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Kinetic modelling of peat water treatment with continuous electrocoagulation using aluminium electrodes

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ABSTRACT

Peat water source could be utilized to mitigate water scarcity issues that are experienced by the local communities in Sarawak rural areas. However, this water source needs to be treated prior to domestic consumption due to the levels of humic substances being incomparable to the Malaysia water quality standards. As such, this study aims to formulate the kinetic models for peat water treatment with continuous electrocoagulation system by using aluminium electrodes. Correspondingly, the kinetic models are formulated with adsorption isotherm models and variable kinetic order models (VOK). Subsequent, the study has found that the formulation of VOK model with Freundlich isotherm model is well fitted to the experimental data due to the regression coefficient (R^2) values being higher than 0.90 in comparison to VOK-Langmuir and VOK-Jovanovic models. Additionally, the formulated VOK-Freundlich model able to predict the removal of turbidity, chemical oxygen demand, and colour from peat water with continuous electrocoagulation treatment system. Overall, this study demonstrates that peat water treatment with continuous electrocoagulation system by using aluminium electrodes follows VOK-Freundlich kinetic model.

1. Introduction

Wetlands areas have an abundant supply of unutilized peat water sources that are derived from the leaching process between rainwater and decomposed organic matter. Sarawak that located on Borneo Island has a vast accumulation of total peat soil deposits which are the natural primary source of peat water formation, especially in remote rural areas [1]. In 1992, a study conducted by Mutalib [2] reported that about 70% of 2.6 million hectares of Malaysia wetlands located in the Sarawak territory. As reported by Department of Irrigation and Drainage Sarawak [3], peat water covers approximately 1.698 million hectares of Sarawak overall land whereas 12.4 million hectares belonged to mangrove areas. In Sarawak, the wetlands areas could be found within the river delta and stretch inland along the Samarahan-Sadong, Lupar-Saribas, Rajang, Baram and Limbang river tributaries. These regions have a high presence of permanently high-water tables which favour the formation of peat water due to the high aerobic decomposition rate of vegetation such as mangrove and swamp forests. Peat water, on the other hand, is detrimental to human health because it is largely contained humic acid that is derived from lignin decomposition [4]. Peat water is constituted with various colour intensity that ranged from dark brown to black depending on the levels of humic substances that presence in such water source. Realizing this circumstance, several conducted studies in the published literature have suggested to treat peat water prior to domestic consumption due to the fact that the water source is acidic [5–7].

In Sarawak, some local communities are experiencing water scarcity issues especially in the remote wetlands areas. This is due to the fact that about 60% of rural Sarawak local communities lived in scattering population patterns. In order to mitigate these issues, these local communities have been supplied with water sources from gravity-feed water catchment areas [8]. In 2017, about 39% of Sarawakians in remote rural areas are yet to receive a clean water supply [9]. Some local communities in southern Sarawak are forced to utilize untreated peat water source in order to compensate their water supply daily [7]. This undertaken may not be sustainable for long-term application due to the fact that direct consumption of peat water source could lead to severe health

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