摘 要

本研究係以中台灣某廢紙回收造紙廠之廢水初沉池水樣中，培養出降解纖維素產甲烷之嗜熱厭氧混合菌群。此嗜熱厭氧菌群以濾紙(filter paper, Whatman No.1)或 α-纖維素 (α-Cellulose)為主要碳源，以批次方式培養在不同的溫度、pH 值、碳源、生長輔因子 (yeast extract, peptone)、不同纖維來源，包括 α-纖維素、濾紙、影印紙 (office paper)、瓦楞紙 (card board)、報紙 (news paper)及稻稈 (rice straw)及鹼度的條件下生長。根據結果顯示此嗜熱厭氧生物降解纖維素產甲烷之最佳溫度與 pH 值分別為 70℃與 pH 6.8，而最佳碳源 (α-纖維素)添加濃度為 8 g/L；另外最適當生長輔因子添加濃度均為 1 g/L；再由最佳條件之下進行不同紙類之降解產甲烷研究，依比甲烷生成率最高至最低依序為瓦楞紙、報紙、稻稈、α-纖維素、濾紙、影印紙，其中稻稈只出現一些細長的絲狀纖維殘渣，而其它紙類皆可被降解；最後以 $NaHCO_3$ 提高鹼度，最佳鹼度添加濃度為 8 g/L $NaHCO_3$，其初始與最終 pH 值分別為 7.6±0.01 與 6.2±0.01，有效減緩因纖維素降解造成不利甲烷生成之酸化現象，以最佳化生長條件培養時，有最高之纖維降解速率為 1.66 g $L^{-1}day^{-1}$，且可生成最高 4287±73 μmole 之甲烷生成，此研究具有減廢產能之應用性。

關鍵字: 纖維素、嗜熱厭氧菌群、甲烷

Abstract

Thermophilic anaerobic biodegradation of cellulose by mixed microorganisms from primary clarifier of a recycle paper-making plant at Central Taiwan was investigated in this study. Pure cellulose (α-cellulose) or filter paper (Whatman No.1) was used as the carbon source for methane production by the mixed thermophilic anaerobic culture. Batches of the mixed culture were grown at different conditions such as different temperatures, pH's, carbon sources, growth factors, various sources of cellulose and alkalinity to determine the optimal conditions for cellulose bioconversion. The optimal temperature and pH value for bioconversion of cellulose to methane was 70℃ and pH 6.8 respectively. The optimal substrate concentration for methane production was 8 g/L of α-cellulose. Addition of 1 g/L of both yeast extract and peptone stimulated growth methane production. Various sources of cellulose (α-cellulose, filter paper, office paper, cardboard, newspaper and rice straw) were tested for methane production by the mixed thermophilic anaerobes under optimal conditions. The result showed that the potential of tested materials for the methane production by the mixed culture was card board >news paper >rice straw >α-cellulose >filter paper >office paper. These tested cellulosic materials, except for news paper and rice straw were completely degraded by the mixed culture. The optimal alkalinity concentration for methane production was 8 g/L $NaHCO_3$. The initial and final pH's were 7.6±0.01and 6.2±0.01 respectively. When grown at the optimal conditions, the highest cellulose degradation rate and methane yield by the mixed culture were 1.66 g $L^{-1}day^{-1}$ and 4287±73 μmole respectively. This study demonstrated the feasibility of using thermophilic anaerobic bacteria for methane production from cellulose.

Keywords: cellulose, thermophilic anaerobes, methane

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