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**EVALUATION OF FOULING IN  
A PILOT SCALE MEMBRANE BIOREACTOR**

**Thesis submitted by**

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**Queensland, Australia**

## LIST OF PUBLICATIONS

M. Tiranuntakul, P.A. Schneider and V. Jegatheesan, H.L. Fracchia, “Modelling based design of a pilot-scale membrane bioreactor for combined nutrient removal from domestic wastewater”, Conference proceeding, IWA World Water Congress and Exhibition, Beijing, China. 2006.

M. Tiranuntakul, V. Jegatheesan and P.A. Schneider, “Assessment of critical flux in a pilot scale membrane bioreactor”, Bioresource Technology, Volume 102, Issue 9, May 2011, Pages 5370-5374.

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## **DEDICATION**

*Dedicated to*

My parents, my aunty and my husband

## ABSTRACT

A 2.4-m<sup>3</sup> pilot plant MBR for wastewater treatment was designed and constructed for membrane biofouling studies. Three categories of membrane fouling study were carried out with this MBR pilot plant in order to obtain a better understanding of MBR performance and fouling. Firstly, critical flux assessment based on various defining concepts and influencing parameters was examined. The results showed small variations of critical flux values obtained from different defining concepts. Decline of critical flux as the step change of fouling air flow rate increased was observed, while step length had no obvious effects on the critical flux. A positive relationship between aeration rate and critical flux is observed, while higher sludge concentration caused lower critical flux. Secondly, fouling mechanisms under different sludge composition and different flux regimes were tested. Under supra-critical flux operation, cake resistance accounted for the main fouling contribution, while pore fouling was marginal in both supra-critical flux and sub-critical flux regimes. EPS carbohydrate in soluble and bound forms has greater impact on both pore fouling and cake fouling than protein. Finally, optimization of the MBR pilot plant was carried out. Based on equivalent permeate yield and equivalent energy consumption for each experimental run, three operational variables showed significant influence in membrane fouling rate increase. They were, in the order of importance, filtration mode > scouring frequency > regular aeration intensity. The optimum operating conditions determined by the proposed methodology were 11 L/m<sup>2</sup>.min air intensity with continuous filtration and scouring 24 times per day for the pilot plant MBR.

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