CHAPTER I

INTRODUCTION

1.1 Research Background

The application of membrane techniques in water treatment and wastewater treatment is growing. Membrane processes have become better functioning and more cost effective than they were a few years ago. Now they are an efficient and reliable way to treat water. Due to population growth and increasing demand for water, new methods to create clean water have to be found. Conventional sources for fresh water such as rivers, lakes, and groundwater are overused or misused. Desalination of salty water and water reuse offer one solution for water shortage. Reverse osmosis (RO) is one of established process for the desalination process of saline water (Heidi, 2009).

RO is a membrane based process technology to purify water by separating the dissolved solids from feed stream resulting in permeate and reject stream for a wide range of applications in domestic as well as industrial applications. In this process, semipermeable spiral wound membranes are used to separate and remove dissolved solids, organic, submicron colloidal matter, color, nitrate and bacteria from water.

Feed water is delivered under pressure through the semi permeable membrane, where water permeates the pores of the membrane and is delivered as purified water called permeate water. Impurities in the water are concentrated in the retentate stream and flushed to the drain is called reject water. These membranes are semi-permeable and reject the salt ions while letting the water molecules pass (Garud et al., 2011).

The desalination performance of RO membrane depends largely on the membrane material and the membrane structure .An industrially useful RO membrane must exhibit several characteristics such as high water flux, high salt rejection, mechanical stability, tolerance to temperature variation, resistance to fouling, and low cost. So far, a number of polymer materials have been used to make RO membranes (Chaoyi, 2010). In this study, polysulfone (PSF) had been used to produce low pressure reverse osmosis surfactant (LPROS) membrane.

By referring to the commercial RO membrane that had been used in many industries, usually low pressure RO membranes are operated in the pressure between 5 to 20 bars (sterlitech.com, 16 August 2015).Using a low pressure membrane to reduce feed pressure requirements can save money by lowering initial capital equipment costs. This is done primarily by enabling the use of a less expensive, lower pressure pump. Lower pressure can also mean reduced operating costs since less energy is required to force water through the membrane barrier layer (watertechonline.com, August 2015).

1.2 Problem Statement

Nowadays, natural water supplies are decreasing as a result of climate change and over exploitation of water pollution. Solutions such as water conservation and water transport, or construction of new dams, are insufficient to cope with increasing demand in water supply. Therefore, the most pressing challenges today include the recovery of clean drinking water from salty or sea water which are, by far the most abundant global water resource. Desalination, a technology that converts saline water into clean water, offers one of the most important solutions to this problem. Polymeric reverse osmosis (RO) membranes have dominated commercial applications for desalination due to their low-cost fabrication, ease of handling and improved performance in selectivity and permeability. For industry, low pressure reverse osmosis is most favourable for used in desalination of water. The lower pressure operation is very attractive in reducing capital and operation cost. It also can provide an easier method for the system maintenance and then achieve energy saving.

1.3 Objectives

1. To develop and fabricate a newly polymer-surfactant dope for LPROS membrane via phase inversion process.
2. To examine the major effects of hydrophilic surfactant on performance of LPROS membrane.
3. To characterize the LPROS membrane using SEM, FTIR and TGA.

1.4 Research Scopes

Polysulfone (PSF) is a polymer widely used as a membrane material for liquid separation processes such as ultrafiltration and reverse osmosis. It has excellent characteristics which include good solubility in a wide range of aprotic polar solvents (dimethylformamide, dimethylacetamide, dimethylsulfoxide), high thermal resistances, good chemical resistances over a wide pH range, good resistances in oxidative medium, and high mechanical resistances of the films. These criteria make PSF the best membrane materials for separation process. The good solubility allows extensive uses of PSF membranes, with special emphasis on phase inversion by immersion precipitation. However, PSF exhibit two main disadvantages which are the hydrophobic character and the low resistances to UV radiation. Thus, suitable materials need to be introduced in the casting solution in order to prepare membranes with excellent penetration properties.

Addition of surfactant as a new material is one of the effective strategies to produce membrane with high performance in separation process. There are studies which reported on the use of surfactant in membrane formulation, focusing on the effect of surfactant towards the performance characteristics and physical structures of the membranes (Tsai et al. (2000), Mulijani et al. (2010), Saedi et al. (2012)) However, till now there is no study reported on the use of surfactant for the fabrication of low pressure reverse osmosis (LPRO) membranes, specifically for water desalination.

Since surfactant as additives were found to affect the performance and morphological structures of ultrafiltration (UF) and gas separation membrane, the potential of these surfactants towards production of newly RO membrane (LPROS) were studied. In this study, the effects of hydrophilicity, types, and concentration of different surfactant (cationic, anionic and non-ionic) on the performance, morphology and physico-chemical characteristics of the newly synthesized low pressure reverse osmosis surfactant (LPROS) membrane were investigated. In context of application in water desalination, at different range of salt concentration, the effectiveness of LPROS were studied. Ultimately, this research shows potential in generating an important knowledge on the roles of surfactants and their major effects which is truly beneficial towards advancement in membrane fabrication principle for the production of new membrane for different application in the future.