Processes **CONSIDERED**

Microfiltration and Ultrafiltration

Microfiltration or ultrafiltration processes are under consideration as the first stage of the *Water2WATER* treatment process.

Membrane filtration is a process of separating particles from water as it passes through a physical barrier (a membrane with pores). Depending on the application and geometry of the membrane, this can be either under a positive pressure on the feed side of the membrane, or by drawing the water through the membrane by applying a negative (vacuum) pressure on the filtrate side of the membrane. Particles greater than the pore size of the membrane are retained on the feed surface of the membrane.

The size of particles removed by the membrane depends on the effective pore size of the membrane. Figure 1 gives details on the size of particles of interest in water treatment and the separation processes which can be used in their removal.

Microfiltration (MF) membranes generally have larger pore sizes than ultrafiltration (UF) membranes. Microfiltration will typically remove all bacteria, Giardia cysts and Cryptosporidium oocysts. Ultrafiltration will typically remove all bacteria, Giardia cysts and Cryptosporidium oocysts as well as most virus particles (refer to Figure 2).

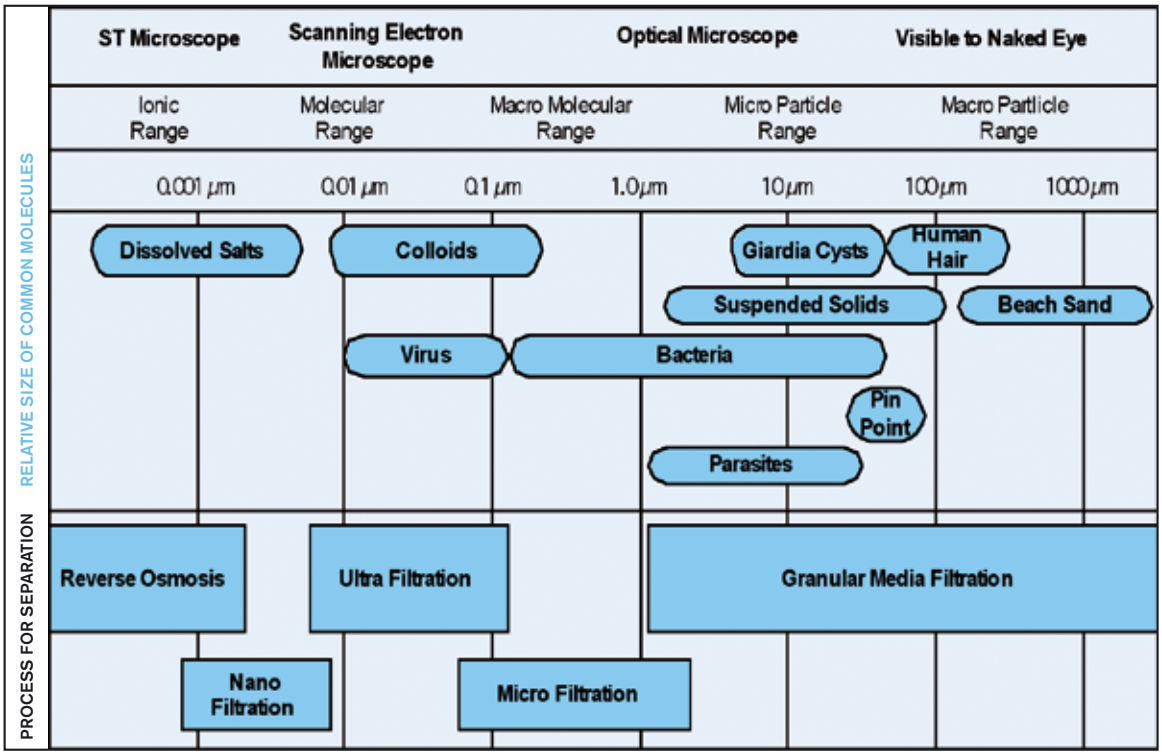

Figure 1: Particle size and water filtration processes

MF membranes are generally considered to have a pore size range of 0.1 – 0.2 µm (nominally 0.1 µm), although there are exceptions, as MF membranes with pores sizes of up to 10 µm are available. For UF, pore sizes generally range from 0.01 – 0.05 µm (nominally 0.01µm) or less[1] . [1 µm (micron) is 0.001 mm or one millionth of a metre.] The fibres vary in diameter and length between manufacturers. The most common configuration of MF / UF filter modules comprise of a large number of porous hollow fibres. Normally a treatment plant will have a large number of membranes and the membranes are bundled together in racks (refer to Figure 3). Membrane fibres are made from a range of synthetic polymers including polyethylene, polypropylene and polysulphone depending on the manufacturer. Typically each module is checked before it leaves the factory to ensure it meets validation criteria, and that there are no defects.

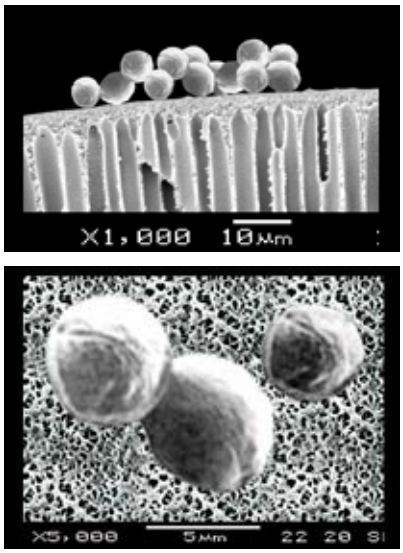

Figure 2: Cryptosporidium oocysts captured on membrane surface
Figure 3: Part of microfiltration process at Seletar NEWater plant, Singapore

Solids filtered from the water are backwashed off the membranes approximately every 30 minutes, with backwash water returned for reprocessing. Regular chemical cleaning of the membranes is undertaken to remove any adhered solids.

The integrity of MF and UF membranes may be checked by two methods - firstly by continuous online monitoring of the water passing through the membrane filter by using particle counters and turbidity meters. Secondly, by performing regular 'air pressure hold' (or 'pressure decay') tests on membrane modules while that part of the filter plant is offline, to detect any broken membrane fibres.

[1]United States Environmental Protection Agency, *Membrane Filtration Guidance Manual*, 2005, p. 2-3.

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