

## Rayne of Phoenix Awarded AZ Water 2011 Water Reuse Project of the Year

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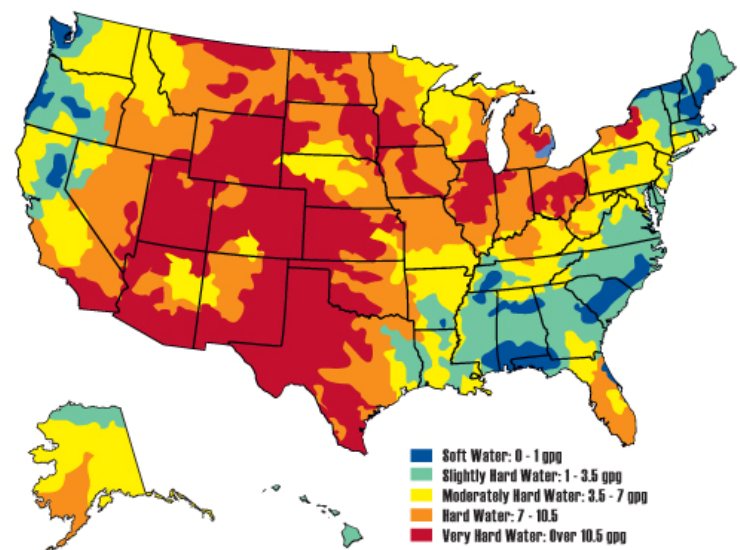
The AZ Water Association is recognizing Rayne of Phoenix for its work in developing its Zero Liquid Discharge (ZLD) Facility for Centralized Water Softening Regeneration this year. For its efforts, Rayne of Phoenix's ZLD Facility was awarded the *AZ Water 2011 Water Reuse Project of the Year*. The Project of the Year Award is presented annually to recognize outstanding engineering excellence and achievement in the water, wastewater, and water reuse categories.

According to the United States Geological Survey (USGS)<sup>1</sup>, 89.3% of US homes have hard water. That makes hard water the single most widespread water problem in American homes today (see Figure 1). Phoenix suffers from some of the hardest water in the nation. If left untreated, water hardness results in plumbing and appliance failure and waste, as well as excessive soap, detergent, chemical, energy, and water use.<sup>2</sup>

Due to the severe water hardness levels of the Phoenix Metro area, many homes use self regenerating water softening (SRWS) systems to remove the hardness to acceptable levels. These SRWS remove the hardness for a pre-determined volume of water until it no longer has capacity, and must be regenerated by flushing a salt brine solution through the exhausted tank. As a result, brine consisting of water, salt and hardness minerals is discharged into the sewer. In fact, a typical SRWS wastes up to 85 gallons of water and dumps up to 15 pounds of salt per cubic foot of resin in the softener into the sewer with every regeneration. Furthermore, many SRWS are undersized for the number of people in the house and water usage and not properly set to regenerate when the resin is exhausted, and as a result prematurely regenerate.

This self regenerating process, when taking place in tens of thousands of homes using SRWR in the Phoenix area, creates 450,000 tons of salt pollution and wastes nearly 2.7 billion gallons of water each year. This waste costs the utilities and their customers millions of dollars in water production, treatment and distribution. To see an animation of this process, go to [www.RayneWater.com](http://www.RayneWater.com) and click on the animation for "Eco-Friendly Soft Water" in the sidebar.

**Concentration of Water Hardness in Grains Per Gallon**



**Figure 1 - National Water Hardness Levels**

1. The USGS is responsible for collecting data on water quality and water supply throughout the nation.
2. According to the Battelle Memorial Institute in Columbus, Ohio, "The Effects of Hard Water, 2010" and Scientific Services Laboratories near Middleton, New York, "The Effects of Hard Water, 2011." Studies conducted by the Water Quality Association (WQA).

H. Martin Jessen, Vice President of Rayne Corporation explains, “To Rayne, the issue of water conservation is vital. We identified the need to develop cutting edge technologies to significantly reduce salt pollution and conserve precious water. As a result, we succeeded where no other company even bothered to try. Rayne was determined to take water softening to an unprecedented, environmentally-responsible level.”

Three years ago Rayne contracted with Eric Dole of Hydro Engineering Solutions L.L.C. and Dr. Wendell Ela of the University of Arizona Chemical and Environmental Engineering Department to help Rayne develop a system whereby no salt and very little water would go to the sewer. PE has been around for years but the manner of regeneration is what changed. Consumers could still enjoy the benefits of soft water, but instead of installing a SRWS that regenerates in the home, consumers could use Rayne’s Portable Exchange Tank Service. With PE system, a Rayne technician delivers a fully-regenerated Soft Water Exchange Tank to the home and exchanges it as needed for a fee. This service provides the same benefits as a water softener, but uses no salt or water for regeneration in the home. Rather, resin regeneration takes place in a properly-designed and professionally-operated centralized ZLD regeneration facility operated by trained Rayne technicians. When Dr. Ela was asked about this process by the *Phoenix Business Journal* and in an article dated March 5, 2010 and he explained, “There is no question their system will work. It’s a new twist on an old technology.”<sup>3</sup>

Eric Dole, Principal at Hydro Engineering Solutions, L.L.C. describes the implications of this project, “The far-reaching effect of this innovative process is astounding. We estimate that the Rayne of Phoenix facility saves 2.6 million gallons per year of water and 281 tons of salt from reaching the sewer from just their customers. Imagine what it could mean if every self regenerating softener was converted to a Rayne exchange tank? I am very proud to be part of this project and I am excited about what this means for the future of water treatment.”

Rayne regenerates 120 cubic feet of resin per batch at the Phoenix facility. The steps for the ZLD regeneration process are outlined below:

### Step 1: Spent Resin Transfer

The process begins when water is used to transfer 120 cubic feet of spent resin from tanks that are returned from the customer into the regeneration vessels. For this process, 890 gallons of water are used and 890 gallons of water are recycled.



Figure 2 -Resin Transfer Manifold

3. *The Business Journal, Rayne developing new approach to water issues, May 5, 2010.*

### Step 2: Backwashing

Regeneration starts with backwashing the resin by upflowing water through the bed to clean it of any dirt or other solids. For this process, 1,650 gallons of water are used and 1,650 gallons of water are recycled. The process uses filtered, backwash/spent resin transfer water in a closed loop system with an occasional blowdown.



Figure 3 – Dirty BW Water



Figure 4 – Filtered BW Water

### Step 3: Brine Recovery

For this process, 1,800 gallons of 13% saline water are used to “deliver the salt” needed to exchange the hardness minerals from the resin so that it is ready to soften water again. All 1,800 gallons of brine are processed and 1,500 gallons are reconstituted with the ZLD process thereby eliminating the discharge of salt to the sewer. This step diverts the high hardness and high salinity portions of spent brine to the patent-pending brine recovery process. This step recovers 100% of the treated brine.



Figure 5 – The ZLD Facility

### Step 4: Solid Waste Generation

The brine recovery process generates a solid that contains VERY high concentrations of magnesium and calcium in a “wet solid” containing approximately 300 gallons of water. This sludge can be used as a raw material or feedstock in many other markets such as whitening agents and cement production. The solids may also be safely disposed in any landfill. This further improves the quality of the water going to the drain because it permanently removes the hardness and TDS from the wastewater. These 300 gallons are the only water not recycled within the ZLD facility.



Figure 6 – Solid Waste Generation

### Step 5: Initial Rinse

For this process, 1,400 gallons of water are used to reduce the salinity of the water left over in the regeneration vat from 13% to 1% salinity. All of this water is recycled. This step uses a patent-pending, rinse-reclaim system to process and treat the water for rinse reuse.

### **Step 6: Final Rinse**

For this process, 500 gallons of water are used and 400 gallons are recycled. This step diverts the low hardness and low salinity portions of the final rinse water to the rinse reclaim system.

### **Step 7: Regenerated Resin Transfer**

For this process, the 400 gallons of water are left over in the vat after the final Rinse and all 400 gallons are recycled. This process fills the PE tanks with regenerated resin for use in the customer's home.

Rather than have the water softener regeneration process occur inefficiently in tens of thousands of homes every day in the Phoenix area, dumping high hardness salt brine into the sewer and wasting millions of gallons of water, the regeneration process could take place in a self-contained, closed loop system which separates the solids from the brine, reuses 93% of the water and achieves 98% salt reduction.

Rayne of Phoenix is proud to be partnered with AZ Water Association in the quest to preserve the quality and availability of our water. Rayne of Phoenix extends their gratitude of all of its partners for all of their hard work for the past three years; Eric Dole of Hydro Engineering Solutions, Dr. Wendell Ela of the University of Arizona, Kevin Alexander of Separation Processes Inc., David Morgan of Calsaway, and the City of Phoenix Water Department for WQ analysis.

To learn more about the Zero Liquid Discharge process, see the animation at the Rayne website at [http://www.raynewater.com/exchange\\_tank\\_services.php](http://www.raynewater.com/exchange_tank_services.php) or contact H. Martin Jessen at [mjessen@raynewater.com](mailto:mjessen@raynewater.com) or at 480-836-0887.



**Figure 7 - Resin Transfer Pump**