

Characterization of Expanded Perlite from Albay, Bicol, Philippines with Chitosan as Adsorbent Medium and the Design of a Fixed-Bed Column for the Adsorption of Ni(II), Cu(II) from Synthetic Rainwater

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Submission Category:

- A. This research proposal aims to solve the **Philippines' water and sanitation crisis**. Out of 101 million Filipinos, nine million rely on unimproved, unsafe and unsustainable water sources and 19 million lack access to improved sanitation (Water in the Philippines 2019).
- B. Indicators to measure the impact of chemical engineering on the SDGs:



SDGs Targets/Indicators:

This Research Proposal addresses the following SDG Targets/Indicators:

- the 6th Sustainable Development Goal: “Clean Water and Sanitation” for the Filipinos to substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity. The research proposal aims to test the effectiveness of perlite as an adsorbent medium in water filtration systems for the removal of Ni(II) and Cu(II). For a more comprehensive characterization, a wider range of adsorbent dosage, contact time and effects of temperature will be explored, and focus on understanding cooperative adsorption.
- The 9th Sustainable Development Goal: “Industry, Innovation and Infrastructure” The design and development of rainwater catching systems (fixed-bed column) using perlite, a low-cost adsorbent medium to convert rainwater to clean water for the Filipino households, especially those who has no access to clean water to improve their situation. This study will be

beneficial to concerned non-government and government agencies in solving the imminent water crisis in the Philippines;

Abstract:

Utilizing the abundant rainfall in the Philippines as alternative source of clean water is possible due to the low concentration of contaminants in rainwater. However, the presence of heavy metals such as Nickel and Copper, may pose serious health risks to the users. In this study, the performance of low-cost natural mineral adsorbent called Expanded Perlite infused with different formulations of chitosan in removing heavy metals will be investigated. Batch adsorption studies of Ni(II) and Cu(II) will be conducted by diluting heavy metal stock solutions to 1 mg/L per metal. Results will be analyzed by developing Langmuir, Freundlich and Dubinin-Radushkevich isotherm models, and Lagergren's pseudo-first order and Ho's pseudo-second order kinetic models. The quantitative determination of the metals will be done using the Atomic Absorption Spectroscopy (AAS). The morphological structure of Expanded Perlite before and after the batch adsorption experiments will be determined using Scanning Electron Microscope (SEM). The removal efficiency of EP for Ni(II) and Cu(II) will be computed. The adsorption capacity of Ni(II) and Cu(II) will be computed. The study will indicate if EP is significantly effective in adsorption of Nickel and Copper ions in rainwater. Optimum pH and contact time will be evaluated at maximum adsorption capacity. A fixed-bed column will be designed using the breakthrough curve evaluation of Thomas Model and by using batch data gathered from the batch adsorption experiments.

Graphical Abstract:



Fig. 1 The Perlite Research Team headed by Prof. Lola Domnina B. Pestaño, Ph.D. (5th from left) when they visited the Lamba Perlite Project Mine Site at Lamba, Legazpi City, Albay Bicol with VP for Operations, Mr. Florentino Florez (2nd from right).