BEAR RIVER ZEOLITE BRZ™

Stormwater Remediation Research

Clinoptilolite is widely recognized as environmentally friendly and effective for the absorption of toxins. Performance is based on purity, cation-exchange-capacity (CEC), porosity, composition, surface area and particle size. In 2009, Bear River Zeolite (BRZ™) was selected by the West Valley Demonstration Project (WVDP) as the best performing clinoptilolite for use in a permeable reactive wall (PRW) to effectively remediate strontium-90 contaminated groundwater at a closed nuclear fuel processing plant in West Valley, NY.

The Great Lakes provide 84% of our fresh surface water and drinking water for over 35 million people. They also contribute to a $5 trillion regional economy and provide 1.5 million jobs. Stormwater runoff collects contaminants from roadways, parking lots, lawns, industries, animals, etc. and ends up in waterways, resulting in health issues, environmental damage, and economic losses. The Great Lakes Restoration Initiative (GLRI) was initiated through the United States Environmental Protection Agency (EPA) in 2010 to remediate and protect this valuable resource.

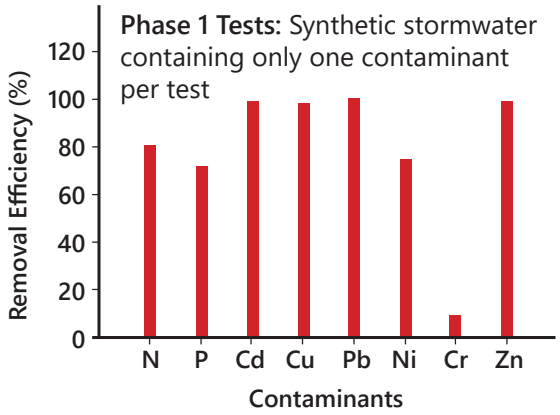
EPA and GLRI funds were provided to the University of Illinois and Illinois Institute of Technology for research to develop viable urban stormwater runoff remediation systems. Bear River Zeolite BRZ™ was selected as a filter media for multiple studies funded by these EPA/GLRI grants based on proven performance, low-cost, availability, and ease of replacement.

Results from EPA/GLRI funded studies that incorporated BRZ™

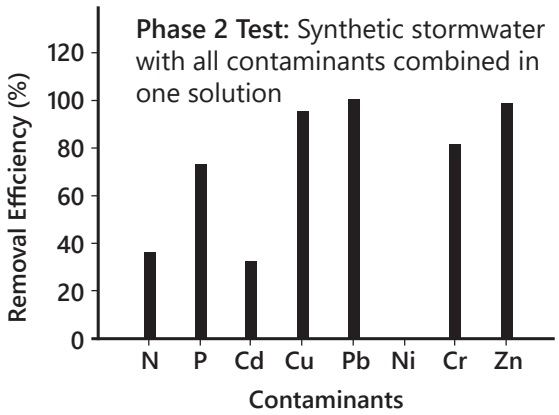
NUTRIENT AND HEAVY METAL REMOVAL WITH BRZ™ Reddy, et. al, 2014

Tests were run to determine the BRZ™ removal efficiencies of nutrients and heavy metals from synthetic stormwater

- **BRZ™ showed high removal in separate contaminant tests**



- **BRZ™ increased Cr removal in combined contaminant test**



E. COLI REMOVAL WITH BRZ™ FILTRATION Prabhukumar, G. 2013

- **BRZ™ reduced *E. coli* below the safe limit from synthetic stormwater containing a 10,000 mg/L concentration of *Escherichia coli* strain ATCC (American Type Culture Collection).**

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BEAR RIVER ZEOLITE BRZ™

RESULTS FROM GLRI/EPA FUNDED RESEARCH USING MULTI-MEDIA FILTRATION WITH BRZ™, CALCITE, SAND, AND IRON FILINGS: Reddy, et. al, 2014a, Reddy, et. al, 2014b

- **Removed over 90% of naphthalene and phenanthrene (PAHs)**
- **High level of nitrate and phosphate removal**
- **Efficient removal of heavy metals (Cd, Cu, Pb, Cr, and Zn)**
- **High flow rates**
- **No clogging**

Levels of contaminants in "worst-case-scenario" synthetic stormwater as compared to typical high range levels in urban stormwater

CONTAMINANTS	"WORST-CASE-SCENARIO" SYNTHETIC STORMWATER	TYPICAL HIGH RANGE URBAN STORMWATER
Nitrate (mg/L)	1	0.07-16.0
Phosphate (mg/L)	0.5	0.01-7.3
Cadmium (mg/L)	30	0.00005-13.75
Copper (mg/L)	5	0.00006-1.41
Lead (mg/L)	50	0.00057-26.0
Nickel (mg/L)	100	0.001-49.0
Chromium (mg/L)	5	0.001-2.3
Zinc (mg/L)	50	0.0007-22.0
pH	6.3	4.5-8.7

Adapted from Reddy, et.al. 2014a

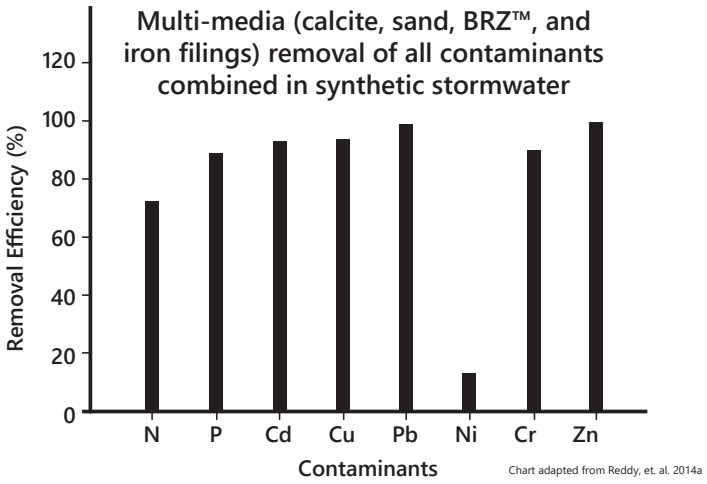
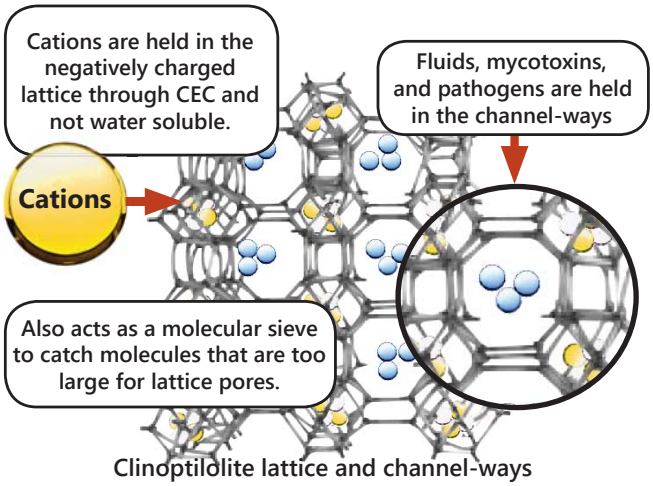


Chart adapted from Reddy, et. al. 2014a

How it works



Clinoptilolite lattice and channel-ways

1. BRZ™ is a negatively charged cation exchange agent and is able to exchange various cations into its lattice depending on their molecular size, competing cations, and concentrations. During the cation exchange process, cations move from the BRZ™ mineral lattice and are replaced by other cations, which are held in a non-water soluble state within the lattice.
2. BRZ™ is an excellent desiccant and can hold up to 55% of its weight in water in its channelways where cations are more loosely held and are water-soluble.
3. BRZ™ acts as a molecular sieve or filter, capturing atoms, ions, and compounds that are too large to pass through the clinoptilolite lattice structure.
4. The negative charge of BRZ™ can be modified with a surfactant to a positively charged surface modified zeolite (SMZ) for anion removal, such as arsenates, phosphates and nitrates.

REFERENCES:
Prabhukumar, G. 2013. *Development of permeable reactive filter systems (PRFS) for treatment of urban stormwater runoff*. Illinois Institute of Technology, Dept. of Civil, Architectural, & Environmental Engineering.
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Additional information on file at Bear River Zeolite Co.

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