PRODUCT OVERVIEW ULTRAFILTRATION

water | wastewater | treatment | recycling

Clearmake
a mak water company

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Overview

MAK Water's ultrafiltration (UF) plants are designed to treat surface water, tertiary treated effluent, storm water and waste water to achieve potable/process water or may be used as pre-treatment to reverse osmosis.

It treats a wide range of highly variable waters with <300 NTU of turbidity and <150 mg/L of suspended solids, producing ultra clear water, with turbidity <0.1 NTU, that is free of viruses and bacteria.

The MAK UF plants are available as skid mounted or containerised systems.

Key Advantages:

- Pore size of 0.08 micron rejects fine colloidal particles
- Physical barrier to viruses and pathogens
- Up to Log 4 reduction for viruses & bacteria
- Membrane selection tailored to customer requirements
- Robust and simple to operate and maintain
- Fully automated system minimises operator attendance
- Factory tested prior to delivery

MAK Skid Mounted 1,500 m^3/day UF Plant

MAK Containerised 165 m^3/day UF Plant

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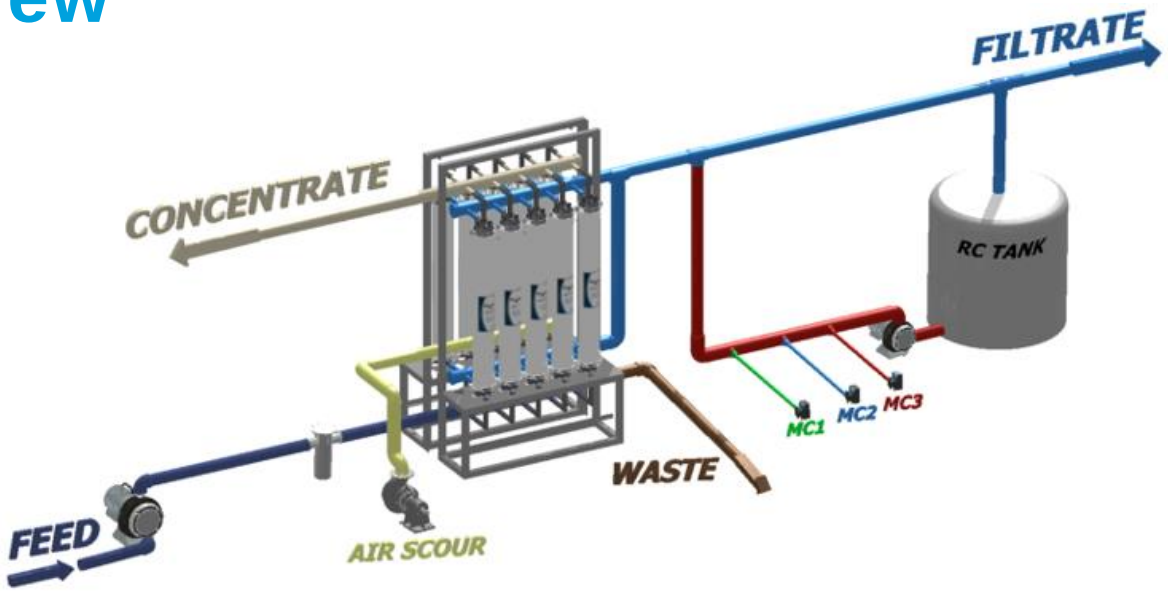
Overview



The standard treatment process includes pre filtration (150 micron screen filter), ultrafiltration, and automated UF membrane cleaning systems (comprising air scouring & chemically enhanced maintenance cleaning) and a CIP/recovery clean system. Optional automated membrane integrity testing (pressure decay test) is also available.

Additional pre-UF and post-UF treatment steps (such as chemical dosing, iron & manganese removal, pH & hardness correction, sterilisation etc) may be added as required to suit feed water conditions and/or treated water quality requirements.

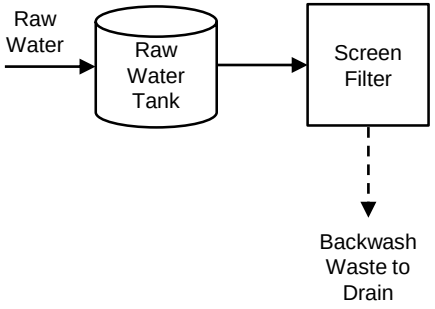
MAK UF systems utilise the “Outside to Inside” filtration concept, and can be configured in “dead end” or “cross flow” mode. The MAK UF plants are available as skid mounted or containerised systems.

Overview

The following table summarises typical raw water and treated water values.

Parameter	Unit	Raw Water (max)	Treated Water (typical)
Recovery Rate	%	-	90-98% (varies according to feed water quality and UF configuration)
Turbidity	NTU	300	<0.1
Total Suspended Solids	mg/L	150	<0.1
Temperature	°C	≤40	-
Bacteria & Viruses	Log removal	-	≥4

Process Steps

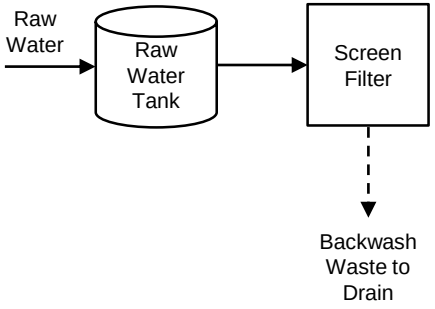


Screen Filter

The UF feed pump (with optional VSD), takes suction from the raw water tank and pushes the raw water through the fully automatic screen filter (typically 150 micron), which protects the UF membranes from damage by debris.

The filter is fitted with a pneumatic motor driven self-cleaning mechanism. Raw water enters from the strainer inlet and passes through the screen. Clean water flows through the strainer outlet. The gradual build-up of particulates on the inner screen surface causes an increase in the pressure differential across the screen.

Process Steps



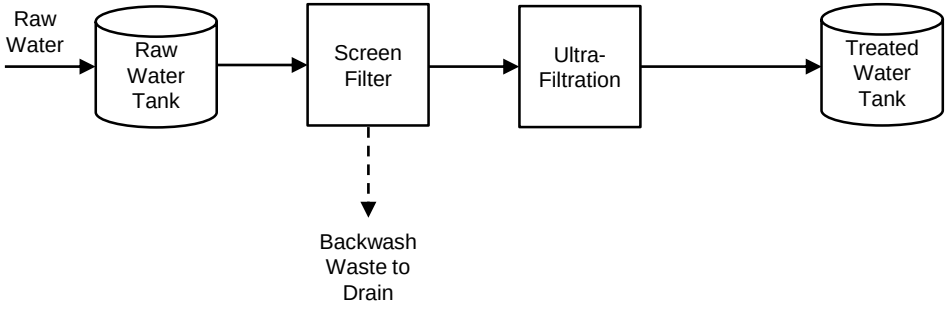
Screen Filter

A differential pressure transmitter continuously monitors the differential pressure across the screen, when the differential pressure reaches a set point, the cleaning process begins.

Cleaning of the filter is carried out by the suction scanner which spirals across the screen (driven by motor). The open drain valve creates a high velocity suction stream at the nozzle tip which “vacuums” the filter cake from the screen. During the self-cleaning process filtered water continues to flow downstream.

For smaller plants, or where capital constraints outweigh the need for automation, the screen filter can be supplied with a manual cleaning function, whereby an operator would periodically clean the filter.

Process Steps

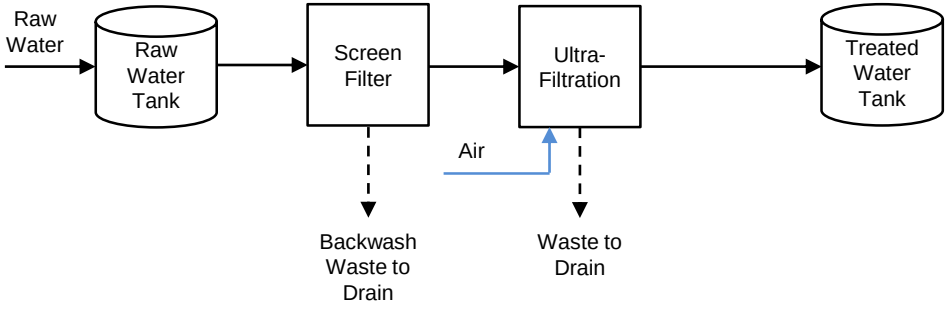


Ultrafiltration

From the screen filter, the water flows through a supply manifold and is evenly distributed to the, outside-in UF membranes. The feed pump will regulate pressure to the UF modules, which thus controls the flow.

Where ClearAccess™ remote monitoring is installed, feed water and filtrate flow, membrane feed and discharge pressure and filtrate turbidity and are continuously monitored; alarms are generated by any abnormal readings.

Process Steps



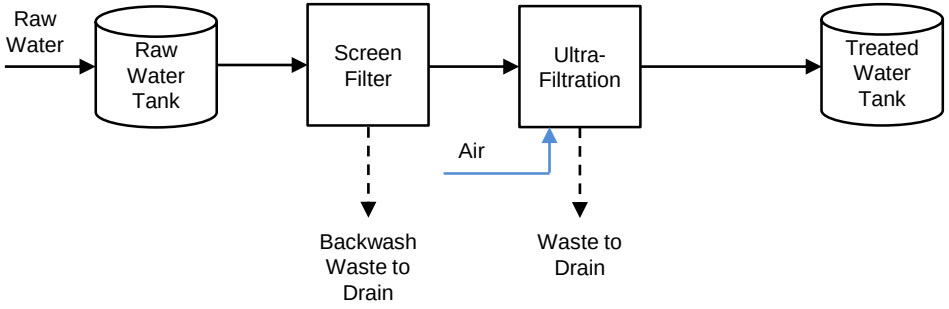
Membrane Cleaning – Air Scour System

Automated air scouring is the primary means of physically cleaning the membranes. The UF membrane racks will periodically be taken out of filtration for air scouring.

Although the air scouring interval is normally controlled by a timer, where ClearAccess™ remote monitoring is installed, pressure transmitters monitor the operating trans-membrane pressure (TMP) and will override the timer, if the TMP exceeds a preset level, and raise an alarm, giving the operator an option to manually initiate an air scour.

When an air scour is initiated, low pressure air is introduced at the bottom of the modules. As the air is evenly distributed throughout the module cross section, coarse bubbles are formed.

Process Steps



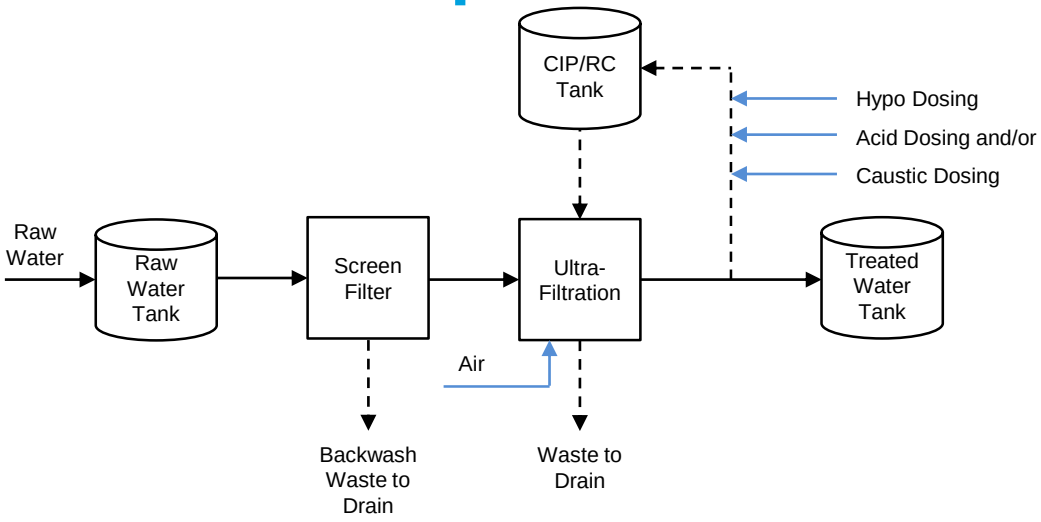
Membrane Cleaning – Air Scour System

As the bubbles rise through the module on the outside of the fibers, a scouring type action is created on the surface of the membranes. Additionally, the bubbling shakes and agitates the fibers. This combination of the scouring and agitation effectively removes particulate matter from the membrane surface.

After the set amount of time, the particulate matter removed from the membrane surface is drained from the module. Low pressure air continues to be introduced to the module during this step, which prevents matter from re-depositing on the membrane surface and decreases drain time by slightly pressurising the module.

After the module is drained, the modules are refilled with feed water and filtration resumes.

Process Steps

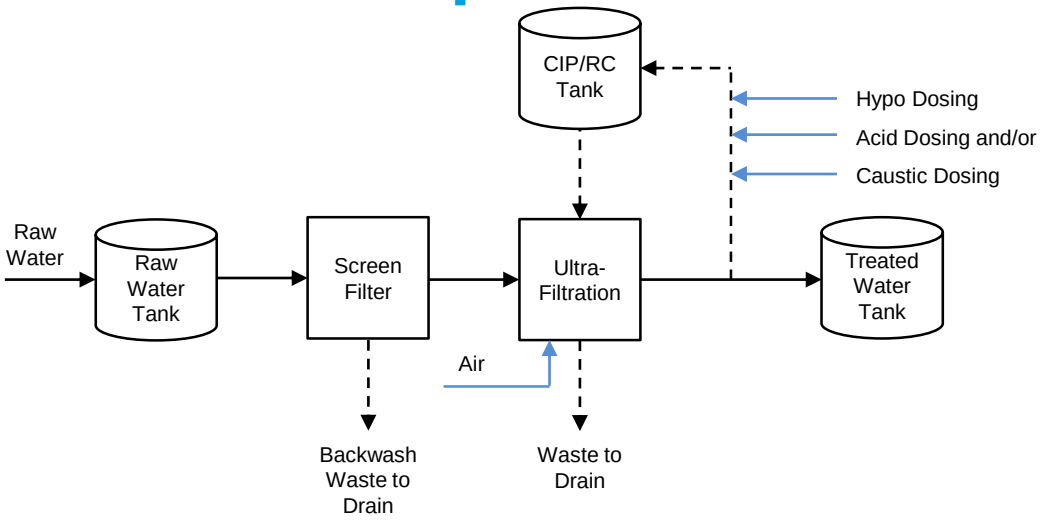


Membrane Cleaning – Maintenance Clean System

Automated maintenance cleaning is the primary means of chemically cleaning the membranes, to remove particulates not readily removed during normal air scouring. Periodically, the UF system is taken out of filtration for maintenance cleaning in order to maintain the permeability of the membranes in the desired range.

As UF filtrate is used as the makeup water for maintenance cleaning, the maintenance clean system is incorporated within the Clean in Place (CIP)/Recovery Clean (RC) system design and chemical solution (hypochlorite + caustic and/or acid) is dosed inline on the CIP/RC pump discharge.

Process Steps



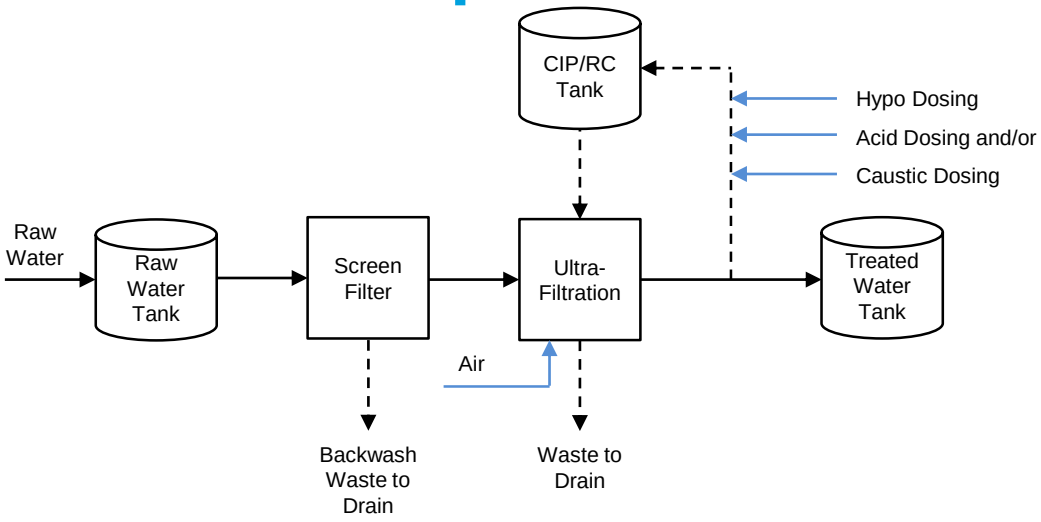
Membrane Cleaning – Maintenance Clean System

Once the modules are filled with the chemical solution, a combination of soaking and scouring is effective for removing foulants and maintaining membrane permeability in the desired range.

At the end of the cleaning, during the chemical rinsing step, feed water is pumped through the membranes to the filtrate side and diverted to drain, prior to resuming normal filtration.

The hypochlorite, caustic and/or acid storage tanks are fitted with low level switches to alert the operator of a low level condition; the tank levels should be checked and topped up as required.

Process Steps



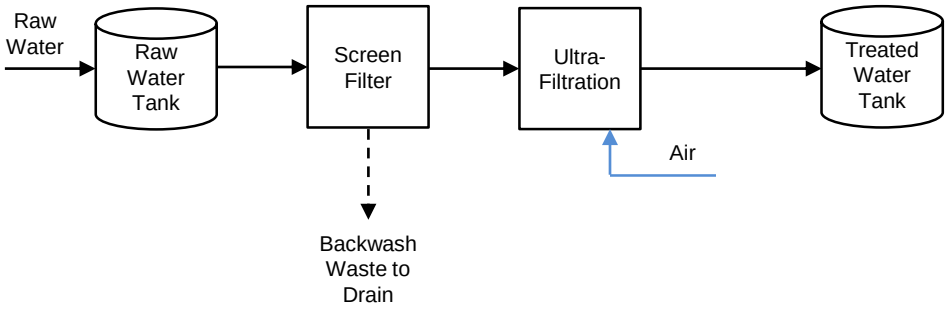
Membrane Cleaning – CIP/RC System

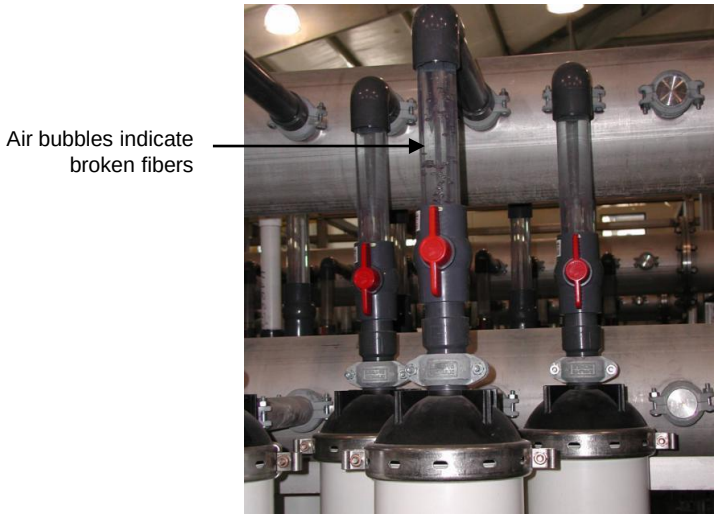
As a supplement to maintenance cleaning, the UF system will require more intense chemical cleaning to fully restore the membranes to a clean condition.

A CIP system is provided for routine membrane recovery clean; the chemical clean is a fully automated function requiring no operator intervention, whereby elevated levels of hypochlorite, caustic and/or acid chemicals are dosed inline on the CIP/RC pump discharge; the CIP/RC pump takes suction form the CIP tank and feeds the CIP solution to the UF membranes.

A recovery clean is typically performed every 30~90 days, depending on operating conditions.

Process Steps – Options





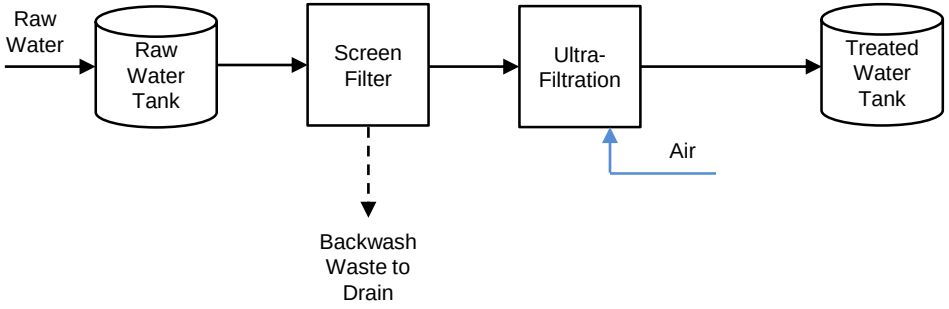
Automated Membrane Integrity Test (Pressure Decay Test) System

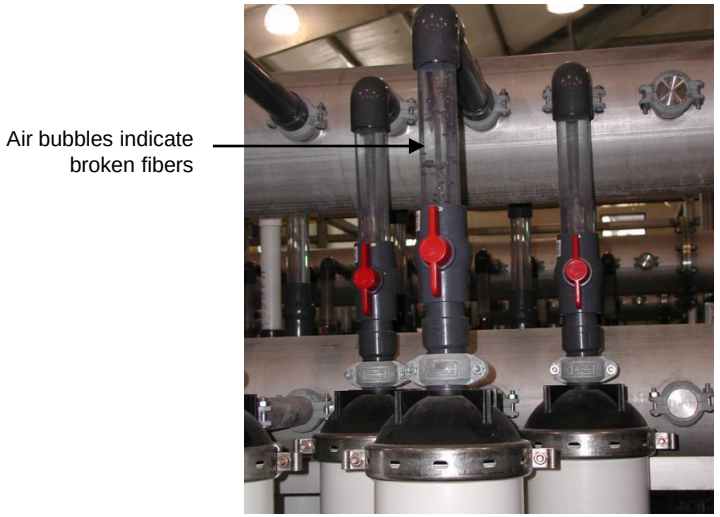
A pressure decay test can be incorporated into the system to determine the integrity of the membranes.

The theory behind the pressure decay test is based upon the bubble point principle, which basically states that the pressure required to force an air bubble through a pore is inversely proportional to the size of the pore. This means that low pressure air should not pass a wetted UF membrane.

The filtrate side is drained and pressurised as the feed side is left open to atmosphere. A broken fiber will allow a rapid escape of the pressurised air. This air can be seen as a clear piece of pipe is included in the line leaving each UF module.

Process Steps – Options





Automated Membrane Integrity Test (Pressure Decay Test) System

When the MIT is initiated, the membrane integrity test valve opens, allowing air into the filtrate end of the module, and the concentrate valve opens. All other valves are closed. During this time, the water is completely purged from inside the fibers and the air pressure is allowed to stabilise at the test start pressure.

After the test pressure has stabilised, the membrane integrity test valve closes and the test pressure is monitored. If broken fibers are present, the decay rate will be faster than acceptable and the system will alarm.

The automated air pressure hold and air leak tests, in conjunction with on-line turbidity monitoring, are effective means of ensuring membrane integrity.

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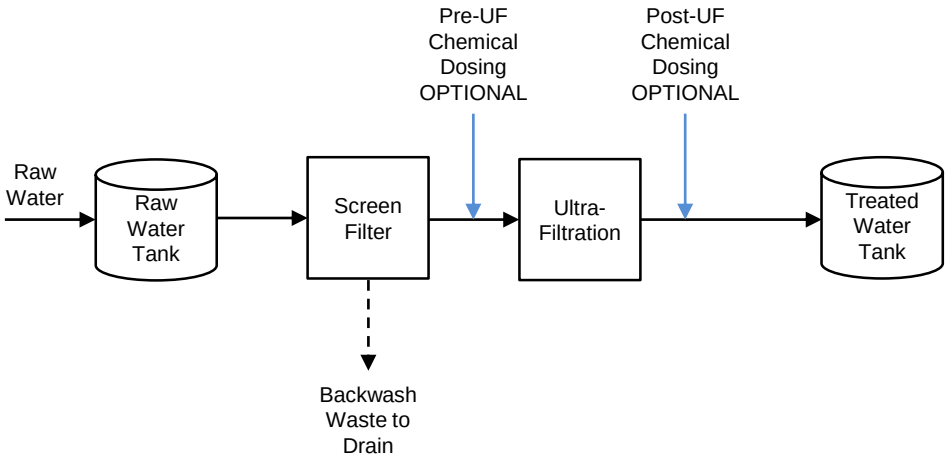
Process Steps – Options



Acid, caustic and sodium hypochlorite dosing systems

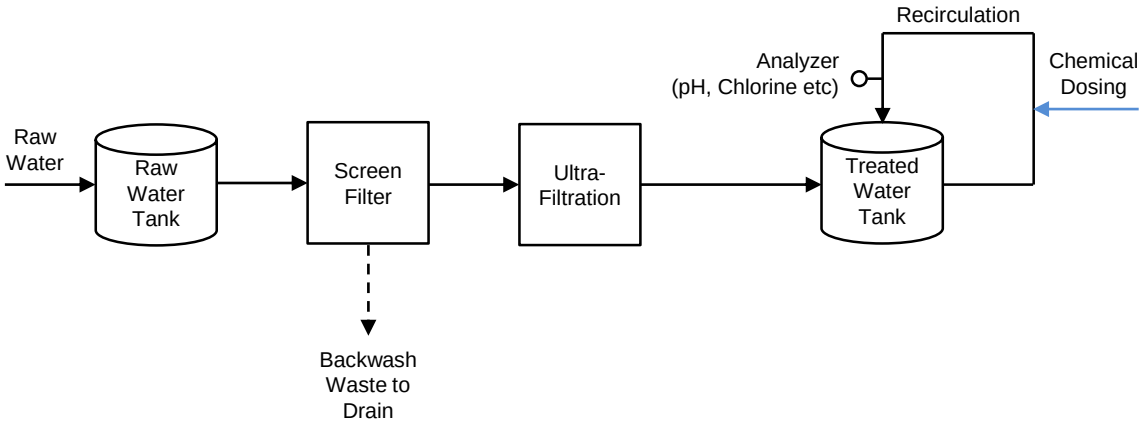
Pre/Post-UF Chemical Dosing

Pre and post UF chemical dosing systems may be added as required to suit feed water conditions and/or treated water quality requirements. Typical chemicals include acid and/or caustic for pH correction, sodium hypochlorite for sterilisation or iron/manganese oxidation, sodium meta-bisulphate for chlorine neutralisation, and calcium chloride for hardness correction.

Depending on the application, chemical dosing rates are pre-set based on the flow rate (i.e. flow paced), or automatically controlled by the PLC, based on online instrumentation (such as pH, ORP or chlorine analysers) downstream of the dose point.

All chemical storage tanks are fitted with a low level switch to alert the operator of a low level condition; the tank levels should be checked regularly and topped up as required.

Process Steps – Options



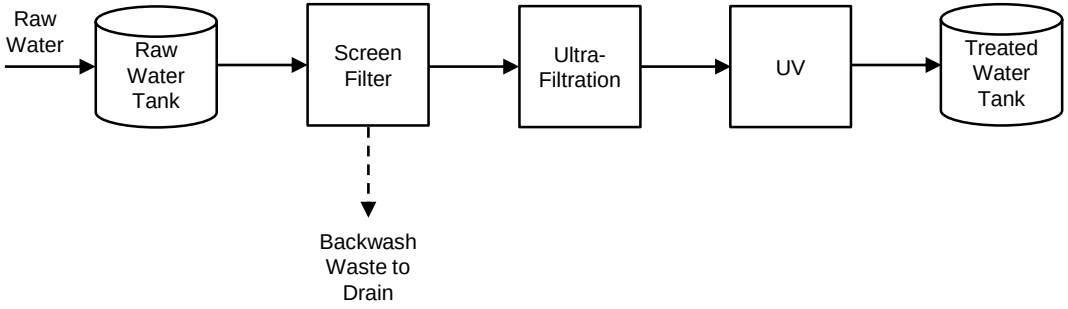
Treated Water Recirculation & PLC Controlled Chemical Dosing

UF filtrate may be dosed with chemicals such as acid or caustic for pH correction, or sodium hypochlorite to maintain a sterile water supply.

The re-circulation pump circulates the treated water inside the treated water tank on a continuous basis. The treated water re-circulation line is fitted with an analyser (pH, chlorine etc), which in turn controls the dosing of chemicals (acid, caustic, hypochlorite etc) as required to maintain the set point at all times.

The chemical concentration in the treated water (e.g. pH, free chlorine etc) is continuously monitored; alarms are generated by any abnormal readings.

Process Steps – Options



Sterilisation with UV

The UF permeate passes though the UV steriliser, which delivers a massive dose of UV radiation (typically >40 mJ/cm^2 @ 85% UVT), ensuring effective eradication of viruses and pathogens.

The on-board UV intensity monitor continuously monitors the UV intensity; an alarm is generated if the UV intensity drops below the minimum requited dose rate.

Pre-validated UV systems are available on request.

Projects Experience

Project	Alinta Energy
Location	Leigh Creek, South Australia
Date	2014
Scope	Decommission old plant, design & construct new plant, commissioning & operator training
Capacity	1,500 m^3/day
Raw Water	Surface (Dam) Water
Treated Water	Potable
Features	Remote monitoring & control Fully automated membrane cleaning systems Membrane integrity testing Delivered within a small footprint Gas chlorination Fast 7 week delivery

Projects Experience

Project	Construction Camp
Location	Combabula, Queensland
Date	2014
Scope	Design & construct, commissioning & operator training, service & maintenance
Capacity	165 m3/day
Raw Water	Bore Water
Treated Water	Potable Water
Features	Containerised solution Treated water recirculation with PLC controlled hypochlorite dosing & free residual monitoring Powered by a combination of solar power & diesel generators Built to MAK Water specifications

Projects Experience

Project	Exxon Mobil PNG LNG Project
Location	Highlands Papua New Guinea (PNG)
Date	2014
Scope	Design & construct, commissioning & operator training, service & maintenance
Capacity	360 m3/day
Raw Water	Surface Water
Treated Water	Potable Water
Features	Containerised solution with 2 x 100% treatment trains and duty/standby dosing pumps Raw & treated water recirculation with PLC controlled acid + caustic + hypochlorite dosing & free residual + pH monitoring Flow paced calcium chloride dosing for hardness correction Tertiary sterilisation via UV Automated membrane integrity testing 20 Year Mechanical/Electrical Design Life

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