Zeolites in the Landscape

by Mark Whitelaw

Scientifically speaking, zeolites are natural volcanic materials with a unique crystalline lattice structure and classified as "hydrated aluminosilicates." (Unscientifically speaking, that means they're crystals made from hydrogen, oxygen, aluminum and silicon.) When volcanoes spewed their ash on ancient lakes a few thousand millennia ago, the resulting chemical reaction of the ash and alkaline water altered the ash into various forms of zeolite crystals.

What's so unique about these crystals is they take on a honeycomb-like structure of pores and channels. These pores are extremely small -- varying in size from 2.5 to 5.0 Angstroms across. Put more simply, the crystalline pores are so small, only one gram of material (about 0.04 ounces) has an equivalent surface area of 40 meters! (That's more than 130 square feet, or roughly the size of a large room!)

Furthermore, when zeolites come in contact with certain liquids and gases, they both absorb and adsorb the materials. That is, they can both suck-up and release moisture, or they can collect certain gases and ions!

"Zeolites are able to absorb up to 30% of their dry weight in gases such as nitrogen and ammonia, over 70% in water, and up to 90% of certain hydrocarbons," states John Shaw, president and owner of National Zeolite Industries, Inc., in Arlington [Texas].

"Zeolites also have the ability to exchange cations, which are positively charged ions. This substitution of ions enables zeolites to selectively adsorb certain harmful or unwanted elements from soil, water, and air. A classic example is the removal of calcium from hard water. Zeolites also have a strong affinity for certain harmful heavy metals such as lead and chromium," John added.

Putting all this together, then: Once gram of zeolite is like having a room-sized sponge that'll soak up water and release it when needed. Or one ounce is like having a filter larger than most suburban home sites to selectively collect and remove unwanted gases and odors.

"In various parts of the world," John continues, "people have been using zeolites for centuries. Many of the pyramids in Mexico and buildings in Rome were built from zeolite blocks. People in Hungary use zeolites for talcum powder and other health products. The Japanese feed zeolites to animals for weight gain and health benefits. Hogs fed a mixture of 95% feed and 5% zeolite gain up to 25% more weight. The Japanese also use zeolites in paper, concrete and many other products.

"Industrial and environmental applications for zeolites are numerous especially with today's federal and state cleanup requirements. Research has been done to use zeolites for natural gas storage for vehicles and to cut air conditioning costs in homes and buildings by up to 90% using zeolite construction brick and tile. Applications currently under study and development include air purification, adsorption of heavy metals, absorbent linings in landfills, removal of radioactive elements from contaminated water, and the clean up of oil rig leakage."

Currently, zeolites are used in cat litter, shoe deodorizers, animal feed supplements, garage floor spill removers, odor and moisture removers in animal stalls and refrigerators/coolers, soil

enhancers, and harmful gas removers in aquarium and pond filters. They are federally classified as GRAS (Generally Recognized as Safe) in most applications. And when used with good agricultural practices and with less than 2% zeolite added to animal feed products, they are exempted from regulations and reporting. They are also USDA approved as an absorbent in food processing and are in compliance with EPA regulations.

How, then, can zeolites be used in the landscape?

There are more than 45 natural and 150 synthetically-produced zeolite compositions. Of the 45 natural zeolites, eight are of major importance in agriculture and industry for their high cation exchange capacity. And of the eight, two are of major importance in agriculture. These are mordenite and clinoptilolite. (Fredrickson, 1985)

It is the clinoptilolite which is the most interesting to horticulturalists since this zeolite not only contains silicon and aluminum, but also potassium, calcium, magnesium, iron and traces of manganese, tin and sodium oxides. This zeolite contains virtually no clay and no salt making it safe to use in heavy clay soils and around salt-sensitive plants.

Clinoptilolite's major exchangeable cations include lithium, cesium, silver, cadmium, lead, zinc, copper, mercury, ammonium, and chromium -- some of the very elements found in our environment that are causing such havoc in our landscapes, water supplies and food sources.

And since it absorbs moisture and releases it during dry conditions, it's potential agricultural uses are bounded only by the imagination.

In sandy soils, for example, clinoptilolite not only retains moisture that would normally percolate or evaporate away, it captures the cationic nutrients of ammonium and potassium and prevents their rapid oxidation by nitrifying bacteria. This means, simply, that the nitrogen and potassium in fertilizers would be released more slowly, thereby requiring you to fertilize less often.

Furthermore, since increased nitrogen in the growth tips of plants and shrubs attracts pestiferous insects like aphids, reducing the release of high nitrogen fertilizers could mean less pesticide applications to food crops and landscape ornamentals.

Clinoptilolite also has potential as a nutrient and moisture-retaining component in potting mixtures and hydroponics, much the way that vermiculite or perlite is currently used.

And in the compost bin, it can not only trap obnoxious odors because you forgot to aerate, it can also trap potentially harmful elements that may have been added because of pesticide applications or the use of CCA pressure-treated lumber. (Remember: "CCA" stands for "chromium, copper and arsenic.")

As a filtration substance, it can reduce calcium deposits in water, thereby reducing those nagging clogs and ugly residues in irrigation systems. In agriculture, clinoptilolite absorbs ammonium from waste water, reducing stream pollution.

A down side?

With all these potential benefits to the landscape and agriculture, there is, of course, a down side. When added to the soil, clinoptilolite is "there to stay." It's stable against both acids and alkalis, and at temperatures up to 1202°°F (or 650°°C). Since its natural pH is 8.0 (alkaline), it may be possible to exacerbate a high pH soil condition by the over use of this mineral. (Exactly what amount of clinoptilolite per square/cubic foot of soil mix significantly affects soil pH is yet to be determined.)

In the [Dallas-Fort Worth, Texas] Metroplex, the soil and water pH normally ranges between 8.5 to 9.5. We, generally speaking, try to reduce our soil pH to neutral (7.0) by incorporating organic materials like compost and mulch. Thus, adding a material of an alkaline nature could send the pH back up, defeating our purpose. Therefore, as with all soil amendments, it is our opinion that clinoptilolite should be used in moderation if you are attempting to maintain a neutral-to-acid soil condition.

So why are we just now hearing about zeolites?

In the western world, research into natural zeolites began only a few years ago. The word is just now getting out! (And, of course, the cynic might ask why a fertilizer manufacturer would want to tell you about a soil amendment that would allow you to buy less of his product. Or why a synthetic zeolite producer would tell you about a natural product that might cost less.) There is also a natural conservatism (read "skepticism") about a natural product that so readily appears to be the answer to so many environmental "ills."

In the next few years, however, we believe you'll be hearing more about (and seeing) zeolite products for the landscape and home gardener. After all, zeolite's been around for a few million years. What's another decade or so to get (re)discovered?

References:

.Fredrickson, Paul, "A Review of the Properties and Uses of Natural Zeolites", 1985.

.Geo-Environmental Resources, Inc., Data Sheets #202, #206, and #210, 1994.

.National Zeolite Industries, Inc., "Introduction to Zeolites", 1994.

.Shaw, John, president, National Zeolite Industries, Inc., personal interview, 1994.

Ed. Note: Since this article was written, Geo-Enviromental Resources Inc. is now known as AANPI.

For information, write John Shaw, National Zeolite Industries, Inc.

Taken from an old link which no longer works: http://www.markw.com/zeolite.htm