UNIVERSITI TEKNOLOGI MARA

THERMODYNAMICS STUDIES ON ADSORPTION OF BSA USING NYLON MEMBRANE

AHMAD MUZAKKIR BIN ROSLAN

Thesis submitted in fulfillment
of the requirements for the degree of
Bachelor of Engineering (Hons.) Chemical

Faculty of Chemical Engineering

July 2017

ABSTRACT

The aim of the study was to investigate the nylon membrane morphology and thermodynamic aspects for adsorption of Bovine Serum Albumin (BSA) as model protein on a nylon membrane. The study focused on the nylon membrane morphology and the effect of temperature on BSA adsorption. The morphology has been studied by using scanning electron microscope (SEM), FTIR-ATR spectroscopy and contact angle analyzer whereas the thermodynamic study would be using the dot blotting method. The findings of the studies show that the nylon membrane sample is moderately porous (46.72±0.018%), small pore size (0.179±0.095 μm, 0.230±0.158 μm) with hydrophilic (55.6°) nature that gave decent adsorption of BSA. While the thermodynamic study indicates that the adsorption reaction was exothermic ($\Delta_r H_o$ -1.858 kJ/mol), the adsorption may be dominated by physical reaction. The distribution of BSA molecules on adsorbent is less chaotic than the BSA mixture ($\Delta_r S_o$ -0.418 kJ/mol.K). In addition, the process is not spontaneous but feasible ($\Delta_r G_o$ 129.4 kJ/mol.K). The findings from the adsorption of BSA may be used to evaluate the modification of nylon membrane needed to obtain optimum adsorption and as the basis for different membrane's performance study in BSA adsorption.

ACKNOWLEDGEMENT

Prima facie, I am grateful to the God for the good health and wellbeing that were necessary to complete this thesis.

I wish to express my sincere thanks to Professor Dr. Norazah Abdul Rahman, dean of the faculty, for providing me with all the necessary facilities for me to carry out my research and my higher gratitude for her continuous encouragement.

I place on record, my sincere thank you to Dr. Norhidayah Ideris, lecturer, in the Faculty of Chemical Engineering. I am extremely thankful and indebted to her for the expertise that she shared and her most valuable guidance and encouragement that has been extended to me.

I take this opportunity to express gratitude to all of the Department faculty members for their help and support.

I am also grateful to my friend for sharing her expertise and knowledge for providing guidance in terms of the writing mechanics to ensure that it could be understood by all.

I also want to praise my parents, Roslan Bin Ross and and my other family members for the unceasing encouragement, support, and attention. I am also grateful to my partner who supported me throughout this venture.

I also place on record, my sense of gratitude to one and all, who directly or indirectly, have lent their hand in this venture.

TABLE OFCONTENTS

CHAPTER ONE

INTRODUCTION

1.1. Summary

The aim for the thesis is to characterize the surface morphology of nylon membrane and to identify the thermodynamic values for the adsorption of BSA on nylon membrane. The thesis is composed of three chapters, which are chapter one, chapter two and chapter three. Chapter one is introduction that discuss background of study, problem statement, objectives of the thesis and scope of the study. Next chapter is chapter two, literature review. This chapter give deeper information regarding the related topic, the membrane technology, the nylon membrane, biomedical devices of diagnostic tool kit, immunoassay and the thermodynamic study. The third chapter is chapter three, research methodology. In the chapter, flowchart of the execution of the research is shown. In this chapter also, the methods on performing all related actions regarding the research are clearly stated. This chapter can be divided into two part. Part A, the first part is the characterization of nylon membrane and part B, the thermodynamic studies for BSA adsorption on nylon membrane. The part A is to characterize five characteristics of nylon membrane, the pore size distribution, the crystallinity structure, the hydrophilicity, the surface charge and the porosity of the nylon membrane. The characterization are performed by using Scanning Electron Microscope (SEM), Fourier Transform Infrared Spectroscopy-Attenuated Total Reflection (FTIR-ATR) and Water Contact Angle (WCA). Whereas the part B was performed at manipulated variables of temperature of BSA-nylon membrane solution at 27, 32, 37, 40 and 45°C. While the constant variables are the pH, concentration of protein