World Academy of Science, Engineering and Technology
International Journal of Environmental and Ecological Engineering
Vol:13, No:05, 2019

Evaluation of Arsenic Removal in Synthetic Solutions and Natural Waters by Rhizofiltration

Authors : P. Barreto, A. Guevara, V. Ibujes

Abstract : In this study, the removal of arsenic from synthetic solutions and natural water from Papallacta Lagoon was evaluated, by using the rhizofiltration method with terrestrial and aquatic plant species. Ecuador is a country of high volcanic activity, that is why most of water sources come from volcanic glaciers. Therefore, it is necessary to find new, affordable and effective methods for treating water. The water from Papallacta Lagoon shows levels from 327 µg/L to 803 µg/L of arsenic. The evaluation for the removal of arsenic began with the selection of 16 different species of terrestrial and aquatic plants. These plants were immersed to solutions of 4500 µg/L arsenic concentration, for 48 hours. Subsequently, 3 terrestrial species and 2 aquatic species were selected based on the highest amount of absorbed arsenic they showed, analyzed by plasma optical emission spectrometry (ICP-OES), and their best capacity for adaptation into the arsenic solution. The chosen terrestrial species were cultivated from their seed with hydroponics methods, using coconut fiber and polyurethane foam as substrates. Afterwards, the species that best adapted to hydroponic environment were selected. Additionally, a control of the development for the selected aquatic species was carried out using a basic nutrient solution to provide the nutrients that the plants required. Following this procedure, 30 plants from the 3 types of species selected were exposed to a synthetic solution with levels of arsenic concentration of 154, 375 and 874 µg/L, for 15 days. Finally, the plant that showed the highest level of arsenic absorption was placed in 3 L of natural water, with arsenic levels of 803 µg/L. The plant laid in the water until it reached the desired level of arsenic of 10 µg/L. This experiment was carried out in a total of 30 days, in which the capacity of arsenic absorption of the plant was measured. As a result, the five species initially selected to be used in the last part of the evaluation were: sunflower (Helianthus annuus), clover (Trifolium), blue grass (Poa pratensis), water hyacinth (Eichhornia crassipes) and miniature aquatic fern (Azolla). The best result of arsenic removal was showed by the water hyacinth with a 53,7% of absorption, followed by the blue grass with 31,3% of absorption. On the other hand, the blue grass was the plant that best responded to the hydroponic cultivation, by obtaining a germination percentage of 97% and achieving its full growth in two months. Thus, it was the only terrestrial species selected. In summary, the final selected species were blue grass, water hyacinth and miniature aquatic fern. These three species were evaluated by immersing them in synthetic solutions with three different arsenic concentrations (154, 375 and 874 µg/L). Out of the three plants, the water hyacinth was the one that showed the highest percentages of arsenic removal with 98, 58 and 64%, for each one of the arsenic solutions. Finally, 12 plants of water hyacinth were chosen to reach an arsenic level up to 10 µg/L in natural water. This significant arsenic concentration reduction was obtained in 5 days. In conclusion, it was found that water hyacinth is the best plant to reduce arsenic levels in natural water.

Keywords : arsenic, natural water, plant species, rhizofiltration, synthetic solutions
Conference Title : ICSGRE 2019 : International Conference on Soil, Groundwater Remediation and Excavation
Conference Location : Berlin, Germany
Conference Dates : May 21-22, 2019

Open Science Index, Environmental and Ecological Engineering Vol:13, No:05, 2019 publications.waset.org/abstracts/101024.pdf