UNIVERSITI TEKNOLOGI MARA

REACTIVE DYES REMOVAL USING PLANT-BASED SURFACTANT IN MICELLAR-ENHANCED MICROFILTRATION (MEMF)

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Thesis submitted in fulfillment
of the requirements for the degree of
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CONFIRMATION BY PANEL OF EXAMINERS

I certify that a Panel of Examiners has met on 28th March 2016 to conduct the final examination of Siti Wahidah Binti Puasa on his Doctor of Philosophy thesis entitled "Reactive Dyes Removal using Plant-based Surfactant in Micellar-enhanced Microfiltration (MEMF)" in accordance with Universiti Teknologi MARA Act 1976 (Akta 173). The Panel of Examniners recommends that the student be awarded the relevant degree. The panel of Examiners was as follows:

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AUTHOR'S DECLARATION

I declare that the work in this thesis/dissertation was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the results 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

Textile industry has grown to become one of the important industries in Malaysia. Reactive dyes are extensively used in textile industry since these dyes are being recognized as the best dyes used for dyeing cotton and cellulosic fiber. However, reactive dyes have low fixation rate and therefore facing the highest loss in dyeing process. Most of these dyes have complex structures that resist degradation in conventional wastewater treatment process. Due to these factors, it is an urgent need to find a way to preserve the environment while keeping the economic growing. In this study, the removal of C.I Reactive Black 5 (RB5) and C.I Reactive Orange 16 using plant based esterquat surfactant (PBE and VBE) via micellar-enhanced microfiltration (MEMF) was investigated. FTIR confirms the existence of functional group and interaction occurred between dyes and esterquat surfactant. The Critical Micelle Concentration of PBE and VBE surfactant obtained was at range of 93 to 97 mg/L and 152 to 159 mg/L via conductivity method and UV-Vis spectrophotometric method. It is verified that the developed simplified method for analysis of surfactant concentration is in a good agreement with the existing colourimetric method. The micelles was formed in vesicle arrangement with particle diameter at size range from 140 to 1500 nm. The MEMF process was performed by using hydrophilic mixed cellulose esters microfiltration membrane (MCE) with pore size of 0.45 μm. Results obtained in MEMF study using PBE and VBE surfactant shows almost complete decolourization of RB5 and RO16 and confirms the existence of competitive binding interaction between RB5 and RO16. The best operating condition obtained for MEMF was achieved at surfactant concentration of 2CMC, pressure of 150 kPa, stirring speed of 200 rpm and initial pH of 5.5 (unadjusted pH). Treatment of actual wastewater for source 1 via combined coagulation/flocculation process and MEMF process shows final treated wastewater achieved more than 80% removal of colour, COD, suspended solid(SS) and turbidity using PBE surfactant, however for VBE surfactant only the colour and COD achieved more than 80%. It is proved that MEMF using biodegradable plant based esterquat has a great potential to become a new green technology for removing reactive dyes from textile wastewater. The overall percentage error for resistances and permeate flux obtained in Resistance in series (RS) model is within ±20%, indicating that all the experimental data were close to RS model data. Therefore this study proved that Resistance-in-series (RS) model is useful in predicting and quantifying the flux decline and resistance occurred in MEMF process.

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