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INVESTIGATION OF THE PRESENCE OF HUMIC SUBSTANCES AND THEIR METAL BINDING ABILITY IN WATER

V.M.T.N. Vijesundara[1], M. Makehelwala[2], I.P.L. Jayarathne[3], R. Weerasooriya[3] and W.M.A.T. Bandara[1*]

[1]Department of Chemistry, Faculty of Science, University of Peradeniya, Sri Lanka
[2]Joint Research and Demonstration Centre, Peradeniya, Sri Lanka
[3]National Institute of Fundamental Studies, Kandy, Sri Lanka
[*]athulab@sci.pdn.ac.lk

Recent research suggests that humic substances (HSs) in water can effectively bind with metal ions, potentially increasing the solubility of metal ions in aquatic ecosystems, hence posing health risks. They are a fraction of dissolved organic carbon that has seen notable changes in concentration across various regions in Sri Lanka. Hence, there is an urgent need to identify the presence of HSs and their metal-binding capabilities within Sri Lankan waters. Further, recent studies have highlighted the increase of Mn levels in groundwater samples, which pose health hazards upon excessive exposure. Given the challenge of Mn removal in the filtration process, understanding HSs-Mn interaction becomes imperative. Therefore, this study mainly focused on the ability of HSs to bind with Mn. Samples were taken from two distinct water sources (groundwater and lake water). The sample preparation, extraction of HSs, and fractionation into humic acid and fulvic acid were carried out using the method available in the International Humic Substances Society (IHSS). Characterization was done using FTIR and Raman spectroscopy. Batch adsorption studies at different pH values and comparisons of FTIR and Raman spectra after metal binding were performed. Furthermore, kinetic studies were conducted. Characterization revealed functional groups of –COOH (C=O stretching: 1740-1770 cm^{-1}, O-H stretching: 3630-3760 cm^{-1}), $–CONH_2$ (N-C=O stretching: 1550-1560 cm^{-1}, N-H stretching: 3070-3140 cm^{-1}), and $–NH_2$ (N-H stretching 3190-3220 cm^{-1}), which facilitate effective metal binding and indicate the heterogeneity of these fractions, extracted from different sources. Although effective Mn-binding was possible at neutral pH, the highest binding was observed at lower pH values (pH 2-3). Significant variations in several spectral bands were also observed, suggesting composition changes after metal binding. As this followed pseudo-second order kinetics, chemisorption is the rate determining step. However, the exact binding mechanism remains unclear, necessitating further investigations.

Keywords: Dissolved organic carbon, Fulvic acid, Humic acid, Humic substances, Manganese