

Aluminum Concerns in Dialysis Systems

Aluminum can exist as a cation, anionic complex or suspended particle in water. It can be removed by several methods depending on the species that it is present as.

When aluminum is found to be present in the effluent of a dialysis water treatment system, the following steps are recommended:

1. Make sure the number is real. Aluminum is not an easy test for a laboratory to perform. Re-sample and re-submit if possible.
2. Profile the system. Test for the presence of aluminum at each step in the process scheme, for example, the inlet water, softener effluent, RO effluent and mixed bed effluent if mixed beds are used. Also, test for both ionic and particulate aluminum.
3. Verify the absence of aluminum components. The water being treated should not be in contact with any aluminum materials such as piping, tubing, RO end caps, etc.

Look at each step in the process to see what contribution or effect it may have on the effluent levels of aluminum.

Carbon filter – Activated carbon can throw low levels of aluminum at startup. To prevent this, always use a high grade, acid-washed activated carbon. Activated carbon does not effectively remove any aluminum from the influent water.

Softener – The strong acid cation resin in the softener will remove the cationic aluminum. The aluminum is strongly held, since it is a trivalent ion and is not effectively removed during the brine regeneration step of the softener. Therefore, over time, the resin can foul with aluminum. An aluminum fouled softener can pass aluminum during service in the cation, anion, or particulate form.

The softener is also capable of removing suspended or insoluble aluminum by acting as a filter. Subsequent service can cause this accumulated aluminum to appear in the effluent. Frequent, strong backwashing is recommended to prevent this accumulation when treating waters that contain suspended or particulate aluminum.

The softener is not capable of removing aluminum that exists as an anionic complex (aluminum usually exists as aluminum hydroxide at a pH of 6.3 or higher.)

RO system – The RO system should remove 100% of any suspended or particulate aluminum. The cationic and anionic species of aluminum are extremely small and difficult to remove by RO.

Polishing mixed beds – The mixed bed ion exchangers should remove essentially all of the ionic aluminum, cationic or anionic. The mixed bed resin does not effectively remove particulate or suspended aluminum (maybe 10 to 25% removal?).

Other Considerations

The best way to remove aluminum is probably through coagulation and filtration, not a practical method, however, for small dialysis systems. Also, pH adjustment would help to convert the aluminum species to all cation or all anion. Again, since this would involve additional chemical feed, it is not practical for dialysis systems.

The best advice for dialysis systems is to rely on the softener to remove the cationic aluminum, and the RO to remove the particulate aluminum. If anionic aluminum is present, add a brine cycle anion unit downstream of the softener.

