CHAPTER V
CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

In this work, the effects of Ni loading, the addition of promoter, and reaction temperature have been employed. The main conclusions of this work are as follows:

8wt% is the appropriate amount of Ni loading on the catalysts. Too high amount of Ni content leads to the increase of the ability of Ni sintering and results in low active surface area for the reaction. Moreover, large metal crystallite size can cause rapid deactivation of the catalysts by decreasing the metal-support interfacial area, which is responsible for cleaning the carbon deposition on the metal surface. Therefore, the catalysts with high metal loading become less active toward this reaction.

The stability of the catalysts can be enhanced by adding the promoters. CeO_2 is known as high oxygen storage capacity and reducible material, which can facilitate carbon removal and clean the metal surface. The other promotion effect of CeO_2 is that it retards the particle growth by partial coverage of CeO_x species on Ni particle results in strong-metal support interaction, and maintains the expose metal active sites. These are the reasons why Ce can improve catalytic activity and stability of the catalysts.

The Zr-promoted catalysts present lower reducing temperature and higher reducibility than the unpromoted catalyst. ZrO_2 is the reducible oxide material that can help increasing carbon removal rate cleaning carbon deposit on the metal surface. 8%Ni-2%Zr/clino exhibited the best activity among the prepared catalysts. However, a slightly decrease in the catalytic activity with time on stream was still observed. This can be ascribed to the effect of the unbalancing between the rate of carbon deposition and the rate of carbon removal. Based on two-path mechanism if the rate of carbon deposition is higher than the rate of carbon removal, carbon starts to accumulate on the metal surface and cause the catalyst deactivation.

The reaction temperature has an important effect to the activity of the catalysts. At high temperature, the catalyst deactivates rapidly due to the Ni sintering during reaction and cause the catalysts lost their active surface area and metal-support interfacial area resulting less ability to clean the metal surface.

5.2 Recommendations

In this work, the modified catalysts show acceptable results of using clinoptilolite as the catalyst's support. However, it needs to be improved for the catalytic activity and the stability of the catalysts to maintain their performance along the reaction. The other preparation techniques, which might give better catalytic performance of the catalysts, are recommended for studying further. Ce and Zr exhibit good properties for modifying the catalysts. Mixing Ce and Zr for using as the promoter is suggested to give synergistic effect to the catalysts.