CHAPTER V
CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

This work composes of an investigation of various effects; metal loading, the influence of preparation techniques, feed ratio, feed component, and bench-scale fuel processor testing.

In the effect of metal loading, the impregnated catalyst containing 11wt% Ni content was the optimum loading which exhibited the highest activity with time on stream. The amount of metallic Ni impacted on the catalytic activity. Higher metal content could promote the reaction except for too high metal loading providing loss of surface area caused by the agglomeration. The catalyst suffered from both two phenomena; thermal sintering and carbon formation. In addition, the 7.3wt% is the optimum loading for the ion-exchanged series.

The preparation techniques influenced to the reducibility of active metal on the support. The impregnation method provided a small interaction between metal and support. While the ion-exchange technique provided a strong interaction with the support due to Ni^{2+} species stabilized the framework of zeolite. Furthermore, the different site of carbon formation was found for the ion-exchanged catalyst with low loading. It enhances the drastic deactivation of the catalysts caused by the presence of coke formation in the pore system of zeolite.

To minimize the coke formation, the ability of carbon removal enhances by utilizing higher steam to carbon ratio. However, at higher steam ratio affects to the deactivation of the catalysts since the presence of steam contribute to suffer from sintering of active metal.

According to bench-scale fuel processor testing used natural gas as H_2 feedstock. The effect of feed component onto the activity of Ni/NaY catalyst was determined and it is observed the higher hydrocarbon can be created by methane coupling and caused the coke formation. However, the impregnated catalyst can tolerate the reaction with time on stream. It is indicated that the higher hydrocarbon could have less effect on the activity of catalyst along time on stream.

Steam reformer in Bench-scale fuel processor is efficient to produce high H_2-rich reformed gas with 57.09% H_2 concentration or 90.43 l/day. The value achieves the goal of 50 l/day. Furthermore, the impregnated Ni/NaY catalyst has potential to provide good activity in larger scale production.

5.2 Recommendations

In this work, it can be summarized that the ion-exchange catalyst provided higher activity in steam reforming reaction. However, the catalyst suffers the coke formation in the pore of zeolite which has a cage structure. According to repeating the ion-exchanged procedure is needed for higher Ni content; therefore, the technique has its limitation on the amount of metal loading and it is not appropriate for practical in large scale. For further study, the catalytic activity and stability should be improved by using other metal-incorporation technique; impregnation technique. It is interested to determine activity on the different support having channel structure. In addition, the catalytic stability can be improved by addition of promoters. The regeneration cycles is interested to evaluation for the large scale.