Produced Water Softening Using SAC & WAC Shallow Shell™ Resin Technology.

Strong acid cation (SAC) and weak acid cation (WAC) ion exchange resins are typically used in lead-lag tanks to soften high TDS produced water and brackish systems. SAC resin in the primary (lead) tank removes the majority of Ca, Mg and Fe, while WAC resin in the lag tank effectively polishes the water to < 0.5 ppm total hardness.
Softening the water helps to maintain the efficiency of downstream steam generators by preventing scale buildup and plugging, and helps to maintain steam quality.
Chemicals used for regeneration and water used for rinsing the resins are a major part of the operating costs for these produced water treatment systems.
The advanced structure of Purolite's Shallow Shell™ (SST®) resin beads facilitates more complete ion exchange and efficient regeneration with less leakage and fouling. The key to the resin's efficiency is the unique shell and core structure of the resin bead. In the production process, the center of each SST bead is left inactive, eliminating the functional sites that take the longest to exchange, are the most difficult to regenerate and are the most susceptible to fouling.

As regenerant passes through beads and gets consumed, the reaction force diminishes.

Because this happens, at the end of the regeneration cycle:

- The bead center remains un-regenerated
- Residual cationic species accumulate within the resin bead (Ca, Mg, Fe and other metals)
- The bead becomes fouled
- Higher hardness leakage occurs in the next cycle
- Excessive, expensive amounts of chemical are required to achieve acceptable regeneration levels

Resin fouling, in large part, is caused by incomplete regeneration, triggering an accumulation of contaminant species that are the source of hardness leakage in subsequent service cycles.

Fig. 1 – Fouling of Ion Exchange Resin

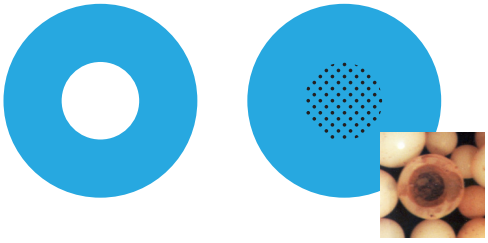

Fig. 1: A graphic depiction of an un-regenerated core with photo insert of a standard resin with a fouled center.

With Shallow Shell Technology , regeneration occurs more quickly and efficiently because chemicals don't have to penetrate the entire bead.

- A short, consistent exchange path improves the efficiency of ion exchange
- Higher purity water is produced

Advantages of Shallow Shell™ Technology

- Requires 15 – 30% less chemical usage to achieve equal or better operating performance; reduces operating expenses
- Significantly reduces rinse water
  - 30% savings for counter-flow operation
  - 50% savings for co-flow operation
- Reduces fouling and leakage from Ca, Mg, Fe and other metals
- Suitable for co-flow, counter-flow and packed bed systems
- Supports ISO 14001:2004 initiatives toward environmental management and impact
  - uses less chemical regenerant and generates less waste

Watch the video to learn how Shallow Shell™ Technology works at www.bit.ly/purolite

The positive impact of Shallow Shell Technology on regeneration and rinse efficiency is most obvious when regenerating WAC resins. Acid, usually HCl, is used to elute the hardness, while caustic, NaOH, is used to convert the resin sites to the sodium form. With standard WAC, two problems are experienced—extended time for complete elution of hardness as well as extended time and volume of water used for rinsing the resin. As the standard WAC resin ages, carboxylic functional groups hydrolyze and retain caustic within the resin bead, resultling in longer rinse-down time of the resin bed. Figure 2 displays the advantages of SST resin. Figure 2 also indicates that no hardness exists for SST resin during the casutic (NaOH) injection step, while approximately 2,500 ppm of hardness continues to elute for standard resin. This residual hardness can ressult in caustic combining with Ca and Mg to form precipitates of calcium and magnesium hydroxides within the resin bed. Such solids can result in increased pressure drop in subsequent service and lead to chanelling and premature leakage of hardness into the treated water. Problems that SST helps to prevent.

Fig. 2 – WAC Regeneration – SST® vs. Standard Resin

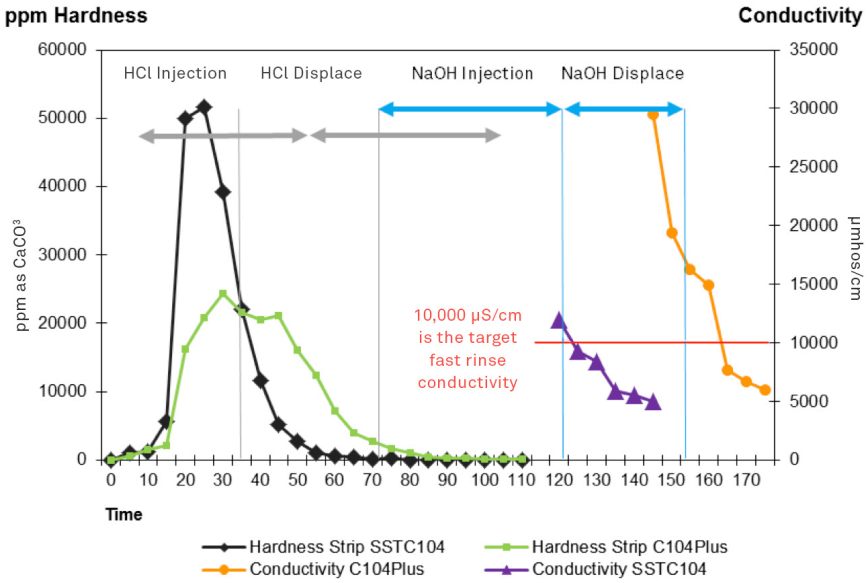

Fig. 2: A comparison between co-current regenerated WAC resin units using Shallow Shell™ SSTC104 and Purolite® C104 Plus.

Left side – Hardness Elution

30% savings in acid is experienced using Shallow Shell Technology resin. Notice how the black line (SSTC104) peaks and drops off quickly, while the standard resin (green line) drags out into the caustic injection step. This indicates that the SST resin works more efficiently, while the standard resin takes longer to achieve the same level

Right Side – Rinse Conductivity

With a target goal of 10,000 µS/cm, the purple line (SSTC104) meets the target during the caustic displace step, while the orange reaches the target during the fast rinse. This indicates a significant increase in regeneration efficiency, which can lead to a 50% savings in rinse water.

Shallow Shell Technology™ …It is possible to cut operational costs without sacrificing performance.

This product overview illustrates how Purolite's SST® Technology enables unsurpassed regeneration efficiency and reduced rinse water requirements for produced water softening applications. Contact your regional technical sales expert to learn how Purolite SST resins can make your softening treatment system more effective, efficient and environmentally sound.

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