some applications. It may therefore be necessary to contact the local water company to check that the installation complies with the requirements of the water company byelaws.

23 Recent research\textsuperscript{12} has shown that chlorine dioxide levels of 0.5 mg/l can, if properly managed, be effective against planktonic legionella in both hot and cold water systems. This is provided that the application is properly assessed, designed and maintained as part of an overall water treatment programme. The research also found that maintaining total oxidant levels below 0.5 mg/l at outlets may be difficult in systems with a low turnover of water.

24 Suppliers of commercial chlorine dioxide systems will need to consider these problems. When choosing a system you should satisfy yourself that these points have been satisfactorily addressed by the supplier.

25 A recent study\textsuperscript{13} has shown that 0.5 mg/l chlorine dioxide successfully controlled a hospital water system which had been persistently colonised by legionella.

26 For most systems routine inspection and maintenance will usually be sufficient to ensure control if the following areas are checked at regular intervals and appropriate remedial action taken when necessary:

- the quantity of the chemicals in the reservoir;
- the rate of addition of chlorine dioxide to the water supply;
- measurement of chlorine dioxide concentration at a representative number of outlets;
- records of all actions taken.

27 As an alternative to manual monitoring, it may be possible to automatically monitor some parameters and feed outputs into a building management system fitted with suitable alarms.

Other control strategies

28 The strategies previously described are dispersive, ie they are directly effective
throughout the water system downstream to the point of application. A number of other strategies are also available, for example ultraviolet light (UV) or ozone. These systems are not intended to be dispersive and are usually designed differently to have their effect at or very close to the point of application. Although this usually results in the active ingredient not being directly measurable in the circulating system. The technology is usually designed to accommodate this factor.

WHERE CAN I GET FURTHER INFORMATION?

29 Additional information on the control of legionella is available from:

- The Health and Safety Executive’s published guidance on the control of legionella in all man-made water systems.¹,¹⁶
- The Department of Health.⁴
- The Chartered Institution of Building Service Engineers (CIBSE) technical memorandum.¹⁷
- The local water company’s inspection team. Advice should be obtained before installing any chemical dosing system which is to be connected to the mains supply.

REFERENCES

1 The control of legionellosis including legionnaires’ disease HSG70 HSE Books ISBN 0 7176 0451 9

2 Health and safety in residential care homes HSG104 HSE Books ISBN 0 7176 0673 2

3 Controlling legionella in nursing and residential homes INDG253


5 Hot and cold water supply, storage and mains services 1995 Management policy ISBN 0 1132 2176 2 Design considerations ISBN 0 1132 2177 0 Operational management ISBN 0 1132 2179 7 Validation and verification ISBN 0 1132 2178 9

6 ‘Safe’ hot water and surface temperatures Health Guidance Note 1998 ISBN 0 1132 2158 4


8 Water fittings and materials directory Water Research Centre, Henley Road, Medmenham, Marlow, Bucks, SL7 2HD. ISBN 1 8726 9956 1

9 Design, installation, testing and maintenance of services supplying water for domestic use within buildings and their curtilages BS 6700: 1997

10 Water supply byelaws guide (2nd edition) Water Research Centre ISBN 0 9021 5624 1

11 Ionisation water treatment for hot and cold water services Technical Note TN 6/96 BSRIA ISBN 0 86022 438 4

12 Chlorine dioxide water treatment for hot and cold water services Technical Note TN 2/98 BSRIA ISBN 0 8602 2486 4

13 Chlorine dioxide field study Thomas et al New Cross Hospital, Wolverhampton, WV10 0QP (unpublished study)

14 The use of copper and silver ions for control of legionella species in domestic hot water services JV Lee et al Public Health Laboratory, Queens Medical Centre, Nottingham (unpublished study)


16 The prevention and control of legionellosis (including legionnaires’ disease) Approved Code of Practice HSE Books ISBN 0 7176 0732 1
