

CHAPTER V

CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

In this work, both KH zeolite synthesis and activity measurements on Ni/KH zeolite catalysts were investigated. Therefore, the conclusion is separated into two sections as follows.

5.1.1 KH Zeolite Synthesis

Synthesized KH zeolite can be successfully scaled up with different conditions from single batch to double, triple and quadruple batches, respectively. For single batch synthesis, the KH zeolite was successfully synthesized via the sol-gel process and microwave heat treatment using silatrane and alumatrane as precursors and potassium hydroxide as the hydrolytic agent by fixing the reactant ratio at $\text{SiO}_2:0.1\text{Al}_2\text{O}_3:3\text{K}_2\text{O}:410\text{H}_2\text{O}$ with 12 hrs gellation time at 150°C for 5 hrs hydrothermal conditions. In addition, KOH concentration had a significant effect on synthesized KH zeolite morphology. Also, KH zeolite was successfully synthesized when using $\text{SiO}_2:\text{K}_2\text{O}$ above 1:2. Moreover, the crystallization time also affected on crystalline phase of products. The crystallinity of synthesized product was increased with increasing crystallization time. The observed morphologies of synthesized KH zeolites were flower-shape and dog-bone, however, a product yield was only 0.1 g.

By maintaining the composition ratio of starting materials, crystallization temperature, and crystallization time constant at 150°C , and 5 hrs, respectively, the different gellation time should be applied to the different batch scale. The production yield of KH zeolite corresponded to the scale of synthesized batch. However, KH zeolite morphology obtained from the triple batch was in the disorder shape.

5.1.2 Activity Measurements

The up-scaling synthesis did not affect to the activity of Ni/synthesized KH zeolite, while the morphology of the zeolite did. Dog-Bone and

Flower-shape KH zeolites provided a better activity than disordered KH zeolite in terms of hydrogen production, and coke formation. Therefore, it can be concluded that Ni/KH zeolite seem to be a promising catalyst on both activity and stability for CH₄ reforming of CO₂.

5.2 Recommendations

In this work, the nickel-based catalyst showed good results of using KH zeolite as the catalyst support. However, the further study on the KH zeolite synthesis must be investigated in order to obtain same morphology, and sufficient amount for being a catalyst support. The parameters that should be taken into an account may be gellation time, crystallization time, crystallization temperature, precursors, and so on. Moreover, intrinsic properties of the zeolite should be studied to understand more on the acidity and basicity of the zeolite by TPD technique. Furthermore, the TPO technique should be investigated more for the confirmation of the amount of carbon deposition determined by TGA results. Besides, the KH zeolite properties should be further studied because there are no report on its properties, and the reaction.as other zeolites.