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**Resin Refresher Part 2 Anion Resin**

- When we talk about cation resin, we're removing positively charged cationic species like hardness and iron. The functional group is anionic. A cation bead is a big ball of anionic or negative charge which attracts positively charged ions.
- Anion resin is the opposite – A big ball of cationic or positive charge. Anion resins have positively charged functional groups which attract negatively charged ions such as nitrates and PFAS.

**Specialty or Selective Resins**

- **Selective resins** are not selective (deselective) towards higher charges like sulfate. Nitrate has a minus 1 charge, and sulfate (also usually in water), has a minus 2 charge (higher charge).
    - How it works. The technical term is sterically hindered, the functional groups are just bigger and there's more in the way. Defined as "Situations where there are multiple possible reaction sites on a molecule, the presence of bulky groups can favor one site over another by blocking access to less hindered sites."
    - Functional groups, one on one, have a certain selectivity; for instance, for one charge. But when you bring two into the equation, meaning there's a minus 2 charge or even a plus 2 for a cation, you need two functional groups close together to make it work properly. When we say sterically hindered, what we're really saying is the functional groups really act like they're further apart so that the ion you're trying to attach really can't reach 2, it can only reach 1. So, when a very high selective minus 1 charge comes in (like Nitrate), it's going to knock that minus 2 out of the way.
    - There are other highly selective minus 1 charges. PFASs are negative 1 charges. The attraction of the **PFAS** chemistry is that one to one charge pull. Selective resins are used for **perchlorate** removal, also a minus 1 charge. These are the big three minus 1s that we deal with.
- **Tannin resins** are strong base anion resins with larger pore structures (macroporous), specifically designed to accommodate tannin removal. These larger pores effectively capture tannin compounds from the water.
    - The challenge with tannin resin is maintaining its cleanliness for repeated use. In an ideal scenario, it would require regeneration with a two to five percent brine concentration at 140 degrees Fahrenheit for four hours, which is not practical for typical home applications. Due to these limitations, tannin resins typically last around a year to 18 months in normal use.
    - In industrial or commercial environments, it might be more feasible to implement the regeneration process for tannin resin. However, even in large commercial applications, such as municipal water treatment, practical limitations can still make it challenging to achieve the optimal regeneration conditions mentioned above.
    - The practical constraints and costs associated with ideal regeneration processes often limit the lifespan of tannin resins in real-world applications. It's a constant struggle to balance the effectiveness of tannin removal with the available equipment and resources.

- Extending the brining process is one approach to try and maximize the resin's lifespan, but it can still be challenging to achieve long-term durability given these limitations. This method allows for the introduction of brine into the treatment process, followed by a temporary pause in the process, during which the brine is allowed to interact with the resin. After this pause, the brine treatment step is resumed. Assuming the control valve can accommodate the procedure, this can be used to enhance water treatment processes by optimizing the interaction between brine and the treatment system.
- Heating the brine before introducing it into the system would be ideal, although this might be impractical or impossible to achieve in certain situations. Heating brine can enhance its effectiveness in certain water treatment processes.
- Soda ash can be used to raise the pH of the brine for cleaning purposes, but it's not practical to simply throw a bag of soda ash into a brine tank and leave it, as soda ash is highly soluble at low concentrations. Moreover, this approach would require frequent addition of soda ash during each regeneration cycle, and handling soda ash can be hazardous.

**Cleaning Anion Resins**

- Anions are tricky to clean compared to cation. It's recommended to raise the pH of the brine when dealing with organic fouling. In a commercial or industrial setting heated brine with sodium hydroxide or soda ash to raise the pH can be used. But it's essential that no hardness is present as they can precipitate and cause issues like calcium carbonate or calcium sulfate scale.
- For hardness fouling on anion resins, the best approach is to use hydrochloric acid or muriatic acid, but this choice depends on the equipment's compatibility and handling precautions. Avoid citric acid and phosphoric acids due to their weak dissolving power for scale and their tendency to introduce citrate ions, which can be selective for anion resin and reduce its capacity for subsequent uses.
- However, if you must choose an acid cleaner for anion resin, it's safer to opt for phosphoric acid-based products. It's important to note that this may not be strong enough to achieve the desired cleaning goals, but they are less likely to damage the resin and it will regenerate off.
- When performing a resin cleaning, it's advised to be thorough. The typical resin cleaning instructions are designed for everyday regeneration or preventive maintenance. If you're conducting a more intensive cleaning, it's recommended to hit it hard and allow it to soak. Afterward, ensure thorough rinsing before initiating the regeneration process. Additionally, you should do a double regen, meaning extend the chemical addition time twice as long during regeneration to ensure that all traces of the cleaner are effectively removed from the resin bed.

- pH cleaning - If you use caustic or soda ash to raise the pH during cleaning, it can result in an elevated pH level of the resin, which can cause a smelly fish odor. To address this, a critical step in the process is to perform a regeneration after the treatment. This regeneration involves a “hard normal” brine regen to thoroughly remove any residual high pH from the resin, allowing it to return to its normal state. This process should prevent any lingering odor issues, and while the resin may be temporarily affected, it is not permanently damaged.

**Resin Condition**

- When anion resin is in use, it can change color over time, typically transitioning from a light color to light brown and then darker brown. If the resin appears to be jet black when it's removed from the tank, it's likely fouled and may need replacement.
- Another method for checking resin integrity is by rolling some resin beads through your fingers. If the resin easily turns into a paste or dust in your hand, it's an indicator that it may be oxidized or has lost its bead integrity, suggesting that it's time to replace it.
- A simple home microscope can be helpful in determining resin condition. If you don’t see nice, round spheres, it’s a good indicator that the resin beads are broken.

**Silica**

- Silica is one of the most abundant elements on Earth and commonly found in various water sources. Silica concentrations can range from 5 parts per million to 30 parts per million and can contribute to the taste of mineral water. In fact, synthetic mineral waters often incorporate silica to enhance taste.
- Addressing silica issues in water treatment requires a comprehensive understanding of the water chemistry and careful consideration of other factors that may contribute to scaling or corrosion problems.
- It is a misconception that silica alone causes scaling issues. Scale is typically caused by other factors, and silica may be carried along with it. Silica is highly soluble, so the presence of scale may be due to other dissolved solids or the result of evaporative water leaving residues behind.
- When addressing silica-related issues, it's important to identify the root cause of the problem, such as the presence of scale in appliances or powdery coatings. Understanding the underlying issue can help in implementing effective water treatment solutions.
- It's essential to consider the interplay of multiple factors. Depending on the water chemistry, addressing hardness, alkalinity, or TDS may be more effective in mitigating scaling issues.
- Silica is not an ion in water but rather a species that needs to be ionized to be effectively removed. Raising the pH to around 10 or 11 can help ionize silica into silicate, making it more amenable to removal with anion resin. However, the challenge lies in managing the high pH water produced by this method, which can have undesirable odors and other practical limitations.

- The idea of using a "desilicizer," involves using hydroxide-form anion resin after a water softener to remove silica. However, this approach presents challenges related to high pH and potential scale buildup on the resin.
- Managing interference from silica is crucial when using absorption media for contaminants like arsenic or antimony. Lowering the pH of the water can increase the capacity of these media to remove the target contaminants. By reducing the pH, silica becomes less of an interferent, allowing the media to function more effectively. However, even with pH adjustment, the reduction in silica levels achieved by these media may still be limited, perhaps around 25 to 40 percent. In cases where the incoming silica concentration is high, such as 10 ppm, achieving a reduction to 7 ppm may not be sufficient for addressing silica-related issues in water treatment.

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