ULTRAFILTRATION FOR COLLOIDAL SILICA REMOVAL

Ajay Popat
Chief Executive Officer
Ion Exchange Waterleau Ltd.

In the monsoon season presence of colloidal silica is observed in the raw water (river source). This colloidal silica gets reduced to around 60% in the pretreatment system (in contact type of clarifier), however remaining 40% escapes through the normal Ion Exchange Plant, this colloidal silica at high pressure and temperature gets converted into reactive silica due to which the silica level in the Boiler drum increases. In order to avoid scaling of silica on the turbine blades, lower level of total silica has to be maintained in the boiler drum and this calls for increase in blowdown from normal from 1% to 2%, due to which the boiler feed water capacity has to be increased from 20 m^3/h to 40 m^3/h. However, by installing a Ultrafiltration unit after Ion Exchange plant, the boiler blowdown can be maintained at 1%, in this case the boiler feed water has to be increased only 1 m^3/h.

Ultrafiltration system can be economically used to remove colloidal silica and thereby preventing damage of turbine blades. The Ultrafiltration system also provides additional advantages such as:

- Removal of other colloidal particles like colloidal iron and biological slimes (which are quite high in rainy season).
- Ease of operation.
- Consistent treated water quality even with varying inlet load of suspended particles and colloidal silica.

Overview of Ultrafiltration

Ultrafiltration (UF) is a pressure-driven unit operation in which particulates, colloids, emulsified oils, and macromolecules are separated from a liquid feed stream upon passage through a porous semi-permeable membrane (Figures 1 and 2).

Figure 1

Figure 2

The separation is based primarily on the size of the species in the liquid relative to the size of the membrane pores (i.e. a simple sieving process) although geometry of the pores, geometry of the species to be separated, electric charge, and membrane surface chemistry may also play a part. On the separation size spectrum, UF falls between Nanofiltration or NF (membrane pore sizes below approximately 0.01 micrometer) and Microfiltration or MF (pore sizes greater than 1.0 micrometer; see Figure 3).

Figure 3

In Ultrafiltration, small molecules such as water, monosaccharides, simple alcohols, and all ionic species pass through the membrane while larger molecules, particulates, bacteria, and emulsified oils and fats are retained.

The UF membrane is usually a polymer such as polyethersulfone, polysulfone, polvinylidene fluoride, or polyamide and is typically cast on either a flat sheet or on the inside diameter of a tube. It may also be extruded as a hollow fiber. Tubular membrane products are excellent for high solids loadings as may be found in wastewater streams, but their low surface area-to-volume ratio makes them too expensive for pure water applications

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Wastewater RecycleEliminateMultimedia FiltersEliminate Multimedia Filters and Clarifier
ADVANTAGES OF USING ULTRAFILTRATION AS PRE-TREATMENT TO
REVERSE OSMOSIS SYSTEM

UF As Pre-Treatment to Reverse Osmosis System

Membrane Filters offers a positive physical barrier between the feed contaminants and the product water . When the feed water changes (for example, high silt during heavy rains) the product water off the membrane filter reamins the same. Also since the membrane filtration is a physical separation process, there are no chemical additives, polymers, flocculation tests or sludge disposal problems.

Ultrafiltration has a greater removal efficency and gives higher quality product water. We recommend the use of Ultrafiltration over Microfiltration for Reverse Osmosis Pre-treatment because of the low fouling and clogging of the characteristics of Ultrafiltration over Microfiltration. The larger pores in the the Microfiltration tend to be more easily plugged with particles and once the same is plugged it requires replacement which tends to increase the operating costs of the entire system. The tight pore of the Ultrafiltration membrane prevents any such pore plugging and replacement due to the same. Also the output of the Ultrafiltration is higher than the Microfiltration and tend to be more stable over a long period of time.

The Ultrafiltration membranes are cleaned intermittently to remove any possible gel layering of any foulants. The Ultrafiltration membranes offered are also Chlorine compatible.

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Physical Barrier Filtration
–
Positive barrier between feed and product water
–
Handles highly turbid waters (1000 NTU+)
–
Reduces turbidity, silicates and TOC
•
Consistent water quality
–
Product water is independent of feed variability
–
Expect 0.1 NTU, even with 250NTU feed water
•
Non-Fouling Membranes
–
Designed for high TSS and Colloids
•
Competitive Capital Costs
•
Reduced Operating Costs

–
Lower than conventional treatment

•
Improves downstream RO performance
–
Higher flux, longer life, fewer cleanings
•
Chemical-Free Treatment Technique
–
Eliminate coagulants and flocculants
–
No residual chemicals in the filtered water
–
Eliminates handling and safety issues
–
No constant operator attention
•
Chlorine Compatible; High/Low pH Resistant
–
250 ppm Chlorine; Caustic pH13, Acids pH1.5

•
Replaces Multimedia Filters and Clarifiers
–
Direct filtration of source water
•
Environmentally Attractive
–
Spent water recycle
•
Smaller space requirements
–
Approximately 25-50% of conventional treatment
–
Smaller civil and building requirements
•
Modular design for easy expansion
•
Less manpower requirements
–
Fully automated systems
•
Long Membrane Life
–
Typically 5 years; often more!
•
In-stitu leak detection

Economics

- UF is a robust membrane process
  - Remove problem components in the water supply
  - UF is chlorine resistant
  - Open Channel Fibers resist plugging
  - Backflushable
- Reduce foulants to the RO system
- SDI < 1, even when feed is high
- 99%+ silicates reduction
- Higher RO Flux
- Reduce RO Cleaning Costs
  - Expect 2x/yr cleaning or less
- Reduce O&M Costs
  - 5-7 year membrane life
  - Lower energy
  - Fewer RO elements required

Microfiltration (as well as sand filtration, cartridge filtration, and diatomaceous earth filtration) would not be effective in removing colloidal silica, some bacteria, smaller particulates, and large molecular-weight organics.