



As Published in Water Technology, March 2002

Understanding Zeolites
This silica-crystalline media is not your grandfather's resin

By: *Glenn Gruett, Founder and President*
Mike Hamberger, National Sales Manager

General confusion exists – especially after all these years.

The earliest use of the word “zeolite” dates back to 1756. It was coined then to describe natural aluminum silicate rocks that produced a boiling effect when heated and placed in water. Zeolite crystals are produced by nature whenever mineral-rich underground water deposits crystallize. Only after years of human innovation and engineering did they find their place within water softening applications. And though their use in our industry goes back over 150 years, the zeolite moniker is often misunderstood today -- sometimes even misapplied to other man-made products.

Historical records indicate that zeolites were used in ion exchange as far back as the late 1700s for agricultural purposes. Known as “greenhouse” operations, potassium was exchanged in the soil for lime. It wasn't until 1818 in Germany that the first synthetic zeolites were produced by combining a sodium silicate solution with sodium aluminate. The resulting precipitate, however, would not be applied in water treatment applications until many years later.

Natural zeolites found today throughout North America are called glauconites, meaning grayish-green. This is greensand. Between 1850 and 1920, greensand was used as an ion exchange media – mostly in steam boilers and steam locomotives. It had a capacity of 2-3,000 grains per cu ft.

Then in the early 1900s, high capacity zeolite was discovered. Natural greensand was washed, graded, mixed with sodium silicate and aluminum sulfate, and then dried. The process yielded a greensand capable of 5,000 grains per cu ft. Though the process nearly doubled the capacity of natural greensand, it took five tons of raw material to make one ton of the high capacity media.

The Beginning of Synthetic Zeolites

In 1925 Emmett Culligan, with help from Fred Lindsay, formulated the process to produce synthetic zeolites. Together, they started the Northwestern Chemical Company. Fred's brother, Lynn Lindsay, was one of the company's salesmen, who later started the successful water softener company bearing his name.

The Northwestern Chemical Company closed during the Great Depression. Emmett Culligan pushed onward, starting the Culligan Zeolite Company in 1936 in Northbrook, Illinois. The zeolites manufactured through his operation had a capacity of 10,000 grains per cu ft – two times better than processed greensand. This accomplishment essentially created the modern water softening industry we have today.

In the late 30s and early 40s, there were two zeolite plants: one in San Bernardino, CA, and the other in Yuma AR. By the late 40s, the company had produced a high-capacity zeolite with capacity of 20K grains – doubling capacity of domestic water softeners.

The Changing Marketplace

That accomplishment was soon overshadowed by the development of synthetic – or plastic – resins in the early 50’s providing even higher capacities of 30K grains per cu ft. With increased competition from plastic resin manufacturers, Culligan closed the Yuma zeolite plant.

The remaining zeolite facility in San Bernardino was later purchased in 1985 by Glenn Gruett, the owner and founder of Water-Right, Inc., a water softener manufacturing firm based in Appleton, Wisconsin. Water-Right had previously used Culligan’s zeolites extensively and successfully in a majority of the softeners they manufactured. They were also one of the largest customers of zeolite at the time.

With the purchase of all rights, equipment and technology, Gruett moved the entire operation to Phillipsburg, Kansas, under the corporate name of Mineral-Right, Inc. This operation became the first modern synthetic zeolite plant in the country. Through carefully controlled manufacturing, zeolites are now produced in several different grades, each possessing different water conditioning characteristics.

Zeolites Find a New Niche Using Chlorine

Modern formulas of synthetic zeolite have proven to be excellent for treating problem water without added equipment or processes. In a single pass, the media softens water and removes up to 15 ppm of iron, manganese, or a combination of both. The media also raises the pH of acidic water at the same time.

Continual applications in treating problem waters led Water-Right to research and experiment with chlorination in 1998 as a cure for iron and sulfur bacteria. These nuisance bacteria, once introduced into the household plumbing via well water, incubate in water treatment media beds and other plumbing fixtures.

Unlike plastic resin, the silica crystal remains completely stable and unharmed by long-term exposure to chlorine. In fact, the porous crystal structure encourages chlorine residual following regeneration to allow continued disinfection.

Now the zeolite media enjoys an expanded role in treating problem water in a self-sanitizing water softener produced by Water-Right. The chlorine is generated by electrolysis from the system’s own brine solution with every regeneration. This patent-pending solution to fighting iron and sulfur bacteria has been successful in thousands of installations to date.

Removal of Ammonia

Most municipality water treatment plants chlorinate their drinking water. A chlorine residual should exist at the end of every line. Since chlorine will dissipate given time and elevated



Zeolites are first cured outdoors in large beds before refining and processing. Here, the mild weather and prevalent sunshine of the Kansas City region provides ideal conditions.



As the zeolite cures, the beds start to shrink and crack and the crystals begin to form.

temperatures, high amounts of chlorine are needed. By converting the chlorine to a chloramine, (through the addition of ammonia), dissipation is reduced, thus reducing the amount of chlorine needed to carry a residual through the municipal system.

Ammonias, however, attack rubber washers, toilet flappers, and other rubber plumbing components found in household plumbing systems. Ammonias are difficult to remove, too, even using RO and carbon filters.

Zeolites do an excellent job of bonding with ammonia. When chlorinated during regeneration, the ammonia is forced out with regeneration. The application is so successful, a major pharmaceutical company is using the process to completely remove ammonia prior to using city water in a compressor still.



The finished product is a refined silica crystal that is slightly denser and heavier than synthetic plastic resins. Its irregular shape and porosity allows for excellent ion exchange and filtering while remaining impervious to chlorine.