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ENHANCEMENT THE FLUX OF PVDF-CO-HFP HOLLOW FIBER MEMBRANES FOR DIRECT CONTACT MEMBRANE DISTILLATION APPLICATIONS

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ABSTRACT

Phase inversion technique has been utilized to prepare Poly (vinylidene fluoride-co-hexafluoropropylene) PVDF-co-HFP, hollow fiber membranes. Polyvinylpyrrolidone (PVP) with 9 wt. %. added as a pore former additives to the polymer dope solution. Characteristics of the PVDF-co-HFP hollow fiber membrane with / without PVP particles have been studied. It was found that the membrane prepared without PVP additives has a low porosity and a high contact angle. Existence the PVP additives of 9 wt. % causing the increase of the membrane porosity by 28 %.Whilst increase PVP content resulting in decrease of membrane hydrophobicity. MD experiment was done using a direct contact membrane distillation (DCMD) configuration as crucial test to investigate performance of product PVDF-co-HFP hollow fiber membrane. Increase the amount of PVP to 9 wt. % in dope solution, this in turn leads to an increased the permeate flux from of 4.5 to 15.8 Kg/m2.h at 70 oC The effect of operating conditions such as feed temperature, concentration of feed solution and permeate flow pattern on the performance flux of the hollow fiber membranes were studied.

Keywords: Poly (vinylidene fluoride-co-hexafluoropropylene), Polyvinylpyrrolidone, contact angle, permeate flux.

INTRODUCTION

Membrane distillation (MD) is a novel separation process which depends on the phenomenon that fresh water can be permeate from aqueous solutions by evaporation using membrane (Camacho *et al.* 2013),(Gryta, 2011),.When a temperature difference is occurs across a hydrophobic microporous membrane while the vapor crossing it. A vapor pressure variation will be established across the membrane because of the temperature difference. Just the vapor passes through the membrane as a result of the hydrophobic nature of the membrane. It is recognized that the driving force of membrane distillation operation is the temperature difference across the membrane (Al-Anezi *et al.* 2012), (Alsaadi *et al.* 2013), (Yu *et al.* 2011), (Qtaishat *et al.* 2008).

There are four kinds of MD according to the design of the cold side of the membrane; Direct Contact Membrane Distillation (DCMD), the hydrophobic microporous membrane will be in the direct contact with the liquid in both sides. Air gap membrane distillation (AGMD), by an air gap a cold surface will receives the condensed water vapour which has been separated. Sweeping gas membrane distillation (SGMD), for sweeping and holding the vapour particles to the outside of the membranes via a cold inert gas in permeate part. Vacuum membrane distillation (VMD), Using vacuum at the permeate parts achieves the driving force across the membrane (Hwang *et al.* 2011), (Cath *et al.* 2004). The effect of two typical additives, lithium chloride (LiCl) and glycerol, and the effect on the manufacturing of poly (vinylidene fluoride-co-hexafluoropropylene) (PVDF-HFP), was studied by (Shi *et al.* 2008). He pointed out that these additives led to the obtainment of the asymmetric microporous hollow fiber membranes that have been investigated in terms of membrane conformation, installation, permeation performance, hydrophobicity and effectiveness.

Many of the previous research in the field have pointed out that the polymeric additives are appropriate with good miscibility with the base material, which indicates that these materials may be advantageous in multiple applications. It can form some highly hydrophilic membranes with highly effective resistance to protein adsorption using several functional groups, such as the s, pegylated, and carboxylated groups, and this is due to the creation of highly hydrophilic membranes (Ahmad *et al.* 2013). (Gryta and Barancewicz, 2011) pointed out that by blending PTFE with PVDF allows to reduce the rate of membrane wettability, so PTFE blending can be utilized to improve hydrophobic properties of the PVDF membrane.

EXPERIMENTAL WORK MATERIALS

For the removal of trapped moisture PVDF-co-HFP and PVP were dried in a vacuum oven (Model 282A, Thermo Fisher Scientific Inc.) at 50 °C. DMAC, used as a solvent. PVP with 9 wt. % was first dissolved with DMAC in a glass flask. Then, PVDF-co-HFP was added to the mixture at 50 °C. The casting solution was kept under magnetic stirring until a homogeneous dope was gained and removing air bubbles from it before spinning was also done. The casting solution was transferred to a vertical stainless steel tube. Via a phase inversion spinning method the PVDF-co-HFP hollow fiber membranes were fabricated.

Direct Contact Membrane Distillation

Stainless steel hollow fiber membrane modules were first prepared. Five PVDF-co-HFP hollow fiber