

## CHAPTER V

### CONCLUSION AND RECOMMENDATION

#### 5.1 Conclusions

The investigation in this work leads to the following conclusions:

1. Fly ash is appropriate as a raw material for the synthesis of zeolite X.
2. The optimal conditions for the synthesis of zeolite obtained from this work are:
  - NaOH/Fly ash weight content 1.75
  - Si/Al molar ratio 2.29
  - Fusion temperature 450°C
  - Fusion time 45 min
  - Crystallization temperature 90°C
  - Crystallization time 2 h
  - Amount of water 65 mL
  - Mixing temperature 30°C
  - Mixing time 12 h.

#### 5.2 Contributions

A large quantity of coal fly ash has been generated from the activity of the power plant. Currently this fly ash was mostly utilized as a supplementary raw material in cement kiln, and some used to make card board. The remaining then goes to landfill. The alternative utilization of the fly ash is therefore necessary to reduce the amount of waste which seems to increase in an unsustainable rate due to the perpetual-like expansion of industry. This work could take part as a small piece in the overall waste utilization strategy where at least the coal fly ash could be converted into something of higher value than cement clinker. The zeolite could be applied in several industries, just like mentioned in the preceding text. However, this is only a preliminary work which needs to be polished up before being scaled up to actual industrial size. At the end of the day, the synthesis of the zeolite might be better controlled and the adjustment towards the desire type of zeolite might become

possible. In such case, local industry will be benefited from the new zeolite products and the country will earn much more than just importing the zeolite from oversea.

### **5.3 Recommendations / Future works**

Based on the results of this study, some recommendations for future studies can be proposed.

1. The method applied in this work still could not remove impurities which might remain during the course of synthesis. It would be interesting to fine tune the treatment technique to minimize the formation of impurity and to yield zeolite of the purest quality.
2. The adjustment of zeolite properties might be possible with a proper selection of synthesizing circumstances. This should be scrutinized in laboratory scale.
3. Scaling up is always the ultimate goal in chemical engineering point of view and it will be of great value if this work could be extended to include the aspect of scale up, either to pilot scale or to actual industrial scale. Pre-economical analysis is unavoidable for such work.