以連續式填充床生物反應器探討脂解酵素催化生質柴油之最優化合成

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摘 要

生質柴油為一種替代能源，具有環保、無毒性與可再生的優點，已成為國際各國關注的焦點。雖然現今商業界可由化學合成的方式來生產，但含有許多缺點，如合成副產物複雜與催化劑分離不易的問題，增加不少生產成本。相反地，以酵素催化合成生質柴油的條件相當溫和、副產物單純且更屬天然。因此，以酵素催化合成生質柴油成為國際間各國與商業界未來發展之趨勢。 本研究以固定化脂解酵素(NovozymR 435)催化大豆油與甲醇(或異丙醇)，並配合填充床生物反應器進行轉酯化反應合成生質柴油，並利用反應曲面法(Response surface methodology, RSM)及三階層三變數之Box-Behnken實驗設計分別探討流速、反應溫度與基質莫耳比等反應參數對莫耳轉換率之影響，求得生質柴油最優化之合成條件。 實驗結果顯示，無論以甲醇或異丙醇為基質合成之生質柴油反應，流速與溫度皆為重要影響之因子。由反應曲面迴歸分析，在兩種不同基質中分別取得優化反應條件。以甲醇為基質之系統中，最優化之莫耳轉換率83.31 ± 2.07%。其各反應條件分別為溫度52.09 ° C、流速0.10 mL/min與基質莫耳比1:4(大豆油:甲醇)；以異丙醇為基質之系統中，最優化之莫耳轉換率76.62 ± 1.52%。其各反應條件分別為溫度51.5 ° C、流速0.10 mL/min與基質莫耳比1:4.14(大豆油:異丙醇)。此外，分別以最優化之條件進行三次重複實驗得到82.81 ± 0.98與75.62 ± 0.81%之莫耳轉換率。最後在酵素重覆使用性可看出NovozymR 435可在長時間之下進行，十分適合連續式的反應。 以上實驗結果顯示，利用酵素於連續式系統中催化大豆油與甲醇(或異丙醇)合成生質柴油，莫耳轉換率皆屬良好。證明了以酵素催化法合成生質柴油可有效運用於工業上量產。

關鍵詞 : 生質柴油 ; 異丙醇 ; 脂解酵素 ; 轉酯化反應 ; 填充床生物反應器 ; 反應曲面法

目錄

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