SUPPORTED LIQUID MEMBRANE FOR ACETIC ACID EXTRACTION: SCREENING OF MEMBRANE SUPPORT PREPARATION FACTORS

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ABSTRACT

Lignocellulosic materials can be acid hydrolyzed into fermentable sugars for ethanol production. However, inhibitory compounds such as carboxylic acid, furans and phenolic substances are also generated during this process. It is necessary to separate these inhibitors from the sugars or to reduce their concentration prior to the fermentation process in order to maximize the ethanol yields. This work focused on the removal of the acetic acid from biomass hydrolysate using supported liquid membrane (SLM) process. The membrane support for the SLM system was fabricated from 15wt% PES, 42.5wt% DMAc, 42.5wt% PEG 200 and 0.1wt% graphene by using vapour-induced phase separation (VIPS) method. Tri-n-octylamine (TOA) and 2-ethyl hexanol were used as carrier and solvent respectively in organic liquid membrane formulation. Two level full factorial design (FFD) was employed to perform the screening of three factors during VIPS process which are temperature of water bath (A) (30-60ºC), exposure time (B) (10-60 seconds) and air humidity (C) (70-90%). The response was evaluated based on acetic acid extraction percentage from 10 g/L aqueous acetic acid feed solution. From the screening result, all three main factors were significant to the SLM performance. Air humidity factor (C) gave the highest contribution of 28.96% among the main factors. In term of the interaction between factors, water bath temperature (A) and exposure time (B) give the most significant effect with 45.01% percentage of contribution. The second highest interaction effect with 13.20% contribution was the interaction between air exposure time (B) and air humidity (C), however the interaction graph is not intercept. Meanwhile, the interaction effect of water bath temperature (A) and air humidity (C) is insignificant as extraction of acetic acid decrease as both factors were increased. The highest extraction percentage for the acetic acid using SLM system was 75.95% which is using the membrane prepare at 30ºC water bath temperature, 10 seconds exposure time and 70% air humidity.

ABSTRAK

Bahan lignoselulosa boleh dihidrolisiskan melalui asid kepada gula beragi untuk pengeluaran etanol. Walau bagaimanapun, sebatian terlarang seperti asid karbosilik, furan dan bahan-bahan fenolik juga dihasilkan dalam proses ini. Ia adalah satu keperluan untuk memisahkan inhibitor ini daripada gula atau mengurangkan kepekatan inhibitor sebelum proses penapaian untuk mendapatkan hasil etanol yang maksimum. Kajian ini tertumpu kepada penyingkiran asid asetik daripada biojisim hidrolisat menggunakan sistem sokongan membrane cecair (SLM). Sokongan membran untuk SLM telah disediakan dengan komposisi 15wt% PES, 42.5wt% DMAc, 42.5wt% PEG 200 dan 0.1% graphene dengan menggunakan kaedah pemisahan fasa wap (VIPS). Tri-n-octylamine (TOA) dan 2-ethyl hexanol masing-masing digunakan sebagai pembawa dan pelarut dalam penggubalan cecair membrane organik. Dua tahap reka bentuk faktorial penuh (FFD) telah digunakan untuk menyaringkan tiga faktor dalam proses VIPS iaitu suhu air untuk rendaman (A) (30-60 darjah Celsius), masa pendedahan (B) (10-60 saat) dan kelembapan udara (C) (70-90%). Prestasi sokongan dinilai berdasarkan peratusan pengekstratan asid asetik daripada 10 g/L sebagai tindakbalas. Daripada keputusan yang diperolehi, ketiga-tiga faktor utama memberi kesan yang ketara terhadap keupayaan proses SLM. Faktor kelembapan udara (C) memberikan sumbangan tertinggi iaitu 28.96% antara semua faktor utama. Dari segi kesan interaksi antara faktor, suhu rendaman air (A) dan masa pendedahan (B) memberi kesan yang paling ketara dengan 45.01% peratusan sumbangan. Kesan interaksi kedua tertinggi dengan sumbangan 13.20% adalah interaksi antara masa pendedahan (B) dan kelembapan udara (C), bagaimanapun interaksi graf tidak bertindih. Sementara itu, kesan interaksi suhu rendaman air (A) dan kelembapan udara (C) adalah tidak ketara kerana penurunan pengekstrakan asid asetik apabila kedua-dua faktor meningkat. Peratusan pengekstrakan tertinggi bagi asid asetik menggunakan sistem SLM adalah 75.95% yang menggunakan membran yang disediakan pada 30°C suhu rendaman air, 10 saat masa pendedahan dan 70% kelembapan udara.