Resin Regeneration— More than Meets the Eye

Troubleshooting regeneration systems

By Frank DeSilva and Carl Galletti

Ion exchange resins are regenerated every day, and whether regenerating in huge vessels or regenerating in small laboratory columns, mixed beds or two beds, the object of the regeneration is the same: to restore the exhausted resin back to its proper ionic form for service.

Although there are hundreds of pages in engineering manuals on how to regenerate resins based on scientific data, regenerating resins sometimes seems like an art form or worse, a toss of the dice.

Frequently there are inconsistencies between the effectiveness of two regenerations even though the same procedure was followed. There can even be inconsistencies in the quality of resins from the same batch regeneration. Simply determining what the quality of a regeneration means may be confusing. By quality are we referring to the amount of water the resin is capable of treating or are we referring to levels of ionic leakage in the product water? Are we reporting the levels of ionic contamination as conductivity or resistivity?

Regenerating resins is a very complex process, some of the variables that affect the quality of the regeneration include the following:

- Resin condition;
- Differences in service water quality;
- Quality of regenerant chemicals;
- Amount of regenerant chemicals / concentration;
- Regenerant process water quality;
- Temperature;
- Flow rate; and
- Contact time.

While some variables can be controlled, it may not be possible to control all of them. Yet the greater the understanding of how those variables affect a regeneration, the more likely one will be able troubleshoot and develop techniques to achieve their regeneration goals. The following case studies are just a few examples of how understanding the factors affecting a regeneration may lead to better solutions.

Case Study No. 1

Problem: Separation Anxiety. A Portable Exchange Deionization (PEDI) plant using a traditional style funnel system was using the bottom portion of the funnel for separation of cation and anion resin components from a mixed bed. Separation was taking a long time. The water shot up the middle of the funnel and was not getting any distribution to the sides of the funnel. The operator knew they were getting cross-contamination of cation and anion resin and worked tediously with little success.

Solution: Backwash Assist. It was recommended to the operator to put a riser tube with a distributor basket down the center of the funnel, just above the bottom opening. This riser tube would introduce additional backwash water for separation, precisely at the cation and anion interface. It worked well because water was evenly distributed across the funnel. As a result, the mixed bed separation step was reduced in time from 1 to 1.5 hours, to 10 minutes. This not only made the process faster, but there was also a significant improvement in conductivity and run lengths. This was due to the lack of cross-contamination, less cation in the anion to improve quality (less Na+ form cation), and less anion in the cation to increase run lengths (more anion in the OH- form). This distributor tube also improved the air mix step at the end of the regeneration sequence.

Case Study No. 2

Problem: Low Conductivity out of Two-Bed DI. A resin regeneration company specialized in the supply and regeneration of mixed bed units. High quality water and decent run lengths were the norm. However, when the regenerator decided to supply two bed cation-anion deionizers to a local customer, long rinses and poor quality results occurred.

Solution: More is Better. The regeneration plant was initially designed to regenerate mixed beds. The nature of a mixed bed resin is very forgiving. Often, if the cation or anion component receives a less than optimal regeneration dosage, the mixed bed effluent quality may still be in the acceptable range, assuming the components are well mixed and have had time to soak and come to equilibrium. In the case of this particular plant, both the cation and anion chemical dosages were set at relatively low levels. After reviewing the regeneration sequence and procedure, a recommendation was made to increase the amount of acid applied to the cation, and increase the amount of caustic applied to the anion. Results were a two bed cation-anion system that rinsed down quickly and exhibited low conductivity throughout the service run.

Case Study No. 3

Problem: Same Resin, Different Results. A regional PEDI plant treated resins for several satellite locations. As part of the quality control procedure, all completed mixed beds were checked for effluent resistivity using the plant's DI water supply. On several occasions, mixed beds that made excellent quality on the QC rig, failed to make even minimum quality once at the satellite location, several hours away.

Solution: Keep it Mixed. It turns out that the operator at the regeneration facility who performed the QC, failed to drain the mixed beds of water prior to putting the tanks on the truck for the two-hour ride to the satellite location. Once on the truck, there was some resin separation, due to the fact that the resin was in water and the truck provided mild agitation. The density differences of the cation and anion resin, as well as the particle size difference, allowed for a slight separation. This caused a layer of cation resin at the bottom of the tank. Because this is the last resin that the treated water sees before exiting the vessel, the product water had a low pH and low resistivity.

Case Study No. 4

Problem: Why is it Different? A regenerator who performed both mixed bed and two bed regenerations was experiencing inconsistent results with the two bed tanks but not the mixed bed tanks. Dedicated, large cation and anion chemical dosing tanks were used to regenerate the two bed resins in batches. The resin used was not mixed bed resin, but a separate float just for two beds. It was noticed that when the regenerated resin was loaded from the dosing tanks into the service vessels, that the effluent rinse results tank to tank were never the same. It would range from 2 to 20 uMhos of conductivity. The operators tried to flip flop the cation and anion tanks, but still got the same results.

Solution: Even it Out. Because the large batch tanks regenerated downflow, the least regenerated resin was at the bottom and the most highly regenerated resin was at the top. Consequently, the service units that were filled with resin from the bottom of the tank performed poorly, and the units that received resin from the upper portion of the bed performed much better. The recommendation in this case told the operators to perform an air mix in each cation and anion batch tank prior to loading the resin into the small exchange tanks. As a result the effluent water quality of the two bed DI tanks were the same across the board, and rinsed up quickly.

Although a multitude of factors affect the outcome of a regeneration, we covered just a few here. More importantly, we hope to have shown that there may be more than meets the eye and that the better you understand the regeneration process the more effectively you will be able to troubleshoot problems. *wqp*

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