CHAPTER V

CONCLUSION

5.1 Conclusion

The experimental results showed the possibility for the production of activated carbon with well developed pore structure, high specific surface area and adsorption capacity from palm-oil shells by one step pyrolysis and steam activation. Experimental data showed that the increase in temperature and time resulted in a better activation. However, at the higher temperature, the decrease in micropores was observed, which was due to coalescence or widening of already formed pores. The activated carbon from palm-oil shells in medium size (1.18-2.36 mm) had the highest adsorption capacity and surface area. When the flow rate of air was excess, the adsorption capacity and the surface area decreased. The optimum condition for the production of activated carbon from palm-oil shells by one step pyrolysis and steam activation in a fixed reactor was 200 g of palm-oil shells in size of 1.18-2.36 mm at 750°C for 2 hr with air at a flow rate of 0.72 nl/min and steam. The resulting characteristics were yield of 19.66%, bulk density of 0.5160 g/cm^3, ash of 6.03%, iodine number of 620.16 mg/g, methylene blue number of 176.75 mg/g, B.E.T. surface area of 559.48 m^2/g, micropore area of 432.02 m^2/g, external area of 127.46 m^2/g and average pore diameter of 15.53 Å.

In addition, it had been found that when there was an adding of pyrolysis time with air before steam activation, it would led to higher porosity development than one step pyrolysis and steam activation. From these experimental data, it was observed that the maximum surface area and the adsorption capacity could be obtained from using 200 g of palm-oil shells in size of 1.18-2.36 mm at 750°C for 3 hr by add pyrolysis with air for 30 min (0.72 nl/min) before steam activation. The resulting characteristics

of final product were yield of 12.18 %, bulk density of 0.5017 g/cm^3, ash of 7.54 %, iodine number of 766.99 mg/g, methylene blue number of 189.20 mg/g, B.E.T. surface area of 669.75m^2/g, micropore area of 547.21 m^2/g, external area of 122.54 m^2/g and average pore diameter of 16.20 Å.

The experiments in this work would help valuing the by-products from palm oil industry, instead of only using as fuel for steam generation in palm oil factory. From worthless by-products, they would become activated carbon after having been produced, using one step pyrolysis and steam activation, experimented in this work. It would be worth investing money in producing activated carbon as a mass product in the long run. With the Thailand's sinking economy, we could save a lot of money producing our own activated carbon. Beside gaining the financial advantage, the production of activated carbon from palm-oil shells by using one step pyrolysis and steam activation would keep environmental friendly to save our planet.

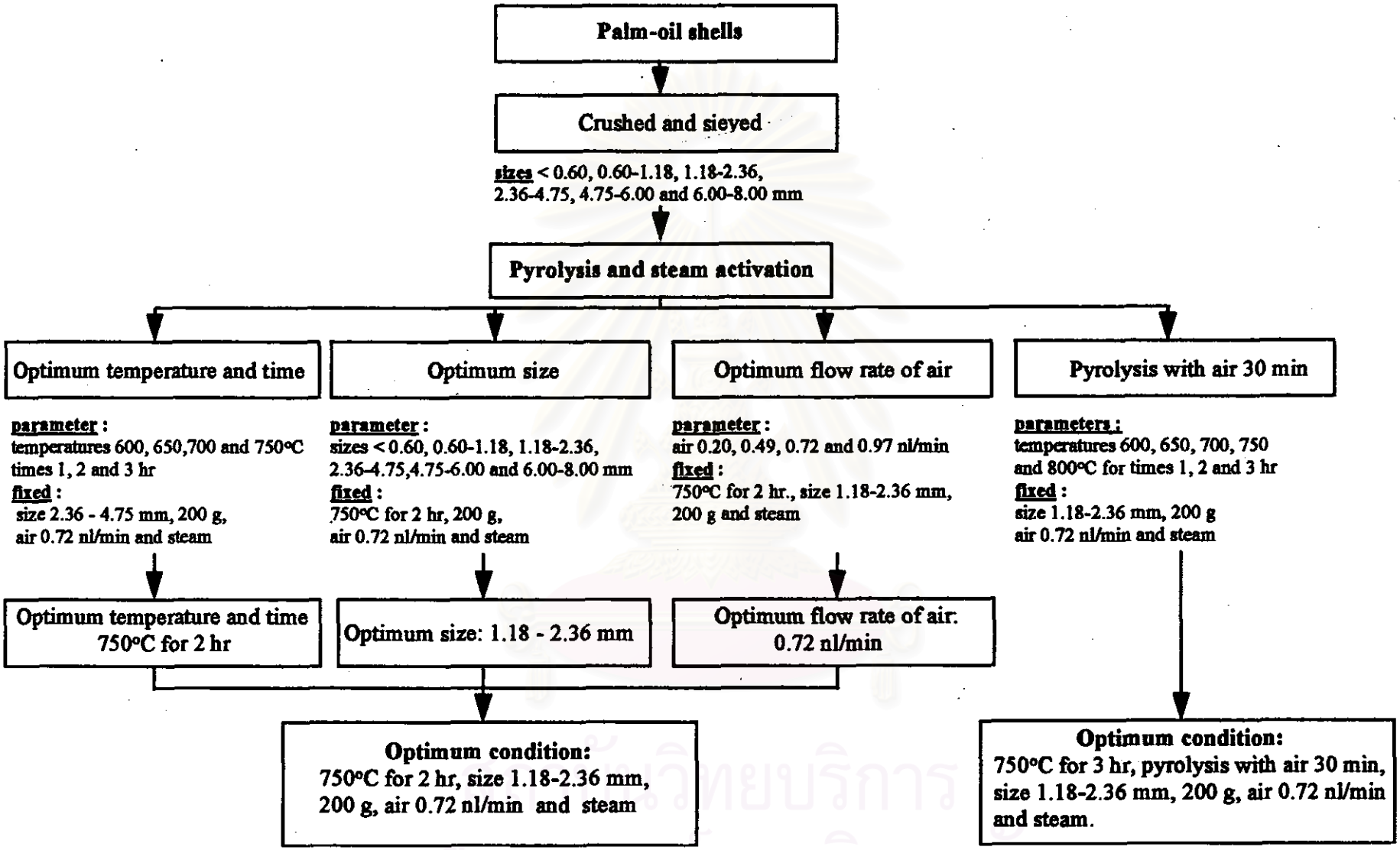

Figure 5.1 The optimum condition of the production of activated carbon from palm-oil shells by pyrolysis and steam activation.

5.2 Future works

1. Experiments on the various activating agents such as carbon dioxide, steam and carbon dioxide mixture, etc.
2. Experiments on the removal of metal ions from aqueous solution by using activated carbon.
3. Investigation of flow rate of steam activation.
4. Designs for an easy removal of activated carbon from the reactor.
5. Experiments on pyrolysis and steam activation by using fluidization technique.