SUSTAINABLE REMEDIATION OF ACID ROCK DRAINAGE BY REGENERATING CLINOPTILOTITE[1]

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Abstract: The popular remediation technique using limestone for acid rock drainage (ARD) treatment may be unnecessarily expensive, generate additional solid waste and not be optimally effective. An inexpensive and locally-available soil zeolite – clinoptilolite – has a high metal adsorption capacity and a significant buffering capacity. An earlier batch adsorption study from our laboratory demonstrated that clinoptilolite has a high adsorption capacity for copper, zinc and aluminum, adsorbing 131, 158 and 215 mg/kg clinoptilolite, respectively, from a local ARD at pH 3.3. If clinoptilolite sorbent could be regenerated by backflushing, it could then be reused on site. The main focus of this presentation is the removal of metals from loaded clinoptilolite by backflushing. Clinoptilolite adsorption capacity for Zn, pH stability and the effect of pH on adsorption of Zn were also investigated. Laboratory batch equilibrium tests (USEPA 1987) were used to investigate the pH dependence and adsorption/desorption characteristics of clinoptilolite.

So long as the pH > 2, the crystal structure of clinoptilolite was found to remain stable after small amounts of Al and Si were leached from it. Clinoptilolite has the ability to retain Zn ions, and the amount adsorbed is a function of the initial concentration of Zn in the solution and of the pH. This suggests that the clinoptilolite may be an ideal candidate for ARD remediation.

The metal loaded clinoptilolite can be effectively backflushed and reused. The desorption efficiency mainly depends on the type of extractants, pH and concentration. For cyclic absorption/desorption, the adsorption by clinoptilolite remained satisfactory for six and nine regenerations with EDTA and NaCl, respectively. After different degrees of exposure to ARD, the crystallinity of clinoptilolite based on XRD indicates that the structure of clinoptilolite remains intact. The water quality of the clinoptilolite treated ARD was tested for metal concentrations and it was found that the metal concentration was drastically reduced, with the degree of reduction depending on the treatment conditions. Clinoptilolite appears to be a promising agent for ARD leachate treatment, with significant potential cost advantages compared to current treatment systems.

The ARD problem at Pennask Creek along Highway 97C in the Thompson-Okanagan region is an ideal site for a case study of remediation based on clinoptilolite. There we compare experimental results for different configurations for field implementation using clinoptilolite. This case study will begin in the spring of 2006 with funding from the B.C. Ministry of Transportation and Highways.

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