PASSIVE TREATMENT OF MINING EFFLUENTS ISSUED FROM AN IRON-ABANDONED MINE LOCATED IN THE NADOR REGION, MOROCCO

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Introduction

The mining industry has an essential contribution to global economic development and the overall progress of human society. At the same time, the mining industry generates large volumes of mining wastes with significant environmental impacts. Furthermore, the mining industry produces the largest quantities of solid and liquid waste from exploration to mine closure. One of the biggest problems with these mining wastes is the mine drainage. This mine drainage can be acidic, neutral and/or alkaline depending on pH values. The Water quality can be affected during water-sulphide minerals interactions. The metals concentrations can be exceed the regulation limits notably in the acidic conditions. The generation of AMD is due to the prolonged exposure of sulphides minerals present in mine wastes to air and water. The most metals are dissolved especially in the low pH conditions of DMA ($pH<6$) and consequently the leachates contain high concentrations of metals and metalloids (As, Cd, Cr, Co, Cu, Fe, Hg, Mn, Mo, Ni, Sb, Se, U and Zn). The majority of these metallic elements are not biodegradable. As a result, the extent of chemical bioaccumulation can cause a toxicity and a significant disruption to ecosystems in the lack of any contaminant attenuation processes. Therefore, treatment of mine drainage is necessary before the mining effluent will be release into the environment. The treatment of acid mine drainage (AMD) is a significant environmental challenge for the mining industry. In case of the acidic effluent is not treated, the mining effluent can have a significant impact on the environment through the acidification and contamination of soils, lakes and rivers.

Objectives of the study

The main objective of the present study is to implement a marsh that can be used at the polishing stage as part of a passive treatment sector for a DMA loaded with Fe, Mn, Ni and Zn. The specific objectives are: (1) to determine a species of plant able to grow in polluted conditions found in studied areas contaminated by DMA effluent; (2) to develop and evaluate the efficiency of a passive treatment system using plant and others natural materials (organic and minerals) to treat an AMD charged with Fe, Mn, Ni and Zn and (3) to evaluate the metal removal mechanisms and their speciation/fractionation in the substrate.

Materials and methods

Passive treatment systems such as artificial marshes represent an interesting approach for the treatment of AMD due to many reasons such as technological, economic and environmental footprints. The use of natural materials in the swamp have the ability to increase pH and alkalinity, remove dissolved iron and other metals, as well as reduce sulfate concentration in the AMD. This water treatment must be accomplished by a variety of physical (sedimentation, flocculation), chemical (sorption), and biological (sulfate-reduction, phytoextration) processes operating independently, in some cases, or interactively.

For this purpose, small-scale laboratory tests were performed to find the best scenario, which can help to remove metals and adjust the acidity of the AMD effluent (with plant, without plant, up and down flow, planted and unplanted marshes).

Preliminary results

The obtained results show that the subsurface marshes with vertical flow is the most efficient due to their large contact surface area contrary to surface marshes with horizontal flow. The presence of plants should reduce the flow rate and increase the hydraulic residence time (HRT). These conditions can promote the growth of bacteria, which actively participate in the transformation of metals. The selected plant species of our experiments is *Juncus effusus*, which is frequently found on mining sites affected by AMD, due to her tolerance of the contamination. These preliminary results will allow us to understand the control and fractionation processes of the contaminants during the passive treatment processes and assess the criteria for the conception and the design of a purifying marsh. These major findings could be answered some issues regarding the passive treatment of AMD effluents. Moreover, the knowledge can be applied for active, closed or abandoned mining sites might be contaminated by AMD.

References

1. APPELO C.A.J., POSTMA D., Geochemistry, groundwater and pollution, Editor: A.A. Balkeman Publishers, 2nd edition, 2005.

2. EDAHBI M., PLANTE B., BENZAAZOUA M., WARD M., MIA PELLETIER M., Mobility of rare earth elements in mine drainage: Influence of iron oxides, carbonates, and phosphates, Volume 199, May 2018, Pages 647-654, Chemosphere.

3. NELSON Eby G., Principles of Environmental Geochemistry, Editor: Keith Dodson, Brooks/Cole Cengage Learning, 2004.

4. RITCEY Gordon M., Tailings Management: Problems and Solutions in the Mining Industry, Elsevier, 1989. SNOEYINK Vernon L., JENKINS David, Water Chemistry, John Wiley & Sons, 1980.

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