DOW™ Ion Exchange Resins

Preventing Biological Growth on Ion Exchange Resins

Introduction

Ion exchange resins in demineralization applications are subjected to extreme changes in pH during regeneration, which hinders biological growth. Most biological growth problems are caused by inactivity of the resin during extended storage in the vessel or under pH neutral conditions, such as water softeners, dealkalizers or non-regenerated mixed beds in ultrapure water production. In order to minimize the potential for biofouling, inactive systems should be stored in a biostatic solution such as concentrated NaCl. Note that this complete exhaustion is acceptable for most demineralizer applications, but undesirable for ultrapure water applications. The recommended procedure is as follows:

- After exhaustion and a thorough backwash, the resin is ready for lay-up.
- Apply a 15%-25% NaCl solution to the bed, and fill the vessel so that no air is present. The concentrated salt solution will minimize biological growth.
- Upon reactivation of the vessel, the resin will need to undergo a double or triple regeneration.

Cleaning Biological Growth from Ion Exchange Resins

The detailed cleaning steps have to be adapted to each regeneration process (cocurrent, different types of countercurrent). Used, mechanically weak resins may suffer from large osmotic (fast swell/shrink) and mechanical (air scrubbing) strains. It is advisable to use gradual changes in solution concentrations and to minimize the mechanical stress.

Regenerated Resin Systems (Demineralization, Water Softening)

In cases where biological growth has occurred, an extended air scour followed by a double regeneration may be able to restore the resins to a usable condition. If this procedure is not successful, there are disinfection procedures which can be used. Oxidative damage can occur from each type of treatment, so these procedures should be considered as a last resort.

Procedure 1: Peracetic Acid Disinfection of Ion Exchange Resins

Peracetic acid has a wide-band action for removing micro-organisms and is an effective treatment for the disinfection of both cation and anion exchange resins. To ensure good disinfection without damage to the resins, it is important to control the concentration, temperature and contact time of the chemical.

The recommended procedure for cation resins is as follows:

1. Apply a thorough air scour and then backwash the resin.
2. If the resin has iron or other metal contamination, pretreat with ~2 bed volumes of a 10% HCl solution.
3. Put resin into exhausted form by treating with a 2-5% brine solution for strong acid cation resins, or with a 0.5% caustic solution in upflow direction for weak acid cation resins (take care to allow for resin swelling).
4. Prepare peracetic acid solution of 0.2% concentration or 2% H_2O_2.
5. Apply 2-4 g peracetic acid/liter resin (57-113 g/ft^3) using 1-2 bed volumes of the 0.2% solution over 30-60 minutes.

6. Rinse out with 4 bed volumes DI water over a period of approximately 1 hour, until no peracetic acid is detectable in effluent.
7. Apply a thorough air scour and then backwash the resin to remove dead bacteria bodies.
8. Complete a double regeneration of the resin.

The recommended procedure for anion resins is as follows:

1. Apply a thorough air scour and then backwash the resin.
2. If the resin has iron or other metal contamination, pretreat with ~1 bed volumes of a 2% HCl solution followed by ~1 bed volume of a 10% HCl solution.
3. Put strong base resins into exhausted form by treating with a 2-5% brine solution (skip if it has been pretreated with HCl), and weak base resins into regenerated form with a 2-4% caustic solution.
4. Prepare peracetic acid solution of 0.2% concentration or 2% H_2O_2.
5. Apply 2 g peracetic acid/liter resin (57 g/ft^3) by passing 1 bed volume of the solution at ambient temperature through the resin bed during a 30-60 minute contact time. Measure the peracetic acid or residual H_2O_2 in the effluent and stop when it reaches a level of around 10% of the inlet concentration.
6. Rinse out with 4 bed volumes DI water over a period of approximately 1 hour, until no peracetic acid is detectable in effluent.
7. Apply a thorough air scour and then backwash the resin to remove dead bacteria bodies.
8. Complete a double regeneration of the resin.

Procedure 2: Chlorine Disinfection of Ion Exchange Resins

Sodium hypochlorite or bleach cleaning is a very intense treatment for sterilizing and removing organic contaminants on cation exchange resins. As a result, this treatment should be carefully controlled in order to prevent possible resin damage (decrosslinkage/defunctionalization). Note that chlorine can be explosive under certain conditions.

The recommended procedure for cation resins is as follows:

1. Apply a thorough air scour and then backwash the resin.
2. If the resin has iron or other metal contamination, pretreat with ~2 bed volumes of a 10% HCl solution.
3. Ensure that the resin is completely exhausted by treating with a 2-5% brine solution for strong acid cation resins, or with a 0.5% caustic solution in upflow direction for weak acid cation resins (take care to allow for resin swelling.), as any residual H^+ on the resin can lead to the generation of free chlorine gas.
4. Use a sodium hypochlorite solution of 0.10% concentration (1,000 ppm).
5. Apply 5 g free Cl_2 per liter resin by passing 5 bed volumes of the NaOCl solution at ambient temperature down through the resin bed with a 30-45 minute contact time. Allow the resin to soak in the solution for 1-2 hours.
6. Rinse out with 1-2 bed volumes DI water.
7. For the most effective treatment, apply more solution if free Cl_2 did not reach the effluent.
8. Perform a final rinse with 3-4 bed volumes DI water (until no Cl_2 is detectable in effluent).

Regenerated Resin Systems (Demineralization, Water Softening) (cont.)

The recommended procedure for anion resins is as follows:

1. Apply a thorough air scour and then backwash the resin.
2. If the resin has iron or other metal contamination, pretreat with ~1 bed volume of a 2% HCl solution followed by ~1 bed volume of a 10% HCl solution. Rinse out thoroughly.
3. Put strong base resins into exhausted form by treating with a 2-5% brine solution (skip if it has been pretreated with HCl), and weak base resins into regenerated form with a 2-4% caustic solution.
4. Use a sodium hypochlorite solution of 0.05% concentration (500 ppm).
5. Apply 2 g free Cl_2 per liter resin by passing 4 bed volumes of the NaOCl solution at ambient temperature through the resin bed with a 30-45 minute contact time. Measure the effluent and stop if free Cl_2 reaches a level of around 10% of the inlet concentration.
6. Rinse out with 3-4 bed volumes DI water (until no Cl_2 is detectable in effluent).

Ultrapure Water Applications

In ultrapure resin systems, it is not desirable to exhaust the resin or to introduce ionic species, such as peracetate, Na or hypochlorite, so Procedures 1 and 2 should not be used. Methods that can be applied are to expose the resin to hot water at 80-90°C (175-195°F) for 2 hours or ozone treatment at a concentration <10 ppb for up to 1 hour at 20°C (70°F). An alternative is to use hydrogen peroxide in Procedure 3. This method can also be used for regenerated resin systems.

Procedure 3: Hydrogen Peroxide Disinfection of Ion Exchange Resins

Hydrogen peroxide is an effective treatment for sterilizing both cation and anion exchange resins. To ensure good disinfection without damage to the resins, it is important to control the concentration, temperature and contact time of the chemical.

The recommended procedure is as follows:

1. Prepare hydrogen peroxide solution of 2% concentration.
2. For cation resins, apply 20 g hydrogen peroxide/liter resin by passing 1 bed volume of the solution at ambient temperature down through the resin bed (20-30 minutes contact time).
3. For anion resins, 10 g hydrogen peroxide/liter resin can be applied using 0.5 bed volumes of the 2% solution over 20-30 minutes.
4. Rinse out with DI water until essentially no hydrogen peroxide is detected in the effluent (minimum 1 hour).

If the resin is heavily contaminated, it may be necessary to repeat the treatment.

Additional Notes

For any of the procedures above, it is possible to apply the following variations:

- Apply the solution downwards till the cleaning agent is detected at the exit of the resin bed.
- Apply the solution upwards till the cleaning agent is detected at the exit of the resin bed.

This variation protects the resin from overexposure to the chemical.

In another case following procedure was applied:

- The resin was transferred to an external cleaning tank.
- The resin was kept in agitation while the cleaning agent was added.
- The preset concentration was kept constant by adding more cleaning agent.
- The treatment was stopped after 30 min.

This variation has the advantage that all the resin gets a uniform concentration of the cleaning agent.

DOW™ Ion Exchange Resins
For more information about DOW resins, call the Dow Water & Process Solutions business:

North America:	1-800-447-4369
Latin America:	(+55) 11-5188-9222
Europe:	(+32) 3-450-2240
Pacific:	+60 3 7958 3392
Japan:	+81 3 5460 2100
China:	+86 21 2301 1000

http://www.dowwaterandprocess.com