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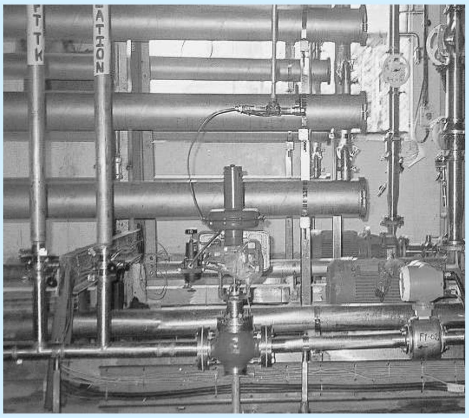
Troubleshooting Ultra Filtration in High Purity Systems

High purity systems are extremely critical for the production process of the pharmaceutical and electronics industries. This article outlines some simple, practical inspection and trouble shooting protocol observations, to help resolve problems encountered with ultra filtration (UF) in high purity water systems.

In most high purity systems the final treated water quality is ensured and enhanced by the use of ultra filtration (UF) membranes. UF is a membrane process with the ability to separate molecules in solution based on size. It is a pressure driven process with a typical nominal pore size of 0.01 micron (100,000 to 6,000 MWCO - molecular weight cut-off), and configurations are either cross flow or dead end filtration.

UF removes bacteria and protozoa, including giardia and cryptosporidium. It reduces turbidity to < 0.1 NTU and removes 6 log of viruses (99.9999% removal).

In the pharmaceutical industry, for generation of highly purified water which would be to multi column distillation units, UF is the most reliable method for removing bacteria and endotoxins.



Ultra Filtration Systems

Demineralised water with conductivity <1µs/cm is passed through the UF membranes to achieve reduction of bacteria, particulate matter and TOC.

The membranes used are of hollow fibre type having a molecular weight cut-off (MWCO) of 6000. The hollow fibre membranes in the system can be fast flushed for removal of particulate or slime (if any) that could get accumulated during the process.

The hollow fibre membranes can be chemically sanitised with 200 ppm of NaOCl solution. In case of hot water sanitisation, the membranes and system can be gradually heated up to 80°C.

The quality of the UF membranes, their maintenance and proper operation become extremely critical in ensuring the integrity of the system and the quality and consistency of the purified water.

Below are some common problems that could be encountered in such UF systems along with their possible causes and remedial action

Problem	Checkpoints	Solution
Total increase in bacterial count	Check the total count every day and make a trend analysis over a period of time	Sanitise either with chemicals or hot water with proper retention
	Analyse the sample	This will help to analyse the cause
	Check the components, gaskets, triclover clamps	Change gaskets. Check alignment of pipework
	Check the surface finish of the components used	Passivation or electropolishing of the piping/joints
	Check the condition of weld joints	Reweld/rework/replace in case of any problem
	Check whether the UF system is idle for more time or is in continuous operation	Run the system continuously
	Avoid exposing to light	At least cover the membranes with dark paper
	Check the gaskets in valves and ageing	Replace if required
Reduction of flow rate	Check the flow rate and calculate % reduction	Check for any blocks
	Check organic matter/COD/ BOD/TOC/TSS/turbidity	Modify the pretreatment
	Check the total count	Chemical cleaning/hot water sanitising
	Check for any foreign particles	Remove particles
	Check for leakage on joints	Attend to the leakage
	Bio-film formation due to idle condition	Use chemicals to clean the UF system
	Fibre breakage	Check and plug the fibres
	Check the valves	Ensure proper opening/ closing operation of valves
	Check the air pressure in case of automatic unit	Low pressure can cause problems in the opening/closing of valves
	Check the flow meter	Calibrate the meter

Slimy layer/colour change of UF membranes	Avoid exposure to sunlight or light source	Wrap/cover UF membranes with dark paper
	Remove the bio-film	Sanitise with either chemicals or hot water with proper retention
	Low velocity	Operate at high velocity or at full flow as per design
		Chemical cleaning
	Check the components, gaskets, triclover clamps	Arrest leakage if any
Treated water colour	Check for high TOC/organics	Modify the pretreatment
	Check the high turbidity	Modify the pretreatment
	Check for iron and other heavy metals	Modify the pretreatment
	Rust formation on the pipelines	Remove the rust with UF treated water and check the material
High pressure drop	Check the flow rate	Adjust flow as per design. Chemical cleaning of UF
	Check the colour of membrane	Chemical cleaning, hot water sanitising
	Check the actual flow rate v/s design	Adjust flow rates
	Feed & reject pressure reading mismatch	Calibrate pressure gauges for proper reading
	Check organic matter	Modify the pretreatment
	Check for high TOC	Modify the pretreatment
	Check for high TVC	Modify the pretreatment
	Check the flow	Calibrate the meter
Leakage of Joints	Check the nature of leakage	Check alignment of joints
	Check the components, gaskets, triclover clamps	Replace if required
	Check the surface finish of the components used	Rework/electropolish/replace the components

	Check for rust formation or any spots or scaling or corrosion on pipework or fittings	Check the material of construction
	Check the condition of weld joints	Check the material of construction
	Check pH of feed water	Low pH can cause corrosion
	Check for chlorine	Chlorine can cause corrosion. Drain the chemically sanitised water
	Check the welding	Poor welding needs rectification
	Check workmanship	Rectify & improve
High TOC value at outlet	Check at the inlet	Modify the pretreatment
	Check the fibres	Plug the broken fibres
High endotoxin value at outlet	Check the total viable count at inlet	Modify the pretreatment
	Check the storage tank	Avoid stagnation of water
	Check for algae in storage tank	Chlorinate water in storage tank

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