Reverse Osmosis (RO) Basics and Methods of Achieving AS/NZS 4187:2014

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Presentation Overview

- AS/NZS 4187:2014 requirement for Final Rinse Water
- EN285 requirement for sterilisation – RO water requirement to produce clean steam
- Definition of Terms
- Brief introduction to Reverse Osmosis (RO)
- RO plant design requirements to meet compliance

AS / NZS 4187:2014 and EN285

CONTINENTAL WATER

Amended AS/NZS 4187:2014

- Final rinse water quality:

Parameter	Units	AS/NZS 4187:2014
Mineral residues	mg/l	-
Silicates (SiO_2)	mg/l	0.2
Iron	mg/l	2
Cadmium	mg/l	-
Lead	mg/l	10
Heavy Metal Residues, except for iron, cadmium, lead	mg/l	-
Chloride (Cl)	mg/l	10
Phosphate (P_2O_3)	mg/l	0.2
Conductivity	µS/cm at 20 ^oC	30
pH value (degree of acidity)	-	5.5 – 8.0
Appearance	-	Clear, colourless
Hardness ∑ (of alkaline earth ions)	mg/l as $CaCO_3$	50
Total viable count	cfu/100 ml	100
Endotoxin	EU/ml	0.25

EN285 - RO water requirement to produce clean steam

Substance	Maximum concentration levels	
	Feedwater for dedicated steam generator	Steam condensate measured at the steriliser inlet
Appearance	Clear, colourless without sediment	Clear, colourless without sediment
pH	5 – 7.5	5.0 – 7.0
Conductivity at 25 °C	≤ 5 µS/cm	≤ 3 µS/cm
Cadmium	≤ 0.005 mg/l	≤ 0.005 mg/l
Total Hardness [$CaCO_3$]	≤ 0.02 mmol/l	≤ 0.02 mmol/l
Chloride [Cl]	≤ 0.2 mg/l	≤ 0.1 mg/l
Lead [Pb]	≤ 0.05 mg/l	≤ 0.05 mg/l
Iron [Fe]	≤ 0.2 mg/l	≤ 0.1 mg/l
Phosphate [P_2O_3]	≤ 0.5 mg/l	≤ 0.1 mg/l
Silicates [SiO_2]	≤ 1 mg/l	≤ 0.1 mg/l
Endotoxin [EU/ml]	-	0.25*

* Steam condensate in relation to contamination of the load

Definition of Terms

Biofilm

- Microorganisms in fluid colonise surfaces results in biofilm formation even when levels of microbial contamination are low.
- Microorganisms living within biofilms produce a slime matrix which protects them against disinfection.
- In order to control the formation of biofilm within a water treatment system, disinfection procedure should be applied from the start of the operation.
- Once formed biofilm is difficult, if not impossible, to eradicate.

Therefore all strategies for microbial control of the water treatment system should be proactive in order to limit microbial growth and biofilm formation (biofouling).

Endotoxins

- “Endotoxin” is a toxin that is released from the cell surface of Gram-negative bacteria either through its growth and cell division (small amounts) or on the cell's death (large quantities).
- Endotoxins when introduced into human body, can cause a fever-like reaction and other adverse effects.
- If gram-negative bacteria are present in the pipework or equipment, any form of sanitisation such as chemical disinfection, steam sterilization or hot water sanitisation will generate endotoxins.

Why worry about endotoxins when everything is terminally sterilized?

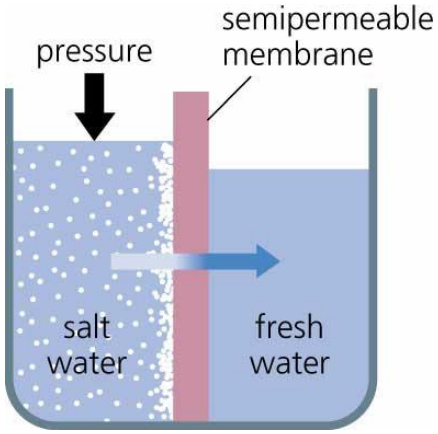
Endotoxins are not readily inactivated by chemicals. They are extremely heat stable, remaining viable even after conventional autoclaving, and have been shown to require a temperature of 180°C for at least 3 h or 250°C for 30 min to be destroyed.

As a result, a proactive solution is required for the control of infection.

Introduction to RO Technology

What is Reverse Osmosis?

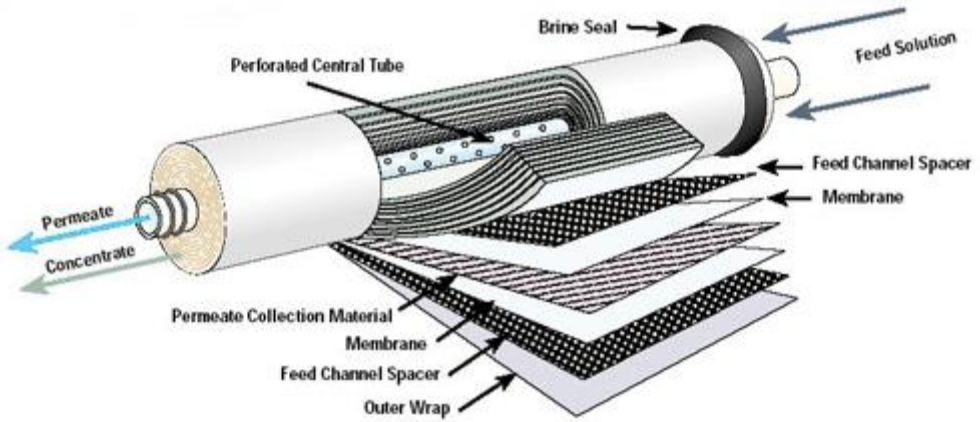
- Reverse Osmosis is a membrane separation process used to purify water.
- Pressure is applied to force water through a semipermeable membrane, while leaving impurities on the feed side of the membrane.



- The membrane allows the solvent (water) to pass through but retains a large percentage of impurities such as dissolved inorganic, organic, bacteria and pyrogens.

Major Issues with Reverse Osmosis

- Need the removal of chlorine prior to treatment – membranes are not chlorine tolerant
- Can remove bacteria and endotoxins entering the RO membranes but not a sterile design – bacteria proliferation possible



AS/NZS 4187:2014

- Final rinse water quality:

Can be achieved using RO

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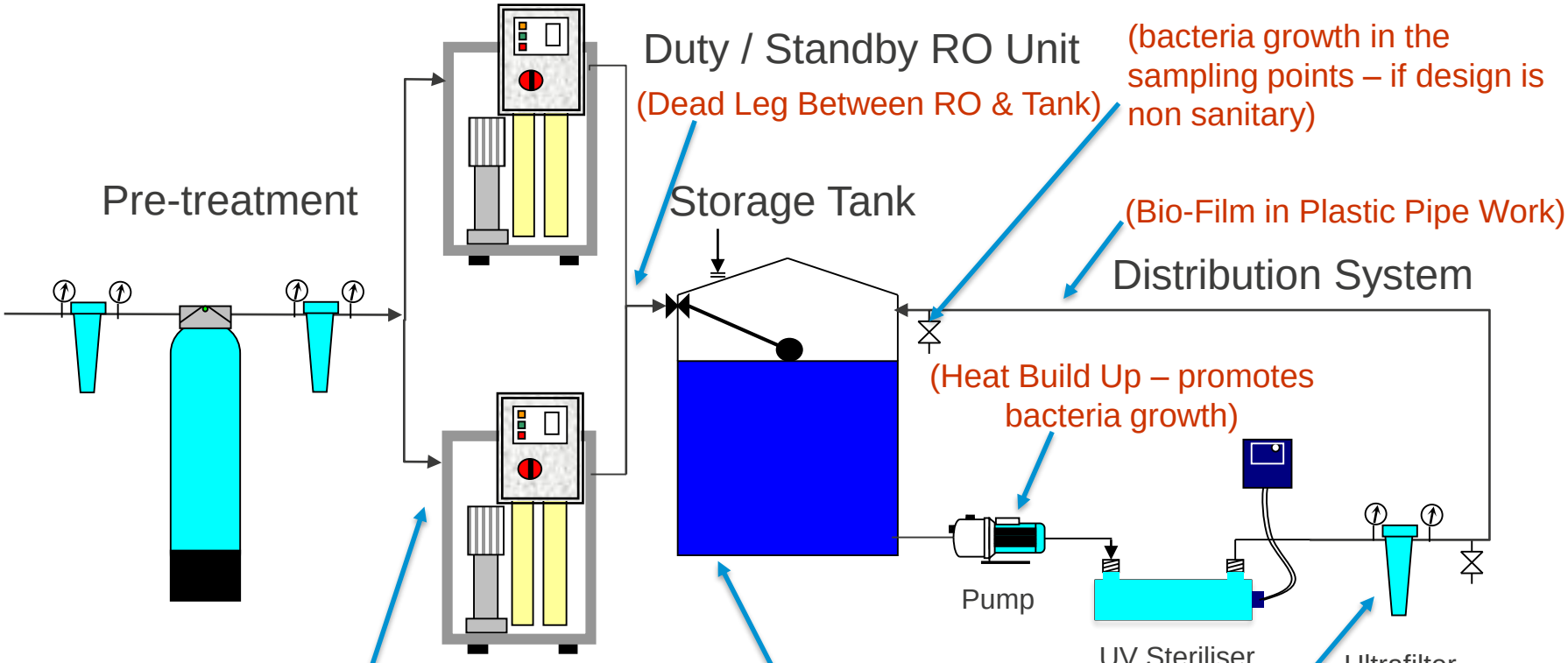
Can be achieved using RO technology

Design of Water Treatment Plant

Compliance vs Non-compliance

Typical RO Plant



CONTINENTAL WATER

Conclusion

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It should be emphasised that if the RO system is not designed adequately for the control of bacteria (with a minimum ringmain velocity, minimum dead leg for bacteria / biofilm growth) and is not regularly disinfected and validated (i.e. Water samples should be routinely taken to demonstrate compliance), meeting AS/NZS 4187:2014 microbial specification is a “hit and miss”.

Instead, the proliferation of bacteria is not uncommon in a poorly designed and maintained water treatment and distribution system**.**

CONTINENTAL WATER

Conclusion Continue….

The system has to be designed to be simple and easily sanitised by the CSSD manager when or if required.

This is critical as there might be times when a unexpected high microbial count is found in the town water supply (can occur in an event of a natural disaster such as floods), the CSSD manager should be able to carry out the sanitisation process to resolve this (without relying on the equipment supplier).

Thank you for your attention

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