# Water Softening Resin Selection

By The Purolite Company

A variety of Purolite Ion Exchange Resins can be used for water softening. During the softening process, calcium and magnesium are removed from the water. Together these two impurities are referred to as the total hardness (TH) of the water.

Testing:

Depending on the accuracy needed, you can test the water for hardness by titration or by the simpler dropper-bottle test. In both cases, a few chemical reagents are added to sample of the water and the sample changes from red to blue at the end of the test.

The result for the total hardness test can be expressed as either "parts per million" (or ppm) of hardness or "grains per gallon" (or gpg), usually expressed as calcium carbonate (or CaCO3).

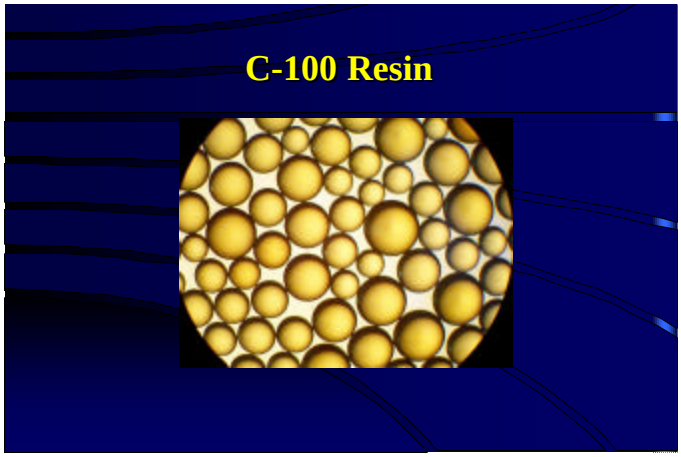
For household water softening, if the water is considered to be "soft water" it usually means that the hardness remaining in the water after passage through the water softener is about 1 grain per gallon (gpg) or less. In terms of the alternative ppm unit above, this would be equal to 17.1 ppm of Total hardness as Calcium Carbonate.

If the water is to be used for industrial or commercial use, such as makeup water to a boiler, or other more demanding application, then reduction of the water hardness to less than 1 ppm is usually desired.

In both cases, the same softening process can be used, but as can be expected, the design for industrial and commercial units would be more stringent to achieve the lower hardness limit set for the treated water.

Softening Basics :

For standard softening jobs, the first choice should be **PUROLITE C-100E** for potable use and **PUROLITE C-100** for industrial or commercial use.

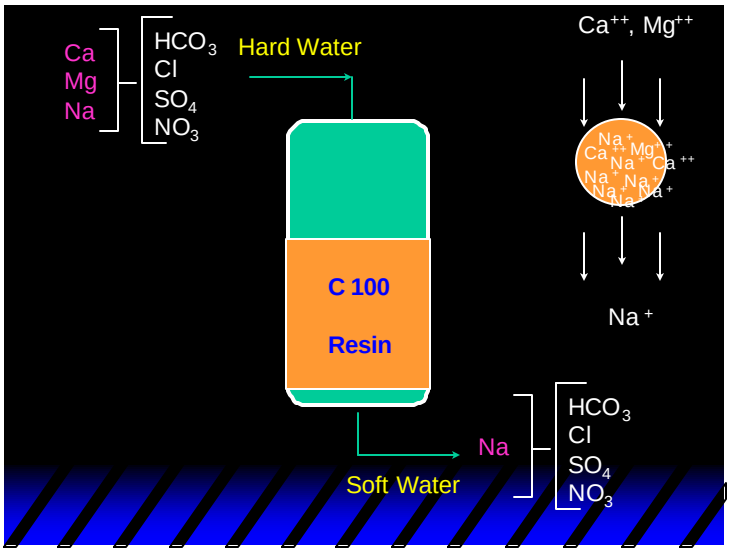



Both resin products are manufactured using an inert co-polymer of polystyrene and DVB which gives them good mechanical strength. Later on in the manufacturing process, functional groups are added and these give the resins their ability to soften the water.

The C-100 E grade, which is recommended for potable use, is put through an additional step so that it can conform to FDA guidelines for resins used for potable use.

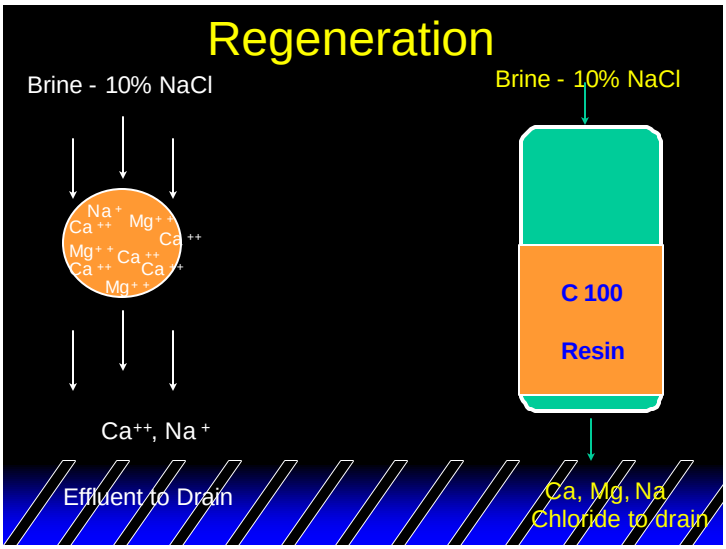
Both C-100 and C-100 E are produced as spherical beads that vary in diameter from 0.3 millimeter to 1.2 millimeter. This referred to as the standard bead distribution, and is also referred to as "16 to 50 mesh" beads. These beads allow a maximum amount of surface area for facilitating the ion exchange process, while not being too small in diameter so as to cause too much restriction in water flow.

During the softening process, calcium and magnesium that are present in the water supply are exchanged on to the ion exchange resin beads as the water flows past a bed of the resin placed in a suitable column. In turn the resin releases an equivalent amount of sodium into the water, so the water exiting the water softener is significantly higher in sodium than the untreated water.




Because the exchange of hardness for sodium is not perfect, a very small amount of hardness usually escapes into the treated water leaving the water softener. But testing of the softened water for hardness at this stage (in a properly working unit) will usually not detect this trace amount of hardness.

Eventually, more and more hardness escapes into the water and it can then be detected with the normal hardness test kit. At this stage, it is necessary to rejuvenate or regenerate the resin so that the quality of softened water can be properly maintained.




<u>Regeneration</u>: During the regeneration process, a solution of salt (brine or sodium chloride) is used to displace calcium and magnesium that

were taken up previously by the resin beads, with the sodium from the brine taking the place of the calcium and magnesium.

All other things being equal, the more brine that is used, the more efficiently is the hardness displaced from the resin. So for more demanding applications (like for use of the water in a boiler), more brine is typically used so that when the resin is put into service again, there is a minimum amount of hardness left on it. If insufficient brine is used, then hardness escaping with the treated water, referred to as "hardness leakage" will be higher.

Other resin choices:
A number of other resin grades and types are available for special situations, including the following:

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|---|---|---|---|
| **C-100 EB** | **C-100 EF** | **C-100 EG** | **C-100 EFM** |
| **C-150** | **C-150 FM** | **C-100 x 10** | **SST-60** |

As indicated above, products names having the "E" suffix indicate resins designated for potable use.

**C-100 EB** – This product is specifically manufactured with black colored beads to facilitate users who prefer this color. (The standard C-100 E and C-100 range in color from honey blond to dark amber; however the quality and performance are the same).

**C-100 EF** – This is a uniform particle size resin from our PUROFINE range that is designed to give a somewhat higher operating capacity than C-100 or C-100 E. The exact difference in capacity will also depend on the actual water quality and operating conditions. Technical help is available for this.

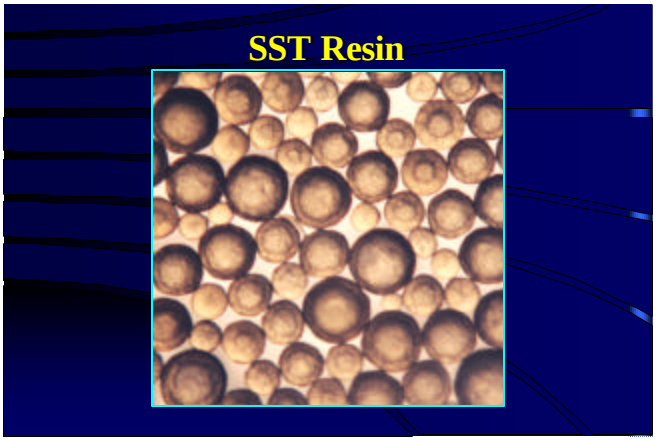
**C-100 EG** – This is a coarser grade of resin beads (16 to 35 mesh) that are designed to allow higher flow rates without the disadvantage of the higher pressure drop that would occur with the standard resin.

**C-100 EFM** – The "FM" designation translates to "Fine Mesh", which refers to a range of bead sizes that are generally smaller in diameter than standard resin. (40 to 70 mesh). Fine Mesh resins offer the advantage of lower salt usage, less rinse water requirement and faster kinetics (the rate at which calcium and magnesium hardness is exchanged onto the resin in place of sodium).

**C-150 and C-150 FM** - These are referred to as macroporous resins, and are manufactured somewhat differently from the standard C-100 and C-100 E resins which are referred to as gel resins. When chlorine or other oxidizing chemicals are present in significant concentrations in the water to be treated, the macroporous resins can be used to advantage due to their higher resistance to oxidation.

**C-100 x 10** – This product is referred to as a 10% crosslinked product, emphasizing the higher 10% DVB content (as compared to 8% DVB in standard softening resins like C-

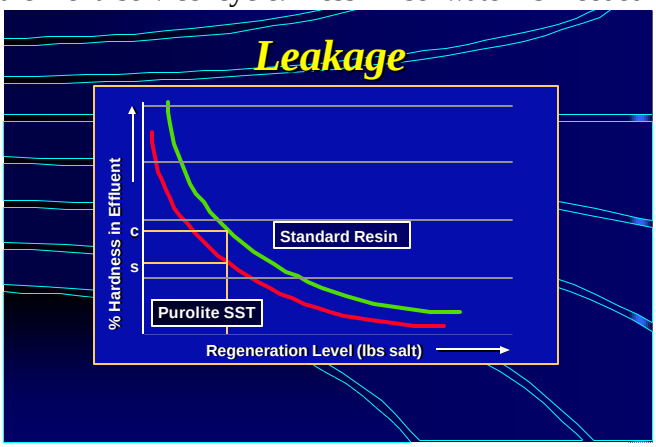
100). The higher DVB content makes the product more resistant to chlorine or similar oxidizing chemicals (such as hypochlorite, ozone, hydrogen peroxide or permanganate). So in situations where chlorine concentrations are difficult to control, this may be a better solution, although it too will eventually be attacked by the chlorine.




**SST-60** – This product represents a revolutionary way of manufacturing resin, with a shell and inner core sections of the beads. A patent is pending for this type of technology. The core of the beads are inert and do not take part in the ion exchange process. All softening occurs in the shell area that is closer to the surface of the beads.

SST-60 is ideally suited for co-flow softening designs (the most popular in North America) in which the water to be treated and the brine used afterward for regeneration enter and leave the ion exchange resin bed in the same direction (usually from top to bottom).

During regeneration, it is easier and faster for the brine to reach all of the hardness inside of the bead, including the boundary of the shell and core regions. Because of this, it is possible to use considerably less salt than that used for standard softener resins and still achieve the same hardness leakage in the next service cycle. Less rinse water is needed for the same reason. From an environmental standpoint, the reduced salt usage and the lower rinse water requirement makes SST-60 quite attractive compared to standard resin.




The extremely low hardness leakage possible with SST-60 allows it to excel in industrial applications (especially) such as the softening of feed water used in low and medium pressure boilers, feed water to Reverse Osmosis systems, and the softening of oil field type (high total dissolved solids) water.

Even though SST-60 sells at a premium to standard softening resins, it is usually possible in most cases to recover this premium in just a few months from the savings in both salt and water used for regeneration. The lower hardness leakage translates to higher efficiency and greater reliability of the equipment being served. Technical help is available to help users assess whether SST-60 is the best fit for their application.