Water Provision for Steam Generation in Steam Sterilisation

Practical tips from the Sterilisation Section of the German Society for Hospital Hygiene – DGKH e.V.

Extract from Annex 1 of the Recommendations by the German Society for Hospital Hygiene (DGKH) for validation of steam sterilisation processes revised by R. Fleischhack, H. Hahmann, P. Kober, U. Kaiser, E. Dennhöfer*

The quality of the water used as feed water is of special importance for the steam quality and hence for the sterilisation process. It is determined essentially by the method used to process the water. Water processing is intended as a means of fully or partially removing the non-condensable gases, hydrogen carbonates and any other dissolved mineral salts from the water. DIN EN 285 specifies corresponding limit values for the chemical and gaseous components permitted.

Information must be obtained from the regional water supply service on the composition of the drinking water (results of analyses) and on the processing methods employed.

How oxygen is supplied to remove iron and manganese may be of special interest in the context of steam generation for sterilisation. Compressed air and oxygen dosages are examples of the methods employed.

The former method, especially, transports a large quantity of dissolved gases (in particular oxygen and nitrogen) to the consumer. Special attention must be paid to this water when subjecting it to further processing to obtain feed water for steam generation.

The customary method of processing water for Central Medical Devices Processing (CMDP, CSSD) in the hospital is as follows:

- Water softening
- Reverse osmosis
- Ion exchangers/mixed-bed exchangers
- Storage containers for demineralised water
- Conveyance to the consumers in CMDP, CSSD

Water softening removes the hydrogen carbonates present in the water as they are broken down by heat to CO_2 and carbonates (limescale).

The reverse osmosis system is able to remove around 90% of the salts from raw water but not the CO_2, oxygen and nitrogen dissolved in the water.

Postconnected ion exchangers (series connection of 2 recommended) can remove any remaining salts as well as the CO_2. Silicates, however, pass through ion exchangers before onset of a change in conductance. This is counteracted by, as proposed, connecting the ion exchangers in series. Large quantities of dissolved nitrogen are not trapped by any of the aforementioned processing aids. Hence special measures must be taken here.

Impeccable functioning of the steriliser can be assumed for conductance values that are continually below 5 mS/cm in the feed water used for the steam generator. In line with recent findings, this value deviates from that specified hitherto in DIN EN 285, Annex B.

Processed water has a very high affinity for all gases present in its immediate environment and thus quickly dissolves them back. This occurs especially if the water surface in the storage container is greatly enlarged due to the collision resulting from the addition of water. This tendency to dissolve back gases must therefore be counteracted by observing what is known as "subsurface filing". This ensures that the surface of the water in the storage container is kept relatively calm and that not too much air, or especially carbon dioxide, is dissolved back.

When the water, which has been processed and stored in a storage container, is supplied to the consumer it contains dissolved oxygen and nitrogen (approx. 25 – 30 ml gas/l water). This proportion has no adverse effect on using demineralised water in washer-disinfectors.

To generate the sterilant "saturated steam", the presence of such gaseous additions in the form of non-condensable gases (NCGs) can have important implications. Hence the latter should be removed by as far as possible resorting to thermal degassing. Otherwise this quantity of dissolved gas would be conveyed into the chamber together with the steam on each subsequent occasion that water is supplied.

The conductance value of the first ion exchanger should be measured and documented daily as a proof of the conductance of the feed water mediated by carbon dioxide. A limit-value signalling device should be used to round off conductance measurement.

Conductance mediated by carbon dioxide will be eliminated if processing is properly effected using postconnected ion exchangers and thermal degassing of the feed water at a boiling point temperature for water under standard conditions. In this respect, the conductance value measured is an indicator of the steam quality.

Ion exchangers have a finite capacity and must be replenished from time to time. The silicate problems mentioned can be overcome by connecting the ion exchangers in series as recommended.

If there are noticeable signs of adverse effects on the sterile supplies and chamber (e.g. discolorations, deposits) following sterilisation, carrying out water analysis as per DIN EN 285 is advisable, in particular before the initial validation, regardless of the type of steam supply. If this water analysis is unable to identify this problem, other troubleshooting measures must be taken (e.g. contamination of the feed water storage container, use of inhibitors, rustproof pipes, etc.).

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