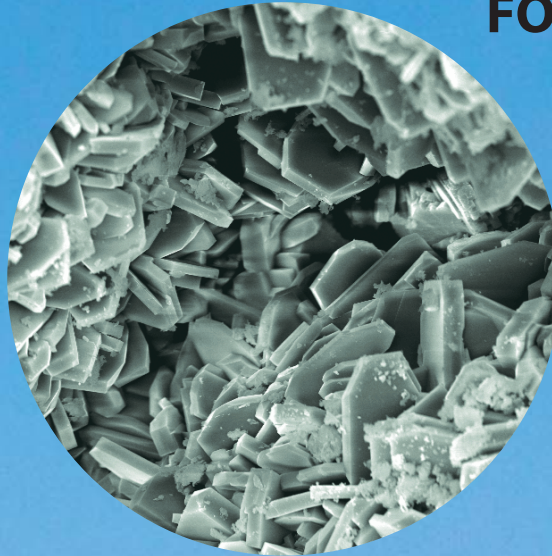




BEAR RIVER ZEOLITE (BRZ™)

FOR AGRICULTURE



WHAT IS ZEOLITE

"Zeolite" refers to a group of approximately 40 minerals that are basically hydrated calcium potassium sodium aluminosilicates, in which the water is held in cavities in the lattice. Bear River Zeolite is a clinoptilolite (pronounced clīnō-tē-ō-līte) zeolite.

Clinoptilolite's ability to exchange one cation for another is known as their "cation-exchange capacity" or "CEC". Cation exchange capacity is a measure of the number of cations per unit weight available for exchange, usually expressed as milliequivalents per 100 grams of material. Nitrogen (as ammonium) is held in the clinoptilolite lattice spaces and is no longer water-soluble but is available to livestock and plants through gradual release for more efficient utilization of energy.

WHY BRZ™ IS ONE OF THE BEST ZEOLITES

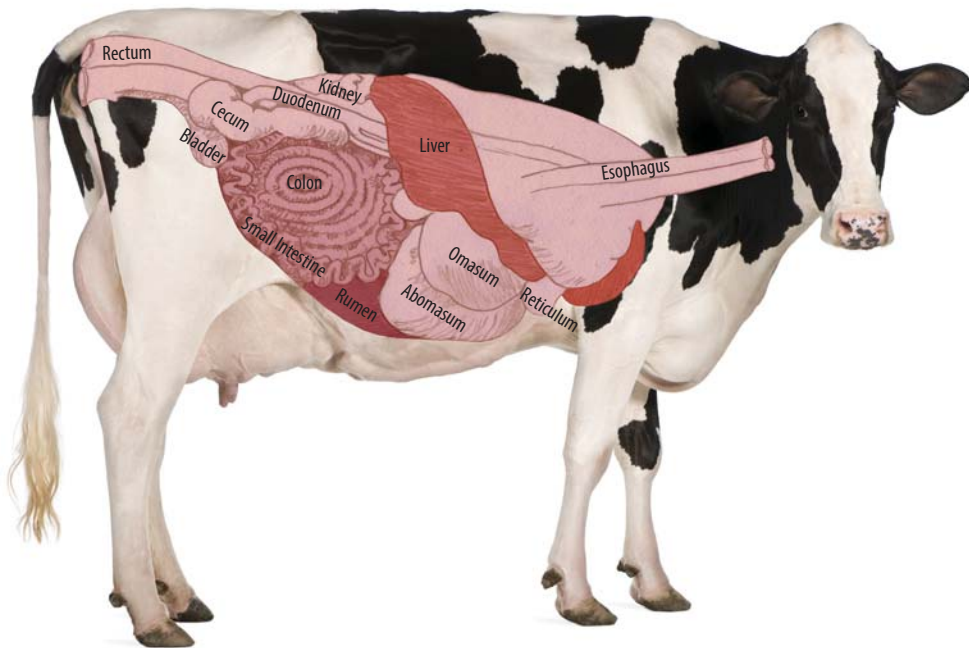
- BRZ™ is almost pure clinoptilolite with a general formula of $(\text{Na}, \text{K}, \text{Ca})_{2-3} \text{Al}_3 (\text{Al}, \text{Si})_2 \text{Si}_{13} \text{O}_{12} \cdot 12\text{H}_2\text{O}$. The balance is primarily opaline or non-crystalline silica.
- Contains approximately 3.5% potassium, a plant nutrient worth \$27.00 per ton.
- Contains approximately 2.02% calcium, a pH buffer for soils and animals.
- Contains less than 0.5% non-water soluble sodium, which is toxic to plants.
- No significant concentrations of toxic trace elements exist. None are water soluble.
- Holds over 55% of its weight in water. Absorbs oil and other hazardous liquids.
- High cation exchange capacity ("CEC") that allows loading of approximately 2.2% nitrogen.
- Low clay content makes BRZ™ hard and resistant to attrition.
- Very large surface area that is approximately 24.9 square meters per gram.
- Has a paste pH of 8.64.
- OMRI listed.
- GRAS classification (generally regarded as safe).

ANIMAL NUTRITION

Some of the following benefits are well accepted and are not referenced in the bibliography. Other benefits that BRZ™ cannot claim due to U. S. Government restrictions can be found in the publications listed in the reference section.

AVERAGE DAILY GAIN (ADG)

The CEC of the clinoptilolite allows the exchange of ammonium from feed stuffs upon digestion. In cows, the ammonium is released when it comes back to the rumen (sodium from the saliva exchanges with the ammonium) and creates a “time release” of the ammonium for better utilization of the nitrogen. ^{3, 6, 7}



CONVERSION RATE REDUCTION

The conversion rate of feed to gain is decreased due to better utilization of the nitrogen. ^{3, 6, 7}

MYCOTOXIN BINDER

Clinoptilolites effectively absorb mycotoxins containing polar groups such as aflatoxins. Clinoptilolite's binding and desiccant properties also inhibit dysentery. ^{2, 7, 8, 10}

ODOR AND MOISTURE CONTROL

One of the major causes of odor from animals is the generation of ammonia gas from urea and manure that become the aerosol for odors. BRZ™ captures ammonium and prevents the formation of ammonia. BRZ™ clinoptilolite holds 55% of its weight in water, an attribute that results in dryer stalls and a reduction in manure fly pressure.

RUMEN BUFFER

Feeding low sodium clinoptilolite mediates rumen pH. ^{2, 3}

DI-CALCIUM PHOSPHATE RATION REDUCTION

When fed to an animal, the clinoptilolite exchanges with the calcium in “di-cal” to help solubilize the phosphate. The net effect is that the di-cal ration can be reduced because the phosphate is better utilized and bone growth is enhanced. ³

MANURE HOLDS MORE NITROGEN

In 30 days the loss of 30% nitrogen in the manure was cut to 10% by feeding clinoptilolite. Clinoptilolite exchanges and holds ammonium before it oxidizes as ammonia. ³

MILK PRODUCTION INCREASED

Proper amounts of clinoptilolite in the TMR enhances milk production.

HEAVY METAL REMOVAL

Feeding clinoptilolite removes heavy metals from the rumen, such as 91% of lead, 45% of cadmium and many other metals. ^{7, 11}

UREA ADVANTAGES

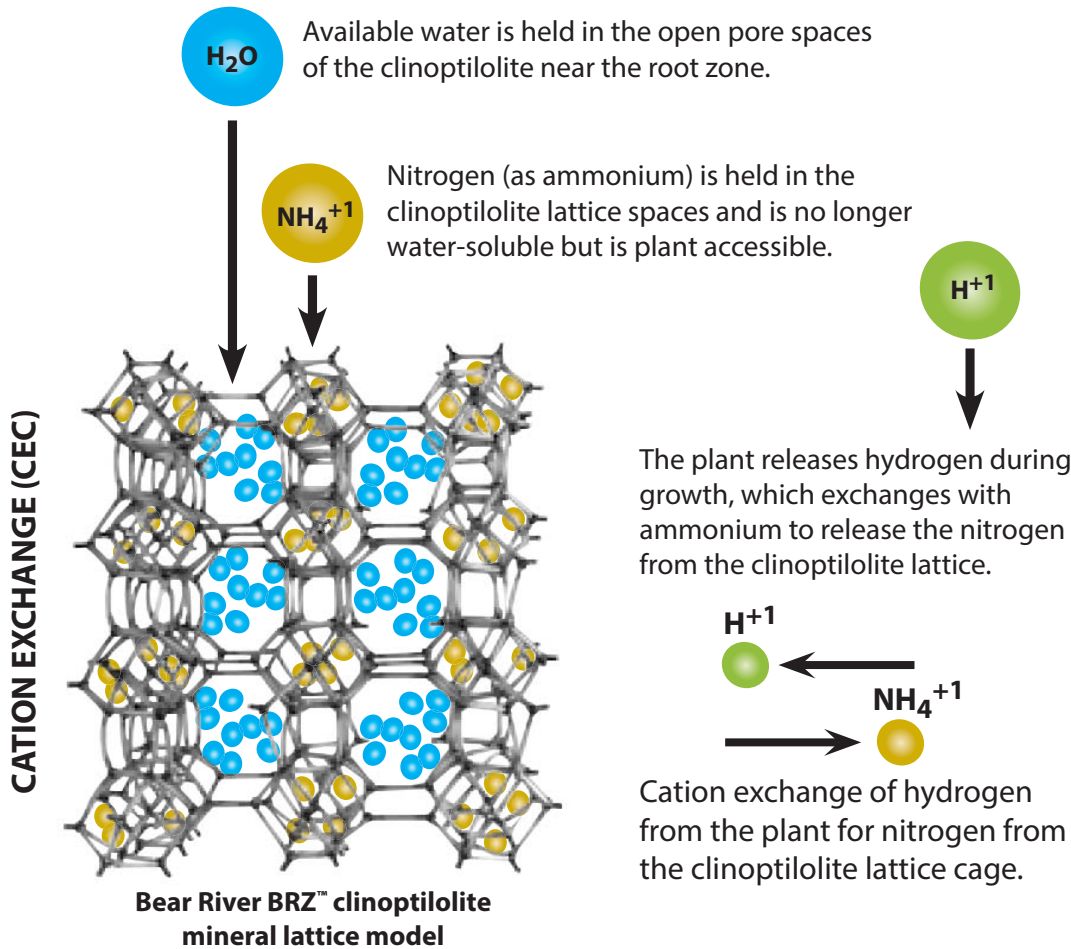
The risk of toxicity due to the increase in pH and ammonium levels in the rumen is mitigated by using clinoptilolite. ¹

COMMON CLINOPTILOLITE RESEARCH INCLUSION RATES*

| <i>Animal</i> | <i>TMR/Animal</i> |
|--------------------------------|-------------------|
| Dairy cows or cattle | 5 oz./day |
| Calves | 2 oz./day |
| Chickens (layers and broilers) | 0.5-2% TMR |
| Turkeys | 0.6-2% TMR |
| Hogs | 1% TMR |
| Sheep | 0.1% TMR |

FERTILIZER AND SOIL AMENDMENT

The ability of BRZ™ clinoptilolite to load with 1.8 to 2.1% nitrogen in the form of ammonium in its crystal structure makes it excellent for fertilizer applications. The nitrogen is not water-soluble, but it is plant accessible. As the plant grows the hydrogen cation is released from the plant that exchanges in BRZ™ and releases the ammonium. The potassium is also released. BRZ™ holds nitrogen and water in the root zone of the plant. In typical nitrogen fertilizer applications, as much as 35 % of the nitrogen leaches out of the growth zone and reports to the aquifer to create nitrite and nitrate contamination.



BRZ™ contains approximately 3.47% potassium, which is an important nutrient in fertilizers. BRZ™ holds at least 55% of its weight in water that protects the plant against drought.



FEED PRODUCTION

| | |
|----------------|---|
| CARRIERS | BRZ™ clinoptilolite can be used as a carrier for insecticides, pesticides, and herbicides due to its large porosity. In animal feeds it is used as a carrier for antibiotics, enzymes, and other medicines. |
| PELLET BINDERS | BRZ™ clinoptilolite allows the use of more steam and higher temperature in the conditioner prior to the pellet machine in pelletizing animal feeds. This in turn reduces friction and allows up to a 30% increase in production with no more energy. The increased temperature increases gelatinization and pellet durability. It also enhances color and imparts a green color to hay pellets and cubes. The inclusion rate is much less than bentonite, and BRZ™ clinoptilolite does not have soluble sodium like bentonite. |
| FLOW AGENT | BRZ™ clinoptilolite helps the flow of animal feed and other products from bins and is an anti-caking agent. It is particularly helpful with urea, oils, and other sticky ingredients. |

AIR

| | | |
|----------------|--|---|
| AIR FILTRATION | Clinoptilolite has been used for the separation of gases such as nitrogen, carbon dioxide, sulfur dioxide, and hydrogen sulfide. | Typical applications would include removal of carbon dioxide, sulfur dioxide, and hydrogen sulfide from methane generators, sewage systems, digesters, and wash-down lagoons. |
|----------------|--|---|

WATER

| | | |
|--|--|--|
| AQUACULTURE, TANKS, PONDS | Clinoptilolite is used for the removal of ammonium from water fisheries, trucks to transport fish, and aquariums. BRZ™ can be added to water troughs to remove ammonium and clean the green water. Green algae cling to the BRZ that holds the ammonium. Clinoptilolite may be rejuvenated by immersion in salt water or by heating. | |
| LAGOONS | It was found that the application of 1 gram of clinoptilolite per liter of fluid in the lagoon increased carbon removal by 17-20% and methane production by 11-31% for a higher return of generator electricity. | |
| WATER FILTRATION and WASTE WATER TREATMENT | Clinoptilolite is used as a filter media for particulate removal with a nominal rating of 5 microns (municipal water treatment plants using sand and anthracite have a rating of 17 microns). The flow rate through clinoptilolite is much faster than sand and anthracite, because the water flows through the grains rather than around them like sand. Additionally, clinoptilolite is used to remove nitrogen, certain organic hydrocarbons, and toxic cations such as lead, cadmium, silver, mercury, nickel, chrome, cobalt, antimony, arsenic, radioactive strontium, cesium, radium, uranium, and other heavy metals. | |

ADDITIONAL USES

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|-----------------------|---|---|
| DESICCANTS | Clinoptilolite has been used as a desiccant for manure, compost, and feed stuffs. | BRZ™ holds 55% of its weight in water. |
| ENVIRONMENTAL CLEANUP | The cation exchange capability of BRZ™ makes it an excellent candidate for cleanup. | Cleanup of oil, diesel, and gasoline, PCBs, feed lots, leaching of nitrogen fertilizers into the groundwater, organically polluted water, and contaminated soils. |

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