



DOWEX Ion Exchange Resins

Recommendations for Maximum Free Chlorine Limits for DOWEX* Ion Exchange Resins

Background

The presence of free chlorine or other oxidizing agents in the feed water can lead to resin degradation over time. Anion exchange resins are very sensitive as oxidants attack the functional amine group resulting in loss of resin capacity and impaired performance. Continuous exposure of anion resins to >0.05 ppm free chlorine should therefore be avoided.

In the case of a cation resin, oxidation occurs by de-crosslinking the copolymer matrix, leading to an increase in water retention capacity and resin swelling. This results in weakening of the mechanical integrity of the resin and wet volume capacity loss. Temperature and chlorine concentration both impact the rate of de-crosslinking. While it is not possible to accurately predict resin life when other factors are considered, the following guidelines for feedwater chlorine levels will maximize the life of cation resins.

Recommended Maximum Free Chlorine Levels for Cation Resins (ppm as chlorine)

Feed Temperature °C (°F)	Gel, Standard Crosslink	Gel, High Crosslink	Macroporous
5-10 (40-50)	0.3	0.5	1.0
10-15 (50-60)	0.2	0.3	0.8
15-20 (60-70)	0.1	0.2	0.6
20-30 (70-85)	< 0.1	0.1	0.5
> 30 (> 85)	Absent	< 0.1	< 0.5

Note that the presence of Fe or heavy metals can have a catalytic effect and increase oxidative damage to the resin.

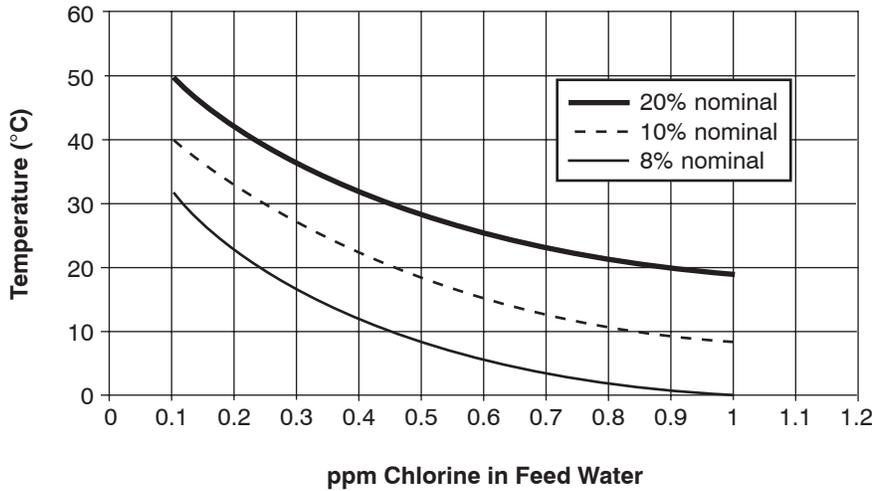
When strong acid cation resins are operated in higher chlorine environments, shorter resin life will be expected. The effect of free chlorine is additive, so the reduction in resin lifetime should be proportional to the increase in the level of chlorine in the feed. For example, if a standard gel cation treating water at 10-15°C (40-50°F) has a lifetime of 10 years with the recommended <0.2 ppm free chlorine in the feed, the lifetime would be reduced to ~ 2 years if the level of free chlorine were to increase 5 times to 1 ppm.

Note that oxidized resins are also more prone to releasing leachables that may impact the performance of downstream anion units in demineralization plants – see Tech Fact 177-01836 for more information on cation leachables.

When operating in high chlorine environments, the use of high crosslinked gel or macroporous resin is recommended. This is demonstrated in the following graph, which shows the effect of chlorine and temperature on nominally 8 and 10% crosslinked gel and 20% macroporous resins.

Effect of Chlorine on Cation Resin

Temperature vs. concentration for a 36-month resin life



Resin lifetime of 36 months is based on a final water retention capacity of 63% (Na⁺ form). Data from Chemical Processing (1961).

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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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