

The background of the slide is a photograph of an oil pumpjack (jack-o'-lantern) in silhouette against a bright, golden sunset sky with scattered clouds. The image is split diagonally from the top-left corner to the bottom-right corner. The upper-left portion is white, and the lower-right portion is a solid blue color with a pattern of small, light blue squares and 'x' marks.

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

This Application Guide illustrates how Purolite™ Resins SST⁰ Technology enables unsurpassed regeneration efficiency and reduced rinse water requirements for produced water softening applications.

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Contents

Introduction	3
<hr/>	
Advantages of Shallow Shell Technology	4
<hr/>	
Cut Operational Costs, Not Performance	5

Introduction

Strong acid cation (SAC) and **weak acid cation (WAC)** ion exchange resins are typically used in lead-lag tanks to soften high TDS-produced and brackish water systems. SAC resin in the primary (lead) tank removes the majority of Ca, Mg and Fe, while WAC resin in the polisher (lag) tank effectively polishes the water to < 0.5 ppm (as CaCO₃) total hardness.

Softening water prevents scale buildup in the boiler tubes which enables the steam generator to provide continuous high quality steam.

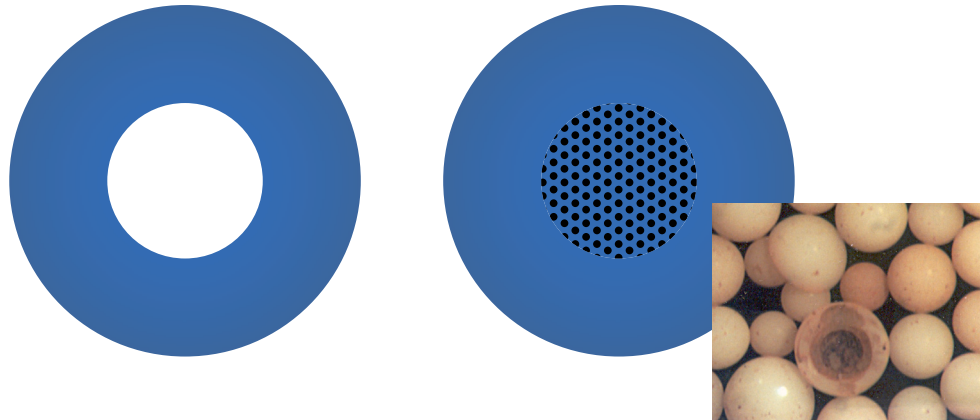
Chemicals and water used for regeneration and rinsing of the resins are a significant part of the operating costs for produced water treatment systems.

The advanced bead structure of **Shallow Shell Technology (SST)** resin facilitates a higher operating capacity, efficient regeneration, lower leakage and no fouling. The key to the resin's efficiency is the resin's unique shell and core structure. In the production process, the center of each SST bead is left inactive, eliminating the functional sites, 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 resulting in:

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

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

FIGURE 1**Fouling of Ion Exchange Resin**

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 counterflow operation
 - 50% savings for co-flow operation
- Reduces fouling and leakage from Ca, Fe and other metals
- Suitable for co-flow, counterflow and packed bed systems
- Supports ISO 14001:2015 initiatives toward environmental management and impact
 - Uses less regenerant chemical and water, resulting in an overall reduction of waste.

Watch the video to learn how Shallow Shell Technology works at <https://bit.ly/3D0BJkG>.

The positive impact of Shallow Shell Technology on regeneration and rinse efficiency is most apparent when regenerating WAC resins in HTDS-produced water treatment. Acid, usually HCl, is used to elute the hardness, while caustic, NaOH, converts the resin sites to the sodium form. With standard WAC, two problems are experienced – extended time for complete elution of hardness and 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, resulting in a 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 caustic (NaOH) injection step, while approximately 2,500 ppm of hardness continues to elute for standard resin. This residual hardness can result in caustic combining with Ca and Mg to form precipitates of calcium and magnesium hydroxides within the resin bed. Such solids can result in extremely long fast rinse times to prevent excessive hardness leakage into the treated water. These are problems that SST resins prevent.

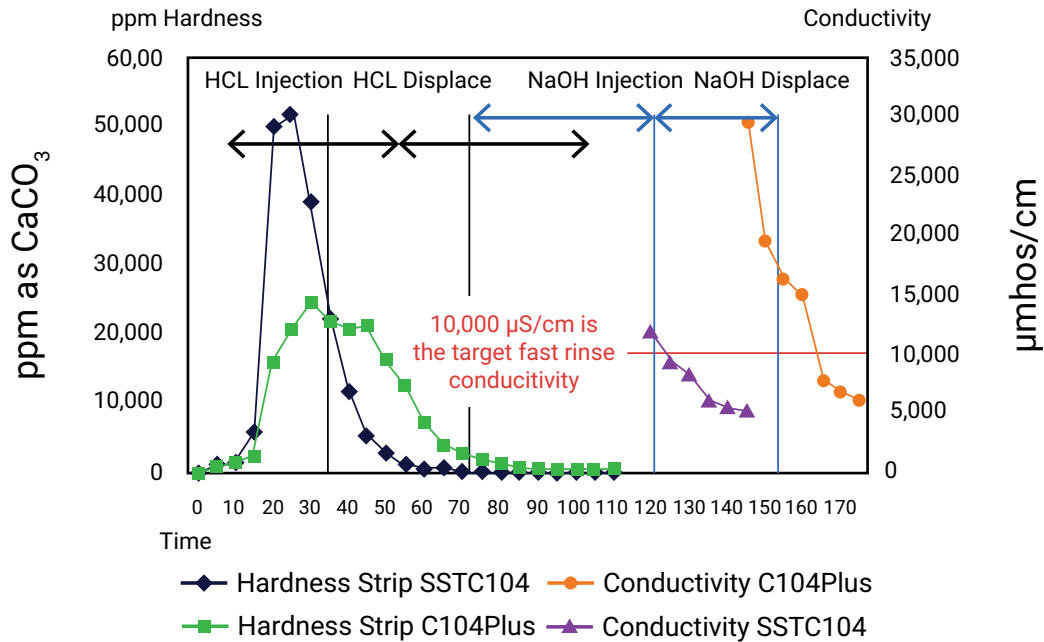
Cut Operational Costs, Not Performance

With Shallow Shell Technology, it is possible to cut operational costs without sacrificing performance.

This product overview illustrates how 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 SST resins can make your softening treatment system more effective, efficient and environmentally sound.

FIGURE 2

WAC Regeneration: SST vs. Standard Resin



A comparison between co-current regenerated WAC resin units using Shallow Shell SSTC104 and C104 Plus.

Left Side: Hardness Elution

30% savings in acid is experienced using Shallow Shell Technology resin. Notice how the black line (Shallow Shell™ 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

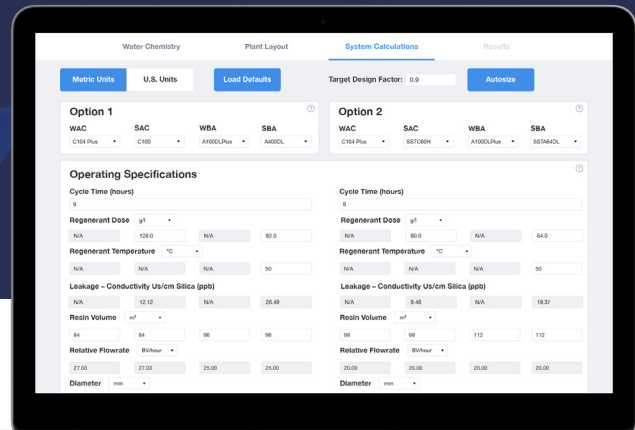
With a target goal of 10,000 µS/cm, the purple line (Shallow Shell™ SSTC104) meets the target during the caustic displace step, while the orange reaches the target during the fast rinse. This indicates a significant increase in regeneration efficiency, leading to a 50% savings in rinse water.

Customized Resin Simulation at Your Fingertips



PRSM™
Purolite Resin System Modeling

PRSM is a free program that models all aspects of plant design associated with ion exchange resin performance and operation.



Plan your next ion exchange resin project with better accuracy and less effort through Purolite's Resin System Modeling platform (PRSM™). This powerful web application for resin plant simulation contains seven specific system modules that instantly consider hundreds of variables. Whether you are designing a new plant or modeling an existing plant, Purolite's expert engineers are giving you the access you need to get the results you can trust.

Key Insight Every Step of the Way



Predict

Calculate the effect of your site's unique variables



Compare

Side-by-side product and plant configuration performance evaluation



Optimize

Add operation and product cost analysis to better understand the value of product options

PRSM includes modules for water softening, demineralization, WAC softening, brine purification, mixed beds and modules for removal of nitrate, arsenic and boron. Features include:

Technical Help – Reach out directly to Purolite engineers for advice

Cloud Backup – Easy and secure retrieval of projects

Reporting – Print/save a pdf of the entire design including all engineering details

ROI Payback Calculations – Contrast performance vs. standard resins

Efficiency Evaluation – Compare operating costs of existing ion exchange plant vs. new design

Schedules – Obtain detailed regenerant schedules for cation and anion resins

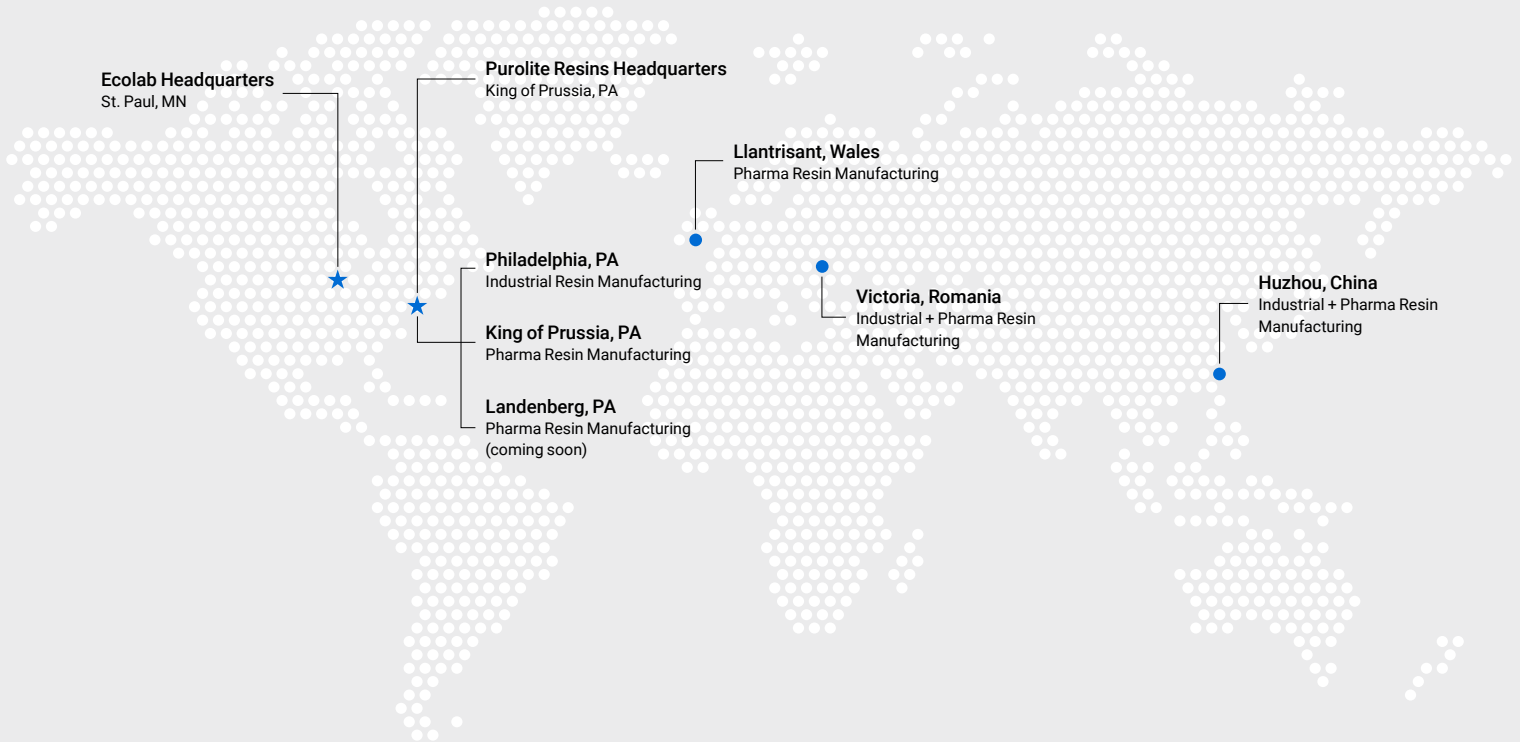
Page, Topic and Calculation Help – View detailed notes and suggestions for the optimal design

Register today and get started at www.puroliteresins.com/PRSM

Ecolab is a global developer, manufacturer, and supplier of Purolite™ Resins including ion exchange, catalyst adsorbent and advanced polymers that make the world cleaner and healthier.



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