REV 0521

Radium Removal

ResinTech CG8 or CGS can be used to remove radium from water. Radium has a selectivity coefficient of about 40:1 compared to sodium. This is 8.3 times as high as calcium, which is only 5:1. On a single use the cation resin will load radium 8.3 times beyond the hardness endpoint. For example, if a resin lasts 1,000 gallons per cu. ft. before hardness starts to break through, then it will last 8,300 gallons before radium starts to breakthrough providing it is only used once. Because of its very high selectivity, radium is very difficult to remove from the resin. Radium has slow kinetics and is usually loaded at trace quantities, which makes regeneration even harder.

SODIUM CYCLE OPERATION

Termination of the run at the hardness breakthrough
Radium leakages remain consistently low when the cation resins are run only to hardness breakthrough. It is advisable to use regeneration contact times of one hour, regenerant levels of 15 lbs. per cu. ft. and salt concentrations of at least 10% on the resin bed.

Termination of the run at radium breakthrough
After a few cycles, this will give only about 5 to 10% more gallonage than running to the hardness break. A normal regeneration level such as 15 to 20 lbs. of sodium chloride per cu. ft. at 10 to 15% concentration is not enough to remove all of the radium, so radium will build up on the resin bed. When the hardness breaks it will push some of the remaining radium off at the bottom of the bed so the radium breaks just after hardness. The minimum recommended salt dosage is 15 lbs. per cu. ft. at a minimum concentration of 10%.

CALCIUM CYCLE OPERATION

This procedure leaves the hardness intact and only removes the radium. Because of the high affinity of radium over calcium, it is feasible to remove only radium and leave the hardness in the water.

Radium and calcium are both divalent, so concentration itself does not play as important a role as in hardness versus sodium exchange. Nevertheless, there is a drop in activity of the radium ion in solutions at the higher salt concentrations, so a more concentrated salt produces better results. It is recommended that concentrations of at least 10% CaCl2 be maintained during regeneration.

High initial radium leakages will always be present during co-current regeneration unless the resin is mixed after regeneration. Calcium is unable to push off all the radium from the bed. However, it is more effective than sodium and pushes the radium to the bottom of the bed.

During the subsequent cycle, calcium ions not removed from solution act as a continual mild regenerant and will push off some of the radium remaining at the bottom of the bed, especially at breakthrough. Mixing the bed after regeneration provides a uniform concentration of radium throughout the bed, which gives consistent and lower leakage. Another way to use the calcium process effectively is to use counter-current regeneration. This way the radium is pushed away from the bottom of the bed so that the radium band is moved up into the bed thus avoiding the problem of high initial leakage. Obviously no mixing can be used with CCR.

CARTRIDGES FOR POINT-OF-USE (POU)

Higher crosslinked resins (POU) such as ResinTech SACMP are best for one time use and worse for multiple cycle use. A 15% crosslinked macroporous resin has about 2 times the selectivity that an 8% resin has for radium over calcium. During regeneration, however, the radium is even more difficult to remove than from a standard resin. This results in a radium band at the bottom. This makes for higher initial leakages and lower regenerable operating capacities.

ResinTech SACMP is a 12% crosslinked cation resin. It is estimated to have 15 times the selectivity for radium as for hardness so it would give 15 times the throughput capacity to a radium break than to a hardness break. This resin would be ideal for cartridges. ResinTech CG8 or CGS would be ideal for regenerable installations.

CONTINUED

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MAXIMUM CONTAMINANT LEVELS FOR RADIONUCLIDES

REGULATED RADIONUCLIDE	MCL	MCLG
Beta/photon emitters	4mrem/year	0
Gross alpha particle	15 pCi/L	0
Combined radium 226/228 (Ra-226, Ra-228)	5 pCi/L	0
Uranium	30µg/L	0

MCL – Maximum contaminant Level
MCLG – Maximum Contaminant Level Goal
pCi – picocurie
µg - microgram

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