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Episode 18 Show Notes What exactly is high capacity resin???

Cation exchange resin used in a softener exchanges sodium for hardness minerals – calcium and magnesium. When the resin is exhausted, that is, no more sodium ions are on the resin bead, it is regenerated with a brine solution, NaCl. This concentrated brine wash pushes off the calcium and magnesium ions, getting the resin ready for action again in the sodium form. This process is repeated over the life of the water softener.

There are different varieties of softener resin, which poses the following questions: Does its color (blonde, brown or black) influence performance? Why is fine mesh resin considered high capacity? How do you know when to specify 6, 8 or 10% crosslinked resin?

Types

Cation resin can be purchased in the sodium (Na) or hydrogen (H). Always confirm the resin is in the sodium (Na) form before loading the tank or installing in a home. If hydrogen (H) form is used in a residence the pH of the treated water will be very acidic at 2-3 pH. This is damaging to people and pipes. Hydrogen form cation is required commercially when deionizing or demineralizing water.

Cation resin is available as 6%, 8% & 10% crosslink. Higher crosslinked 12-15% cation resins are manufactured for special applications (not applicable to this podcast). The higher the crosslink, the higher the cost.

A great article by ion exchange expert, Chubb Michaud, gets into the details of crosslinking. http://wcponline.com/2011/06/07/role-cross-linking-ion-exchange-resins/

Chubb's highlights are noted below:

- Higher cross-linking means higher density with more plastic and less water.
- Higher cross-linking produces a tougher matrix that is more resistant to both chemical oxidation and physical breakdown strength.
- Drawbacks include higher costs and slower kinetics (not a good thing for cold water). Although higher cross-linked resins have a higher **total capacity,** the kinetics in colder water may actually result in a lower **operating capacity t**han a lower cross-linked resin and prove to be an incorrect choice.

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Our rules of thumb when applying these resins:

- 6% - Residential use on well water without chlorine.
- 8% - Residential or Commercial/Industrial well or city water where 1 ppm or less of chlorine.
- 10% - Residential or Commercial/Industrial well or city water where chlorine/chloramine levels are greater than 1 ppm. Also used where there is a combination of hot water and oxidants (chlorine or chloramine).

Installation of an activated carbon filter ahead of the softener to remove the chlorine or chloramine will prolong the life of the resin.

The color of the resin has no impact on performance. Many years ago, Sybron C-249 was considered to be the premier softener resin. It was black, poured easily and performed very well. Dealers loved it. As new companies entered the market more competitively priced cation resins were introduced. Black cation is still manufactured and is generally available at a slight premium.

Some mixed bed resins have black cation and blonde anion. The first regeneration step of mixed bed is to separate the cation and anion. Anion which is lighter in weight and color is floated to the top; cation heavier and darker remains on the bottom. The color difference distinguishes where they separate enabling the regenerator to easily see and move each resin to the appropriate regeneration vessels.

Fine mesh resin is used in residential applications where iron is present. Fine mesh resin beads are smaller and will form a more compact bed with less void spaces. This results in a higher capacity resin because the kinetics of this bed are faster. The ion exchange happens more quickly than in standard sized resin. Be careful of the distributor screen slot size and 1/8x1/16” gravel sub-fill is suggested.

Uniform Particle Size (UPS) Resin is used in commercial/industrial systems. Standard resin size is 16-50 mesh. The size range of uniform particle size resin is narrower - 30-40 mesh. The benefits of UPS resin include higher regeneration efficiency, better kinetics resulting in higher capacity, reduced leakage, and better mixed bed separation.

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Unlike standard resin shallow shell resins have a solid core. Contaminants migrate toward the center of the bead and stay put regardless of the regeneration process. The solid core limits available exchange sites so the exchange activity happens closer to the surface. This results in quicker and cleaner regenerations and salt savings. It does well on water with iron and manganese. The salt savings can be significant in large commercial/industrial applications. The cost of this resin is roughly 30% more.

Other contaminants removed by cation resin:

- **Using softener resin for clear water iron and manganese removal is common along the eastern US.**
- **Contaminants such as lead, aluminum, and copper will be picked up by cation softening resin.**
    - Lead seldom naturally occurs in water. More often it's the result of dissolving brass, lead fixtures, lead solder or improperly treated city mains. Fine mesh resin is recommended because it will pick up particulate lead. Lead is so ionically sticky that one cubic foot of cation will remove up to 9 pounds.
    - Aluminum can be found in city water if alum polymer is overfed.
    - Copper will be picked up by cation resin and turn it green. We've seen this in plating operations.

How long does resin last?

- **In non-chlorinated water 6% resin lasts ~ 8 to 10 years; 8% much longer.** In general, the resin will wear out in the same time frame as the other parts of the softener – the valve, tank, brine tank, etc.
- In iron removal applications we recommend using a phosphoric acid drip to keep the resin bed clean and last longer.

Precautions

- Use sodium form cation not hydrogen form.
- Don't store outside if there is the possibility of repeated freezing and thawing.
- Don't overfeed chlorine. Consider an activated carbon filter as pre-treatment.

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How does softener resin differ from scale removal media?

During the ion exchange process hardness minerals are exchanged with sodium. These minerals are flushed away as part of the regeneration process. There is a means of measuring the removal of these ions. Scale will not build up on fixtures, water heaters, boilers, etc.

The scale removal devices or water conditioners don't remove the hardness minerals but they do neutralize them, so they don't stick or scale fixtures. Chemically they are not "softening" the water so calling them salt free softeners is believed to be inaccurate. If the "scale free" water is left to puddle it will form a powder which can be wiped away.

The Water Quality Research Foundation (WQRF) has funded a study - **Development of a Standardized Scaling Test Protocol for Evaluation of Scale Reduction Devices and Technologies (aka Benchmarking Study)** to create a repeatable protocol that provides scientific evidence of the performance of the scale removal devices. https://www.wqrf.org/current-studies.html.

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