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# DOWEX Ion Exchange Resins

## Understanding Silica Removal by Ion Exchange

### Colloidal vs. Reactive Silica

Silica ($SiO_2$) exists in water in equilibrium with the bisilicate ($HSiO_3^-$) ion as a very weak acid. In the ionic form, silica can be removed by strong base anion exchange resins operated in the hydroxide cycle. Since the two forms exist in equilibrium, silica can be almost completely removed from solution. When present as a single unit of silica, in equilibrium with bisilicate, the compound is termed reactive silica.

Silica can also exist as a polymer, often referred to as colloidal silica. These long chains of individual silica units exhibit virtually no charged ionic character, and cannot be removed by the ionic process of ion exchange.

### Silica and Boiler Feed Water

Silica is a problem for high pressure boilers. It exhibits enough volatility that high pressure boilers will have silica carry over to the vapor partition. When the steam pressure is reduced in the turbines, the silica will precipitate on the blades as a glassy deposit which reduces efficiency. Both types of silica, colloidal and reactive, can cause this problem as colloidal silica will break down and volatilize under high temperature and pressure.

### Silica Removal Techniques

Strong base anion exchange resins can remove virtually all reactive silica, reaching part-per-billion levels in many applications. Engineering brochures about DOWEX* ion exchange resins can help you predict the removal efficiency of this reactive silica at your operating conditions. Colloidal silica, however, cannot be removed by the ion exchange mechanism. Ion exchange resins do provide some colloidal silica reduction through the filtration mechanism, but resins are not very efficient at this process.

Membrane treatment can remove virtually all colloidal silica. Both reverse osmosis and ultrafiltration are effective in this respect. Reverse osmosis offers the additional advantage of significant reduction (98%+) of reactive silica as well.

Finally, coagulation techniques in clarifiers can be very effective at removing colloidal silica. The greatest difficulty with this technique is the occurrence of “spikes” of colloidal silica during periods of high groundwater run-off. If undetected and untreated, the silica may not be properly removed. Careful operation of this unit operation is required for effective colloidal silica removal.

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Warning: Oxidizing agents such as nitric acid attack organic ion exchange resins under certain conditions. This could lead to anything from slight resin degradation to a violent exothermic reaction (explosion). Before using strong oxidizing agents, consult sources knowledgeable in handling such materials.

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