Water quality and sterilisers: how to protect your investment

By Deborah Thame, B.Pharm and Steve Lines

"Damage to your steriliser resulting from the use of poor quality water can be so significant that such damage is normally excluded from any warranty on your steriliser..."

Water. It's a hot topic around the country at the moment as we all learn to deal with water shortages. It is also becoming a hot topic around the dental industry as the consequences of poor water quality become more significant as technology improves. Fundamentally, water is a 'solvent', able to dissolve many salts, solids and gasses into solution. Unfortunately, these 'dissolved' solids are not able to be removed from water with simple filtration as each ion is so small. Examples of common mineral contaminants include calcium, magnesium, potassium, silica, bicarbonates, iron, sodium, chloride and even heavy metals like lead, copper, aluminium and many others.

So why is it important to use high quality water in sterilisers? The quality of water used in your steriliser directly impacts in three areas: the usable life of your steriliser, the amount and cost of servicing required to maintain your steriliser in good working order and the life of the instruments that are sterilised in it. Damage to your steriliser resulting from the use of poor quality water can be so significant that such damage is normally excluded from any warranty on your steriliser. You have made a considerable financial investment in both your steriliser and your instruments - using high quality water is an important part of protecting that investment. Most operator manuals will contain the manufacturer's specifications for the quality of water to be used with their steriliser and it is very important that this is followed.

Why does poor water quality have such a significant impact? In the normal functioning of the steriliser, water is heated to a point where it vaporises to form steam. As this occurs, the soluble minerals and other contaminants are concentrated to a point where they reach saturation and precipitate. As easily seen in most domestic kettles and steam irons, the mineral content of water quickly builds up a solid scale deposit within the boiling chamber when frequent boiling occurs. In older model sterilisers, where the water is boiled in the chamber itself, this scale build-up occurs within the chamber and requires regular thorough cleaning with special solutions to remove it. In the new sterilisers using steam generator technology, the consequences are much worse as this

Figure 1. The water in the bucket has just been drained from the reservoir of the steriliser above and shows severe recycling contamination. The water in this steriliser had not been changed in six months. This is a common sight for technicians servicing sterilisers in busy practices.

scale deposits in the steam generator, which is not accessible for cleaning by the operator. The scale build-up will eventually cause blockage of small aperture components in the steam generator system and when fragments are dislodged they can cause blockages of valves and downstream components within the steriliser. Eventually, and in cases where tap water is used we can be talking about a few months, the steriliser will fail. Removal of this type of scale build-up is a time consuming and therefore expensive process, which must be carried out by your technical service company.

In addition to the problem of scale build up, water quality can impact on the instruments being sterilised in two ways. Firstly, older style sterilisers recycle their water: water from the reservoir is introduced to the chamber and heated to form steam, then cooled and returned to the reservoir. Water that is recycled through a steriliser can become contaminated with oils and other non-biodegradable contaminants. These contaminants can affect your steriliser and may be deposited on subsequent loads and ultimately your next patient. It is very important that the reservoir water is changed regularly to minimise this potential hazard (Figure 1). Most new sterilisers, notably the European Norm compliant ones, do not recycle water and thus avoid this problem.

Secondly, use of poor quality water in any steriliser may also result in contaminant 'carryover' into the steam and create corrosion problems and deposits on the instruments being sterilised. This problem is significant and the cost of replacing instruments prematurely is easily avoided by using good quality water.

Sourcing high quality water for your dental practice is a matter of choice. You may prefer to buy water or you may prefer to produce it on site. The 4 most suitable water purification options for on-site production are:

1. Reverse Osmosis (RO)

Reverse Osmosis is a membrane process that acts as a molecular filter to remove 95 to 99% of dissolved mineral salts. To protect the RO membranes from damage, a carbon filter is required before the RO membrane to remove chlorine. This is often coupled with a pre-filter to remove the 'suspended solids' from the water prior to it entering the membrane.

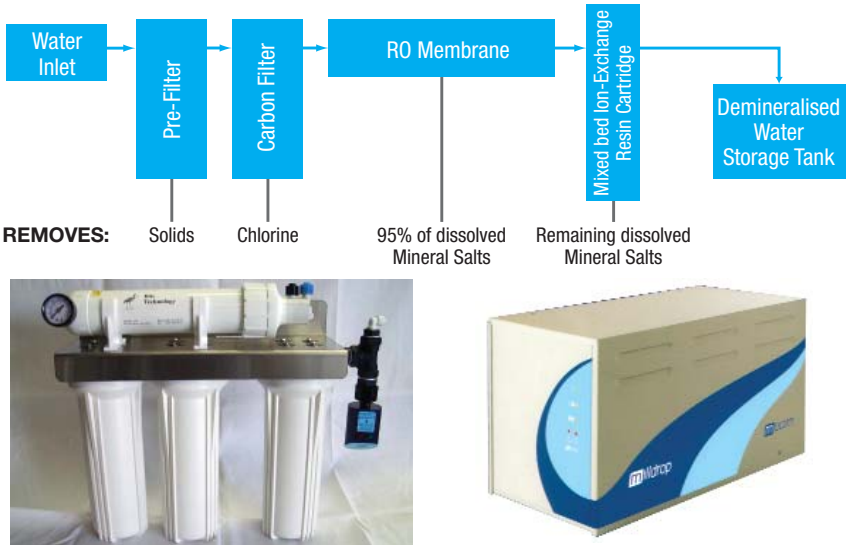

Figure 2. The process steps commonly used to produce high quality water suitable for use in a steriliser and examples of integrated Reverse Osmosis and Ion Exchange systems.

Figure 3. Example of distiller systems for use with bench top sterilisers.

2. Ion Exchange Resins (IX)

The most common resins used are 'Sodium Softener Resin' for removing only Calcium and Magnesium water hardness and 'Mixed-Bed Resin' for removing all dissolved mineral salts. The resin cartridges need to be replaced when they have been 'exhausted'. This technology is not economical to use alone as the regular replacement of cartridges required makes it very expensive.

3. Reverse Osmosis AND Ion Exchange Resins (RO/IX)

Due to the limitations of RO and Ion Exchange resins to perform their tasks economically in isolation, the two technologies are often coupled together to form a smart solution. Figure 2 outlines the process steps commonly used to produce high quality water suitable for use in a steriliser.

4. Thermal Distillation

A water distiller heats tap water up to 100°C, converting the water to steam and leaving behind the dissolved contaminants and mineral deposits in the base of the boiler. The steam vapour is then condensed into pure 'distilled' water and then passed through an integrated Carbon Filter to assist in removing organics and volatile organic carbons (VOC's). It is important to manually remove the scale residues after each cycle, and perform thorough cleaning after several operating cycles to ensure the distiller continues to operate efficiently and the quality of the water remains constant over time.

Whether you are buying water or producing your own, you need to ensure the quality of the water is appropriate. There

are a number of technical terms used to indicate the quality of water:

TDS = Total Dissolved Solids
PPM = Parts Per Million
mg/L = milligrams per litre
MΩ = Mega ohms of resistance
µS/cm = micro siemens per centimetre

As 'pure' water does not conduct electricity, but water with dissolved impurities does, a mathematical relationship between Conductivity and TDS can be derived within accuracy limitations. This then allows tests to be carried out at the dental practice to test the water conductivity and thus determine µS/cm and approx. TDS.

In practical terms, the lower the TDS the better and in most steriliser manufacturer's manuals, the minimum water quality (along with maximum individual solutes) will be advised. This may be indicated either in TDS, µS/cm conductivity or mg/L.

To ensure the integrity of the sterilised instruments and the optimum performance and life of the steriliser, use only a high quality deionised water; never use tap water, even rainwater can be highly contaminated with minerals. Supermarket distilled water is often not suitable for most new sterilisers. Check your steriliser manual for the manufacturer's water specifications. If you are buying your water, request the specification

Figure 4. Convenient TDS Meters used to regularly check water quality for bench top sterilisers.

of the water from the supplier if it is not printed on the label. If you choose to use one of the many quality in-house water purification systems, check the specifications from the system manufacturer and ensure a procedure to replace cartridges regularly, as the quality of water will reduce significantly with the age of the cartridge. Regular testing of your water with a TDS Meter (Figure 4) will assist in ensuring that water quality from your system has not deteriorated below specifications.

Using high quality water is a very cost effective way to protect the substantial investment you have made in your sterilising equipment and instruments.

About the authors

Deborah Thame is the co-founder and Managing Director of STS Health. A pharmacist by profession, she spent many years teaching in the School of Pharmacy at Curtin University and for the last decade, with her company STS Health, has specialised in the area of sterilisation and sterilisation equipment.

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STS Health is a wholly owned Australian company specialising in the distribution and servicing of steam sterilisers and associated equipment. If you are interested in learning more about this topic contact info@stshealth.com.au or call (08) 9244-4628.