



DOWEX Ion Exchange Resins

Procedure for Cross-Regeneration of Cation Resin Used in Sweeteners

Cross-Regeneration of Resins to Maximize Resin Life

Both strong acid cation (SAC) and weak base anion (WBA) resins accumulate organic foulants in service. A portion of these foulants remain on resins even after the use of normal regeneration chemicals. The practice of cross-regeneration with both SAC and WBA resins in sweetener processing is an effective method to extend the useful life of a resin by reducing the build-up of organic foulants on the resins. CAUTION: Dow does not recommend cross-regenerating resins which have had greater than six months service life without prior cross-regeneration. Cross-regeneration on overly fouled resins can cause foulants to slough off into the product syrup stream for a considerable time.

Strong Acid Cation Resin Cross-Regeneration Benefits

Strong acid cation resins remove cations such as calcium (Ca^{++}), magnesium (Mg^{++}), sodium (Na^+), and potassium (K^+), as well as proteins that are in cationic form. Normal acid regenerations remove cations but leave some protein on the SAC resin. With time protein fouling accumulates which reduces cation diffusion rates through the resin. Protein fouling can manifest as a reduction in operating capacity of the resin bed and also lower product quality.

Most proteins can be dissolved at high pH; therefore, cross-regenerating the bed with sodium hydroxide (NaOH) is an effective treatment to remove protein. In addition to removing protein, caustic is also effective at disintegrating bacteria. Caustic helps to remove any biological growth in the resin bed.

Strong acid cation resin in sweetener processing removes divalent ions such as calcium (particularly in the dextrose side) and magnesium (especially in the fructose side) more selectively than monovalent ions such as sodium and potassium. The cation resin holds multivalent at high concentrations on the resin active sites. If resin loaded with multivalent ions is contacted with NaOH, calcium and magnesium inorganic hydroxide precipitates will form in the resin and will subsequently degrade its performance. **Therefore, it is very important to perform a normal acid regeneration with hydrochloric acid (HCl) to remove multivalent ions before exposing the bed to NaOH.**

Strong Acid Cation Resin Cross-Regeneration Guidelines

- 1) **Regenerate the cation resin with normal acid regeneration (7% HCl).** The recommended acid loading is the same as the acid loading used in a standard regeneration of the cation bed.
- 2) **Displace with 2-3 bed volumes water (15-20 gal/ft³) over 30-60 minutes.** The acid that is introduced should be rinsed from the cation bed before base is added to avoid an acid-base reaction. It should not be necessary to rinse the bed to the normal targets of very low conductivity.
- 3) **Cross-regenerate cation resin with 2-3 bed volumes of 4% NaOH over 30-60 minutes.** To remove built-up protein and impair bacterial growth, caustic should be introduced. Soda ash (Na_2CO_3) or ammonium hydroxide (NH_4OH) is sometimes used as the regenerant for the weak base anion resin; however, even if the plant is accustomed to these bases for regenerating the anion resin, 4% NaOH should instead be used for cross-regenerating the cation resin bed for best results. The pH achieved with soda ash or ammonium hydroxide does not yield sufficient cleaning. As a rule of thumb, the caustic loading into the cation bed for cross-regeneration should be the same as the dosage for the anion resin.
- 4) **Displace with 2-3 bed volumes water (15-20 gal/ft³) over 30-60 minutes.** The base that is introduced should be rinsed from the bed before the final acid regeneration, again to avoid an acid-base reaction, but it is not necessary to rinse the bed to the normal targets of very low conductivity since other regeneration steps will follow.
- 5) **Regenerate the cation resin with 7% HCl, using 1.5X-2X normal regeneration procedures.** The increased final acid regeneration will restore the resin to the hydrogen ionic form so it is ready for service. The additional acid dosage is to

minimize the potential for early sodium leakage. An option is to start using a 2X regeneration and optimize the process toward a 1.5X regeneration if possible, in future regenerations to ensure product quality. Even with the additional acid dosage, early Na⁺ leakage may occur as the cation resin ages.

6) **Rinse cation bed to low conductivity.** The final acid regeneration should be followed with a complete rinse to low conductivity.

Suggested cross-regenerating conditions for DOWEX deashing resins

	DOWEX 88 SAC	DOWEX MONOSPHERE 88 SAC	DOWEX 66 WBA	DOWEX MONOSPHERE 77 WBA or DOWEX MONOSPHERE 66 WBA resin
Regenerant Concentration	7% HCl	7% HCl	4% NaOH	4% NaOH
Regenerant Level (100% basis)	6-7 lb/ft ³ 96-112 kg/m ³	5-6 lb/ft ³ 80-96 kg/m ³	5-6 lb/ft ³ 80-96 kg/m ³	4-5 lb/ft ³ 64-80 kg/m ³
Regenerant Temperature (max.)	200°F 93°C	200°F 93°C	140°F 60°C	140°F 60°C
Substitute Regenerants			5% Na ₂ CO ₃ @ 7-8 lb/ft ³ (112-128 kg/m ³)	5% Na ₂ CO ₃ @ 6-7 lb/ft ³ (96-112 kg/m ³)
			5% NH ₄ OH @ 5-6 lb/ft ³ (80-96 kg/m ³)	5% NH ₄ OH @ 4-5 lb/ft ³ (64-80 kg/m ³)
Cross-regenerant Chemical	4% NaOH	4% NaOH	7% HCl	7% HCl
Cross-regenerant Level	5-6 lb/ft ³ (80-96 kg/m ³)	4-5 lb/ft ³ (64-80 kg/m ³)	5-6 lb/ft ³ (80-96 kg/m ³)	4-5 lb/ft ³ (64-80 kg/m ³)

Other Considerations

ISEP and CSEP carousel units are typically not plumbed with a port for cross-regeneration. However, these systems can be plumbed and programmed to include a cross-regeneration step and in some cases this has proven to be very beneficial.

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 reaction (explosion). Before using strong oxidizing agents, consult sources knowledgeable in handling such materials.

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