Neutralization of acid mine water with low cost sorbents

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1. Introduction

Mine water (acid mine drainage-AMD) is water that drains from the mine that is usually acid and contains a large amount of heavy metals. Even though zinc (Zn) and manganese (Mn) are biogenic elements, their excess accumulation in living organisms could lead to metabolic and nervous system disorders [1,2]. The aim of this study is to examine the possibility of the neutralization of mine water from the bauxite mine in Zvornik, Republic of Srpska, and to explore the potential of using different low-cost sorbents to remove Mn and Zn.

2. Materials and methods

Six sorbents were used: zeolite 4A (D.O.O „Alumina“, Zvornik) granulation <45μm, rinsed red mud (RRM) granulation <0.2mm [3], concrete and facade granulation <250μm, beef bones (B500) annealing at 500°C granulation <2mm [4], mollusk shell species *Ostrea edulis* granulation <45μm. 10 ml of AMD was equilibrated with 0,05g, 0,1g, 0,15g or 0,2g of tested sorbents on the rotatory shaker (10 rpm) for 24h at 20±1°C. After that, suspensions were centrifuged (5 min on 9000 rpm), and pH values and the concentrations of metals in liquid phase were measured. To measure the pH value of the AMD and filtrates after sorption InoLab WTW pH meter was used, while the metal concentrations were measured using Perkin Elmer 3100 Atomic Absorption Spectrometer. All sorption experiments were conducted in duplicate.

3. Results

The initial pH value of AMD was 3.2. The pH value increased after sorption due to the buffering of certain components contained in solid materials (Figure 1). For shells and facade this component is CaCO3 in different forms, for RRM calcite and sodalite, while for the B500 is calcium hydroxyapatite (HAP) [4,5,6].

The percent of sorption of Mn was the largest after the application of zeolite 4A (99.99% compared solid: liquid (s/l)> 1:50) and concrete (98.07% for s/l > 1:100) (Figure 1). These two sorbents were equally good at sorption of Zn (99,22% on zeolite and 96,96% on concrete for s/l> 1:100). High efficiency is result of high pH values that affect the precipitation of metal hydroxide on the zeolite [7], or carbonate on the concrete. Besides the precipitation, the sorption mechanism on the zeolite is ion exchange [8], which is also the dominant mechanism in the case of B500. B500 is relatively good in the sorption of both metals (85.7% Mn and 97.6% Zn for s/l> 1:50). Other sorbents are far less efficient, and better in binding Zn than Mn, possibly by the mechanism of specific sorption.

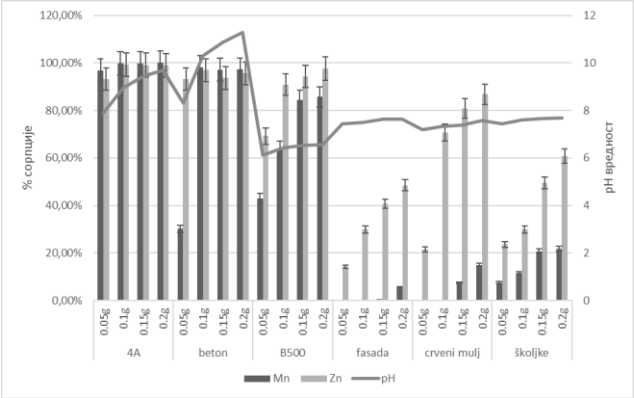

Figure 1. - Sorption efficacy and pH value of the filtrate

4. Conclusion

Examined zeolite 4A and concrete can be used for highly efficient neutralization and removal of Mn and Zn from acid mine water. Zeolite 4A can be easily regenerated with NaCl solution, while the concrete could be used as an additive in the production of fresh concrete. B500 would probably be effective in a multi-stage process. The described method could contribute to the protection of the environment, because it represents a wastewater treatment and a form of recycling of solid waste at the same time.

5. Literature

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