LG QuantumPure™ IX Resins

Technical Service Bulletin 905

Clumping of Ion Exchange Resins

1. What Is the Clumping of Ion Exchange Resins?

The clumping of ion exchange resins is an issue sometimes encountered when mixing cation and anion exchange resins in a mixed bed, particularly when new resins are in regenerated forms (H form for cations, OH form for anions), clumping occurs more frequently.

When clumping occurs, the cation and anion exchange resins intertwine and form clumps, and even after backwashing, due to the difference in densities, the separation of the cation and anion exchange resins is not effectively achieved, leading to poor regeneration. Additionally, parts of the resin layer clump together, causing channeling, and the increase in void spaces leads to an increase in the volume of the resin layer.

2. Why Does Clumping of Ion Exchange Resins Occur?

The clumping of ion exchange resins is known to occur due to the strong electrostatic attraction between the surfaces of the regenerated cation exchange resin (H form) and anion exchange resin (OH form). This phenomenon is especially pronounced in pure or ultrapure waters, where the electrolyte concentration is very low.

3. What Are the Solutions When Clumping Occurs?

3.1 Air-scrubbing and NaOH Injection

Typically, the clumping resolves naturally after 3-4 cycles of service and regeneration as the surface charge of the anion exchange resin decreases, but it can persist in processes using ultrapure water with very little electrolyte. The best environment for clumping to occur is, as mentioned above, when cation/anion exchange resins in ultrapure or pure waters with minimal electrolyte are in their regenerated form. Therefore, methods involve converting the cation/anion exchange resins, artificially, to the exhausted form or injecting electrolytes, with the most widely used methods being air-scrubbing and using NaOH.

The detailed operating methods are as follows:

1) Air-scrubbing: Air is blown into the bottom of the resin column to mix the cation/anion exchange resins and partially loosen the entangled resin layer. (N^2 may also be used depending on the process)
2) After air-scrubbing, a NaOH solution (typically around 5%) is injected from the top of the resin column and discharged from the bottom. The cation exchange resin becomes the Na form, increasing its density (increasing the cation/anion density difference), reducing the interaction with the OH form anion exchange resin, and decreasing electrostatic interactions due to the injected electrolyte (NaOH).
3) Backwashing is performed to separate the cation/anion exchange resins.
4) After separation, the Na form cation exchange resin is regenerated with HCl. The anion exchange resin, already in the OH form, does not require regeneration.
5) Start service after mixing of resins and check water quality.

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3.2 Air-scrubbing and PSA (Polystyrene Sulfonic Acid) Injection

If the clumping does not improve even after air-scrubbing or NaOH injection, a linear polymer electrolyte, typically PSA (Polystyrene Sulfonic Acid), is used as an anti-clumping agent.

1) Typically, about 200-300 mL of PSA original solution is used per 1m3 of anion exchange resin, and it is prepared to be injected by diluting 200-300 mL of the original solution with 10L of pure water.
2) During air-scrubbing with the mixed cation/anion exchange resins, about 10L of the prepared PSA solution is injected from the top of the resin column over 20-30 minutes, and after injection completion, air-scrubbing is continued for another 20-30 minutes.
3) Backwashing is performed to separate the cation/anion exchange resins.
4) The regeneration process is conducted after separation, and water Service is started to verify water quality.

4. Why Does the Volume of the IER Bed Increase When Clumping Occurs?

When clumping of ion exchange resins occurs, the cation/anion exchange resins tangle, increasing the void spaces between the resin layers, which in turn increases the volume.

4.1 Precautions During Commissioning After Regeneration

If the required water quality is not achieved during commissioning after regeneration, separating the ion exchange resins through backwashing and re-conducting regeneration immediately can lead to clumping as the cation/anion exchange resins are in the regenerated form. Therefore, to prevent ongoing trouble, it is necessary to continue the service process for at least 5 hours to partially convert to the exhausted form before performing air-scrubbing for 10-20 minutes and then separating through the backwash process.

Be cautious when attempting to separate and regenerate the regenerated ion exchange resins (H form for cation, OH form for anion) after charging, as there is a high likelihood of clumping.