

CHITOREM[®] Chitin Complex Barrel Test at the National Tunnel NPL Site in Black Hawk, Colorado

Background

- **Superfund Study Area covering 400-square mile drainage basin of Clear Creek.**
- **Discharge from National tunnel Adit contains elevated levels of metals and low pH.**
- **CHITOREM[®] chitin complex tested as substrate for sulfate reducing bioreactor (SRB).**
- **CHITOREM[®] chitin complex evaluated against corn stover, wood chips, and continuous feed ethanol.**



Photo courtesy of Dr. Rachel Brennan, Penn State University

Project Status

Reactor Influent	Water Chemistry	
Constituent	Concentration (mg/L)	Treatment Objective (mg/L)*
Aluminum	0.1 – 1.0	0.1
Iron	40 - 50	1.0
Manganese	20 - 25	1.0
Copper	0.2 – 1.0	0.01
Zinc	8 - 10	0.1
Calcium	200 - 250	Not applicable
Sulfate	900	Not applicable
Magnesium	50 - 80	Not applicable
pH	5.0 – 6.0	6.5 – 8.5

* Typical aquatic limits for Colorado watersheds (U.S. EPA, 2004).



- **Over 90% Mn removal in CHITOREM[®] chitin complex reactor.**
- **Alkalinity increased to over 5,000 mg/L before stabilizing at about 2,000 mg/L.**
- **Metals removal equal to or superior to other substrates.**
- **Longevity of material in excess of 15 months with no signs of breakthrough.**

Data Summary: Biochemical Reactor Results After 9 Months

	Treatment goal	Influent MIW	Ethanol	Wood + hay	Corn stover + wood	Chitin Complex
pH	6.5 – 8.5	4.55	8.11	6.71	6.58	6.98
Alkalinity (mg/L as CaCO ₃)	NA	0	3008	619	725	2000
Sulfate (mg/L)	NA	924	43	681	246	215
Zinc (mg/L)	< 0.1	6.51	0.033	0.006	< 0.0006*	0.009
Copper (mg/L)	< 0.01	0.02	< 0.0009*	0.003	0.003	0.002
Iron (mg/L)	< 1.0	37.5	50.0	20.6	0.26	0.001
Manganese (mg/L)	< 1.0	20.3	50.7	10.9	12.4	2.0

Values shown are replicate averages. * = Below Values meeting treatment goals are bolded.

w Detection Limits Check mark indicates entire category met goal.