ION EXCHANGE
Refreshing the Planet

Technical Information

Cleaning Procedure for HYDRAMEM Composite Polyamide RO Membrane Elements

Once RO system is commissioned and starts running continuously there is a possibility of the membranes getting scaled or fouled due to the impurities present in the water. Based on feed water quality, the plant design, pre treatment scheme/equipments and operation and maintenance practices, the scaling and fouling can be rapid in some cases and user need to be vigilant about such occurrences.

Effects of Scaling and Fouling on Membrane System

	Normalised Permeate Flow (NPF)	Salt Passage (SP)	Pressure Drop (delta P)
Scaling	Reduction in NPF	Increase in SP	Moderate increase delta P
Colloidal Fouling	Normal reduction in NPF	Slight increase in SP	Gradual increase in delta P
Bio Fouling	Reduction in NPF	Increase in SP	Sharp increase in delta P
Organic Fouling	Sharp reduction in NPF	Increase in SP	Moderate increase in delta P

When to Clean

Membrane cleaning is a vital part of any membrane maintenance program. It is important to clean the membrane in initial stage of scaling or fouling. It is very difficult to clean membrane which is extremely fouled or scaled and such membrane may get irreversibly damaged while cleaning.

Cleaning is recommended when one or more of the following parameter changes by more than 10% after data normalisation.

- Decrease in normalised permeate flow
- Increase in product water conductivity or salt passage
- Increase in feed water pressure
- Increase in delta P across the RO block

Effective cleaning requires some knowledge of scalant or foulant and the cleaning options available.

Impurities which can cause scaling and fouling are:

- Calcium carbonate
- Calcium sulfate
- Barium or strontium
- Metal oxides (iron, manganese, copper, nickel, aluminum, etc.)
- Silica
- Inorganic colloidal deposits
- Mixed inorganic/organic colloidal deposits
- Natural Organic Matter (NOM)

- Synthetic organic materials
- Carryover of Pretreatment chemical (e.g. Antiscalant/dispersants & cationic polyelectrolytes)
- Biological (bacterial slime, algae, mold, or fungi)

Method to Identify Scalant & Foulant by Deposit Analysis

Collect deposit from cartridge filter , ro pressure tube with the help of plastic scraper and dry them and analyse as mentioned below to identify the correct scalant/foulant.

- Take 1 gm of dry powder deposit and treat with conc. HCl. Filter the solution and wash the residue with DI water. Further dry the residue and weighed. Difference in weight gives acid soluble deposits which are present on membrane surface. High amount of acid soluble indicate deposit is of scales like $CaCO_3$, metal hydroxide etc. The filtrate is analysed for soluble ions like Fe, Al, Ca etc. to determine the nature of acid soluble deposits.
- Dry residue from the above step is burned in muffle furnace and residue is weighed. Reduction in weight is volatile organics. High amount of volatile organic indicates organic deposits / biological growth.
- Residue after burning is treated with hydrofluoric acid and heated in muffle furnace. The difference in weight is silica. High amount of silicates indicates presence of sand like substance into the systems.
- Once the scalant or foulant is identified, the cleaning chemical can be selected and cleaning carried out effectively.

Selection of Cleaning Chemicals

1. A low pH cleaning solution (target pH of 4) of 2.0% (w/w) citric acid is useful in removing inorganic scale (e.g. calcium carbonate, calcium sulfate, barium sulfate, strontium sulfate) and metal oxides/hydroxides (e.g. iron, manganese, nickel, copper, zinc), and inorganic-based colloidal material.

2. This is a high pH cleaning solution (target pH of 10.0) of 2.0% (w/w) STPP (sodium tripolyphosphate) and 0.8% (w/w) Na-EDTA (sodium salt of ethylene diamine tetraacetic acid). It is specifically recommended for removing calcium sulfate scale and light to moderate levels of organic foulants of natural origin. STPP functions as an inorganic-based chelating agent and detergent. Na-EDTA is an organic-based chelating agent that aids in the sequestering and removal of divalent and trivalent cations and metal ions.

3. This is a high pH cleaning solution (target pH of 12.0) of 2.0% (w/w) of STPP (sodium tripolyphosphate) and 0.025% (w/w) Na-DDBS (sodium salt of dodecylbenzene sulfonate). It is specifically recommended for removing heavier levels of organic foulants of natural origin. STPP functions as an inorganic-based chelating agent and detergent. Na-DDBS functions as an anionic detergent.

General precautions to be taken pre, post and during cleaning

1. The complete cleaning system, starting from cleaning solution tank , cartridge filters, flexible and fix pipes need to be flushed with clean water before starting the cleaning.
2. Always use new set of cartridge filters associated with cleaning system for every cleaning.
3. Permeate valve of individual pressure tube as well as main permeate outlet valve need to be kept open during cleaning.

4. Use the optimum cleaning parameter such as pH, temperature and contact time to get the membranes clean. This will optimise the life of the membranes.
5. Always clean the membranes in the pH range of 4 to 10, if the desired results are not obtained then only go for higher pH range of 2 to12.
6. While selecting cleaning chemical (proprietary chemical or generic chemical) make sure that the chemical is compatible with HYDRAMEM RO elements.
7. Throughout the cleaning i.e. chemical cleaning as well as flushing, the direction of flow should be maintained same ass the feed water flow 8. The pH meter needs to be calibrated before starting cleaning.
9. In case of multi stage system, cleaning should be always done stage wise to maintain high velocity of cleaning solution and foulants from one stage should not be allowed to flow to next stage.

It is always recommended to record the major operating parameters before and after completing the chemical cleaning of RO Membrane to understand the effectiveness of chemical cleaning.

Membrane Cleaning Procedure

The RO membrane elements can be cleaned in place, in the pressure tubes by re-circulating the cleaning solution across the RO Block at low pressure and relatively high flow. There is no fix cleaning procedure for membrane cleaning, the procedure changes based on prevalent situation. The approximate time to clean one RO Block is between 4 to 8 hrs.

General Cleaning Procedure for RO Membrane is as follows:

Low Pressure Flushing: Perform low pressure flushing by using DI water or RO Permeate at approximately 4 kg/cm^2 pressure for around 30 minutes or till the flushing water completely replaces feed water or brine water which was present inside the RO Pressure tube.

Chemical Preparation: Fill the chemical preparation tank with RO Permeate or DI water and mix the selected cleaning chemical as per given quantity. Adjust the pH of the cleaning solution as per guide lines. Record the pH, turbidity and conductivity of cleaning solution.

Chemical Circulation: At the start of re-circulation, drain the water till the concentrated cleaning solution start coming out flexible hose. This needs to be done to avoid the dilution of concentrated cleaning solution. After that couple the flexible hose to RO Unit and start recirculation. For the first 5 minutes, slowly throttle the flow rate to 1/3 of the maximum design flow rate. This is to minimise the potential plugging of the feed path with a large amount of dislodged foulants. For the second 5 minutes, increase the flow rate to 2/3 of the maximum design flow rate, and then increase the flow rate to the maximum design flow rate. Check the pH, turbidity and conductivity of cleaning solution after each circulation step, if the pH drops by 0.5 units, then adjust the pH of the solution to the initial level. If the cleaning solution turbidity, conductivity and Iron content increases significantly than the initial startup values; the cleaning solution should be drained and new solution prepared to continue with cleaning to improve cleaning efficiency. Continue re-circulation for 30 minutes keeping the record of pH, Turbidity and conductivity.

Chemical Socking: Stop the recirculation close the respective valves and sock the entire RO block for 30 minutes in cleaning solution. In typical cleaning, each socking and re-circulation cycle consist of 30 minutes. This can be change based on recommendations of specialty chemical supplier.

Repeat the Socking and recirculation step to get the best results.

Low pressure Flushing: After cleaning, open the drain valve of cleaning chemical tank and drain the cleaning chemical if any. Fill the tank with RO Permeate or DI water and start the flushing the RO block and allow the water to drain. Continue this low pressure flushing till the pH of flushed water is the same as the RO Permeate or DI water