UNIVERSITI TEKNOLOGI MARA

APPLICATION OF ENERGY DISPERSIVE X-RAY FLUORESCENCE SPECTROMETRY AND MULTIVARIATE STATISTICAL ANALYSIS FOR THE ASSESSMENT OF HEAVY METALS AIR POLLUTANT ACCUMULATED BY MOSSES

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AUTHOR'S DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the result of my own work, unless otherwise indicated or acknowledged as referenced work. This thesis has not been submitted to any other academic institution or non-academic institution for any other degree or qualification.

I, hereby, acknowledge that I have been supplied with the Academic Rules and Regulations for Post Graduate, Universiti Teknologi MARA, regulating the conduct of my study and research.

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ABSTRACT

Bio-monitoring of multi elements atmospheric deposition using terrestrial moss was considered as one of a well-established technique, especially in Europe. Although the technique is widely known worldwide, there were very limited reports using this technique to study the atmospheric air pollution in Malaysia. Therefore, in this study, this approach has been used to monitor the distribution of heavy metals deposited that close to the Industrial Kerteh area. To measure the concentration of heavy metals contained in the samples taken, Energy Dispersive X-Ray Fluorescence Spectrometer (EDXRF) method that has been optimized and enhanced its effectiveness has been used. A series of statistical tests was performed on some data obtained from the use of EDXRF to assess the reliability of the technique applied. A total of 13 selected heavy metals was analyzed from the moss samples collected surrounding the areas of oil refinery and petroleum-related industries in Kerteh Terengganu. One of the main objectives of this study is to observe whether these metals are attributed to activity related to the oil refinery in this area. Two moss species that were found abundantly grown in the study areas (*Meithecium Microcarpum and Hypnum Plumaeforme)* were used as the bio-indicator. Sampling was done in fair-weather conditions in three months. All heavy metals were analyzed by using energy dispersive X-ray spectrometer EDXRF while Inductive Couple Plasma-Optical Emission, ICP-OES was used as a standard method to validate the results obtained by EDXRF. The use of cellulose filter paper as a matrix for the preparation of the synthetic standard materials has shown recoveries between 84 to 102 % of certified reference materials Pine Needle, and 92 to 125 % for lichen. To assess the possible emission sources to the levels of heavy-metal pollutants in the study areas, a combination of multivariate statistical analysis and enrichment factors (EF) together with contamination factors (CF) were used. The results obtained using the Principal Components Analysis (PCA) revealed that the elements can be grouped into five distinct components that indirectly reflected the five different potential sources which possibly include the anthropogenic factor, vegetation factor and natural sources (soil dust or substrate) factor. Base on the semi-empirical model formed, V, Cr and Ni, which considered as proxy elements for petroleum industrial base were deposited mostly, in the distance, after 10 to 12 km to the western and southern parts of the study area. These three elements are believed were originated from the local petrochemical activities operating in the surrounding areas. The overall results obtained in this study clearly show that the selected moss species were considered highly suitable to be a bio-indicator material who has been promising potential to monitor the existence of metal's pollutants in the ambient air.

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