UNIVERSITI TEKNOLOGI MARA

ALUMINIUM REMOVAL USING KENAF CORE ORGANIC CELLULOSE AS AN ADDITIVE IN NEWLY FORMULATED ULTRAFILTRATION FLAT SHEET MEMBRANE

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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 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

Alum has been extensively used in the coagulation process in water treatment. Potassium alum, which is a hydrated form of potassium aluminium sulphate, is one of the alum categories used as a coagulant agent in water treatment. Today, the permitted baseline level of the aluminium in treated water is 0.2 ppm as declared by the World Health Organization (WHO) and the Ministry of Health (MOH). Membrane is one of the quick fixes to eliminate aluminium concentration in water treatment. Cellulose can be one of the materials used as a polymer or additive for membrane fabrication. Kenaf core has a lot of cellulose and can be a supply source that is viable and lower-priced for membrane fabrication field. Consequently, the objectives of this study were to develop, determine characteristics and evaluate the performance of flat sheet blend UF membranes by using Kenaf core cellulose (KCC) for aluminium removal. The range of flux rate for KCC membrane, 10.29 $L/m^2.hr$ was smaller than the synthetic cellulose (SC) membrane, which was 39.13 $L/m^2.hr$ with the average pore size of 3.13um for KCC and 3.44um for SC. Hence, the membrane condition of KCC membrane was better than SC membrane. KCC performance test exposes that 69.25% rejection of aluminium documented by KCC5, which was the mid-point of the aluminium removal. To conclude, it was found that the KCC membrane can be used as one of the materials in the membrane field and make the cellulose supply sustainable as well as ecological friendly. Lastly, this study exhibited that KCC5 (Psf 21%: KCC 1%: DMAc 78%) documented the optimum performance as compared to other membranes.

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CHAPTER ONE
INTRODUCTION

1.1 OVERVIEW OF STUDY

Alum has been extensively used in the coagulation process in water treatment (Zhu *et al.*, 1996). A hydrated form of potassium aluminium sulphate, also known as potassium alum, is one of the alum types used as a coagulant agent in water treatment. It has been used to discard contaminants in the water treatment process (Malecki-Brown *et al.*, 2010). Commonly, alum is intended to discard colour, turbidity and bacterial contaminants in water treatment. Nevertheless, one should bear in mind that not 100 percent of the alum would counteract impurities (Cvijovic *et al.*, 2009). As a result, a certain amount of alum stays as residue in the cured water. Even though aluminium solely is not pathogenic, it may produce toxic materials such as Aluminium Chloride (AlCl) and Aluminium Sulphate (Al_2SO_4) when it reacts with ion chlorine or sulphate in water (Srinivasan *et al.*, 1999). Therefore, a preventive action is required and the operation of coagulation needs to be improved in order to reduce as much amount of aluminium in treated water as possible.

The current permitted baseline level of the aluminium in treated water is 0.2 ppm as fixed by World Health Organization (WHO, 2004) and Malaysia Ministry of Health (MOH, 2004). The fact that residual alum can quickly accumulate in human body through drinking water and other ingestion modes has resulted in the rigid amount of alum in sewerage. Aluminium consumption with a high-level concentration will affect human bodies negatively such as illnesses related to nervous system, Parkinson and Alzheimer's disease (Swegert *et al.*, 1999, Polizzi *et al.*, 2002 and Altschuler 1999). To the best of our knowledge, there is inadequate information on the elimination of residual alum that lingers in the treated water. Hence, there is an urgent need to delve into ways to discard and cure the residual alum in treated water.