Cleaning Biologically Fouled Resin

By Frank DeSilva

Ion exchange resin beds are often an attractive growth medium for various biological organisms. Growths may include bacteria, mold and algae. In some cases, these growths can build up in the resin bed to the point where they physically foul the resin. In most cases, however, the concern is that of contaminating the effluent water leaving the ion exchange system.

Microbes can use as a source of food the traces of organic matter, nitrates and ammonia that are absorbed and concentrated by ion exchange beads. Ion exchange units that run for long periods of time between regenerations can therefore support microbial growth. This can cause microbial counts in the effluent of an ion exchanger to be higher than the influent. Also, when ion exchange resins sit idle for long periods of time (months or years), they can become sources of microbial growth.

Normal regeneration of demineralizer resins with acid or caustic subjects the resin to pH extremes, which can act as a sanitization step. Regeneration with salt brine, however, does little or nothing to reduce bacterial counts. There are many approaches to sterilizing ion exchange resin. Steam (or hot water) sterilization remains one of the most effective methods to sanitize resins and leaves little or no residual in the resin after treatment. Equipment must be designed to tolerate temperatures close to that of boiling water. Resins are generally tolerant of boiling water temperatures, at least for the relatively short time they are exposed during a sterilization procedure.

Potable water supplies generally contain chlorine or chloramine, added as a disinfectant. Where there is a chlorine residual left in the feed water to the ion exchange system, biological fouling is seldom a problem; however, long-term exposure to strong oxidants (such as chlorine) is known to degrade ion exchange resin. Therefore, the majority of users de-chlorinate the feedwater supply to the ion exchange system.

Subhead: Resin Sterilization with Bleach

Sterilization with bleach (or with other chemicals that release chlorine as the active oxidant) is an inexpensive method to kill most biological foulants. The degree of risk to most ion exchange resins associated with short-term exposure to chlorine is overrated. One-hour exposure to high concentrations of bleach does not severely degrade ion exchange resins, although some damage does occur. Short exposures to concentrations of 50 to 100 ppm do not measurably harm ion exchange resins and generally do a good job sterilizing the resin.

The steps below outline the proper use of bleach to sterilize resin.

1. Backwash the column of resin in a normal manner. If the resin is cation type used in the hydrogen form, brine treat the bed with 10% NaCl at 10 lbs/cu ft to remove any reactive substances from the bed. Check the effluent pH prior to adding any bleach. The pH must be greater than 6.5 to prevent possible chlorine fumes from forming. For salt regenerated exchangers, it is not necessary but may be helpful to regenerate first, to purge any build up of suspended solids.

2. Next, add sufficient sodium hypochlorite (common bleach available at 5% concentration) to the brine solution to yield a 50 to 100 ppm free chlorine level in the entire solution. In cases of extreme contamination, bleach concentrations of up to 500 ppm may be used without significant risk of damage to the resin.

3. For a typical regeneration using 10 lbs/cu ft salt dose, a ½ cup (4 oz) of household bleach is sufficient—or 2 oz if industrial strength (10 to 15%) bleach is used. Bleach may be added directly to the brine tank and drawn or pumped through the exchanger as part of the normal brine injection step of regeneration.

4. An alternative method is to interrupt the regeneration toward the end of the brine injection step, open the manway, add the bleach directly to the water/brine in the vessel, stir the solution and the resin (air mix or paddle) to get a uniform mixture, then slowly draw the solution through the bed, stopping just a few inches from the top of the bed.

5. For complete sterilization, the bleach should remain in contact with the resin for at least one hour. Contact times up to eight hours may sometimes be beneficial. Longer contact times probably do not improve sterilization results. Warming and recirculating the solution during this time will improve results. Periodic agitation of the bed by air or paddle will also help.

6. Finally, the resin should be rinsed free of the solution using a minimum of 75 gal of water per cubic foot of resin, to remove any disinfection by products that may have formed prior to return to service. If the unit is not placed in service immediately following sterilization, it should be pre-rinsed with a minimum of 15 gal per cubic foot of final rinse water just before it is placed back into service.

Subhead: Resin Sterilization with Hydrogen Peroxide

Hydrogen peroxide can also be used to sterilize resin. By itself, hydrogen peroxide does not damage ion exchange resins, even at concentrations approaching 10%. The presence of iron fouling (or other metals), however, causes hydrogen peroxide to decompose. The decomposition is exothermic and occurs more rapidly when temperatures are elevated. This can result in a run away reaction where the temperature approaches boiling and/or reaches explosive composition.

ResinTech strongly urges caution when using hydrogen peroxide. Keep concentrations at or below 1%. Make sure tanks are vented. Do not leave tanks unattended when full of hydrogen peroxide solutions. Do not leave peroxide in contact with resin for longer than one hour. If resin is iron fouled, treatment to remove the iron should be performed before using hydrogen peroxide.

The steps below outline the proper use of hydrogen peroxide to sterilize resin.

1. Backwash the column of resin in a normal manner. If the resin is cation type used in the hydrogen form, brine treat the bed with 10% NaCl at 10 lbs/cu ft to remove any reactive substances from the bed, and verify pH is above 6.5 before proceeding. For salt regenerated exchangers, it is not necessary but may be helpful to regenerate first, to purge any build up of suspended solids.

2. Next, add sufficient hydrogen peroxide to make up a solution volume of 0.25% H_2O_2 equal to the resin volume. In cases of extreme contamination, hydrogen peroxide concentrations up to 1% may be used without significant risk of damage to the resin. Be sure to completely vent the tank holding the resin. Hydrogen peroxide decomposes back into oxygen gas, which can significantly raise the pressure inside a closed tank.

3. Pass the solution slowly through the resin so that it takes at least 30 minutes to introduce all the solution. When all the solution has been introduced but is still covering the resin bed, stop the drain and allow the resin to soak in the solution for a minimum of one hour.

4. For complete sterilization, the hydrogen peroxide should remain in contact with the resin for at least one hour. Contact times of up to eight hours may sometimes be beneficial. Longer contact times probably do not improve sterilization results. Recirculating the solution during this time will improve results. Periodic agitation of the bed by air or paddle will also help.

5. Finally, the resin should be rinsed free of the solution using a minimum of 75 gal of water per cubic foot of resin, to remove any disinfection by products that may have formed prior to return to service. If the unit is not placed in service immediately following sterilization, it should be pre-rinsed with a minimum of 15 gal per cubic foot of final rinse water just before it is placed back into service.

Subhead: Conclusion

Other oxidants that are sometimes used to sterilize resin beds include ozone, potassium permanganate, iodine and a host of chlorine-like oxidants (such as 1, 3-dichloro-5, 5-dimethylhydantion). By and large, these are all effective and relatively safe; however, the plastic and rubber materials that are commonly used in ion exchange systems may not be impervious to oxidation. Ozone in particular will rapidly degrade some plastic materials. Another consideration is the possibility that there may be other foulants on the resin that act as catalysts, increasing the rate of oxidation.

There are a number of organic biocides that are commercially available that are very effective. Some of these can organically foul the resin. It is generally better not to add an unknown chemical to an ion exchange resin without verifying its effectiveness and harmlessness.

After cleaning for biological fouling, it is usually necessary to physically clean and then to regenerate the resin. This ensures that any residual cleaner is removed from the resin, and that any dead organisms are flushed out of the resin bed.