中文摘要

本文系針對甲醇重組器之燃料霧化粒徑對於產氫特性影響進行研究。研究方法係以甲醇燃料搭配一定比例空氣量，利用不同的重組方式來產出氫氣。實驗參數包括 S/C 比、O2/C 比、甲醇噴霧粒徑(SMD)值、不同操作條件參數等，來探討重組器冷起動暫態反應特性，期望

重組器能在最短的時間內冷起動完成產出氫氣。本文將針對兩個部份來進行實驗探討，第一部份以不同甲醇噴霧顆粒之 SMD 值在進行部分氧化法，找出冷起動最佳參數；第二部份則爲重組器達穩態時期，採用自發熱重組法在不同操作條件下，探討氫氣產率及重組器熱效率。

在第一部份以探討冷起動暫態特性爲主，採用部分氧化法來找出最佳冷起動參數，然後再利用雙流體噴嘴配合不同輔助空氣量，來改變甲醇的噴霧 SMD 值，進行實驗，找出甲醇 SMD 值對於冷起動之關係。由實驗可知，在各種甲醇進料流率下，搭配適當的 SMD 參數，能

促使觸媒快速達到工作溫度，重組器冷起動時間能有效縮短。而第二部份則以提升氫氣產率與熱效率爲主要目標。實驗方式採用自發熱重組法，利用不同的操作條件來有效提升氫氣產率、及提高熱效率。從實驗結果可得知，在氫氣產率(Yield)方面，採用熱回收及原系統加外部加熱方式皆可有效提升甲醇轉化效率，並且提高氫氣產率。在甲醇進料 20.5cc/min 者，其用熱回收方式者，氫氣產率最多可提升 12.6%；若用原系統加外部加熱方式，甚至可提升 28%左右的氫氣產率。在原系統加外部加熱方式者，S/C 在 1.5 以上其氫氣產率皆可達 85.75%以上(約氫氣產出流率 21 L/min)。重組器節能方面，在使用熱回收操作方式後，其熱效率皆有明顯提升。當甲醇進料流率 20.5cc/min，其整體熱效率皆比原系統提高 7%以上，最高熱效率爲 S/C 比 1 時，可達 73.6%。在甲醇進料流率 24.9cc/min，熱回收方式其熱效率比原系統平均提升 12%以上，且在此進料流率下，S/C 比 1 時，最高熱效率達 77%。在最後並用 HSC 商用軟體來計算理論平衡產出，其值與實驗結果也相當吻合。

英文摘要

This study was to investigate the effect of particle size of fuel spray on the hydrogen production of a methanol reformer. Methanol with appropriate air supply rate was reformed to produce hydrogen. The parameters investigated were S/C (water/methanol molar) ratio, O2/C (Oxygen/methanol molar) ratio, particle sizes of methanol spray and different operating conditions. The particle size on the cold start of reforming response and hydrogen production were investigated.

The experiments in this thesis consist of two main parts. The first, the operating parameters for fast cold start were obtained by using different particle size of fuel spray by the partial oxidation reforming. The second,the steady characteristics of a methanol reformer were investigated. In this stage, autothermal reforming (ATR) was adopted, and the objective were to improve H2 production and thermal efficiency.

In the first part, the transient characteristics of partial oxidation reforming were investigated. In the experimental, the twin fluid injector was used to generate various SMD(Sauter Mean Diameter) of methanol spray by different quantity of assisted air. The results showed that the fast response of cold start of reformer could be achieved with appropriate SMD of fuel spray.

The aim of the second part was to improve the hydrogen yield and thermal efficiency. It showed that the hydrogen yield and thermal efficiency increased obviously with different operating conditions. Further from the results of experiments, the yield of hydrogen could be improved due to the increase in the methanol conversion efficiency by using heat recycling system and original system with heating system. The results showed that in the case of 20.5cc/min methanol supply rate, the improvement in hydrogen yield was 12.6% by using the heat recycling system and 28% improvement by using the original system with heating system. 85.75% hydrogen yield could be obtained by original with heating system as S/C higher than 1.5. It was equivalent to 17.25L/min hydrogen production rate. Further, the best thermal efficiency in this case was 73.6% at S/C ratio=1 and 7% improvement was obtained. Moreover, in the case of 24.9cc/min methanol supply rate, the best thermal efficiency was 77% at S/C ratio=1 and 12% improvement was obtained by heat recycling system. Simultaneously, in this study, a commercialized program, HSC software was used to calculate the equilibrium reaction. It showed that the coincidence between the experimental and the calculated results was obtained.