# CHAPTER V

# CONCLUSIONS

This experiment results showed the possibility of the production of activated carbon with high surface area and adsorption capacity from coconut shells by carbonization and activation with superheated steam and carbon dioxide mixture.

## 5.1 Experimental conclusions

The carbonization results showed that the % yield and the volatile matter decreased while the % ash increased during the increasing of temperature and time. The fixed carbon at 400 $^{0}$C was the maximum and it decreased when the temperature was raised to 500 $^{0}$C because some C-C bond in coconut shell structure were broken, and some carbon changed into oxide compound then it was removed from surface of particle. The optimum condition for carbonization was 200 g of coconut shells at temperature 400 $^{0}$C for 60 min with air at a flow rate of 0.005 l/min. The char products obtained 29.53% of yield, 24.86% of volatile matter, 1.19% of ash and 73.95% of fixed carbon.

The chars obtained from carbonization were then activated with carbon dioxide and superheated stem. The results showed that the increase of temperature and time resulted in better activation. However, at higher temperature, the decrease in micropores was observed, which was due to coalescence or widening of already formed pores. The activated carbon from coconut shells in medium size 0.6-1.18 mm had the highest adsorption capacity and surface area. When the composition of $CO_2$ (by weight) was increased more than 8%, the adsorption capacity and surface area decreased. The optimum condition for activation was 950 $^{0}$C for 60 min size of 0.6-1.18 mm with flow rate of air and superheated steam 0.005 l/min 10 g/min. The resulting characteristics were yield of

31.31%, bulk density of 0.5648 g/cm$^3$, ash of 3.87%, iodine number of 999 mg/g, methylene blue number of 188 and B.E.T. surface area of 996 m$^2$/g.

The effect of carbon dioxide and superheated steam activation on properties of activated with carbon, when coconut char was activation with superheated steam, the maximum iodine number, the methylene blue number and the B.E.T. surface area were obtained. Those values were decreased sharply at the composition of $CO_2$ (by weight) over 14% to pure carbon dioxide namely 41% iodine number, 1.5% methylene blue number and 34% B.E.T. surface area.

It was concluded from the above experimental processes that coconut shell, which most people consider to prepare to activated carbon, is useful in commercial. It had also been proved that carbon dioxide could be mixed with steam, in the activation process in order to enlarge the pore size and minimize the cost of production.

In this globalization era, recycling was one of the modern know-hows. Coconut shell and carbon dioxide had been recycled in this work to help solving the pollution problems to keep the atmosphere clean.

## 5.2 Future works

1.Experimental study on the adsorption of activated carbon for removing material ions.

2.Experiments on activation by using fluidization technique

3.Study the effect of $CO_2$ on pore size distribution.

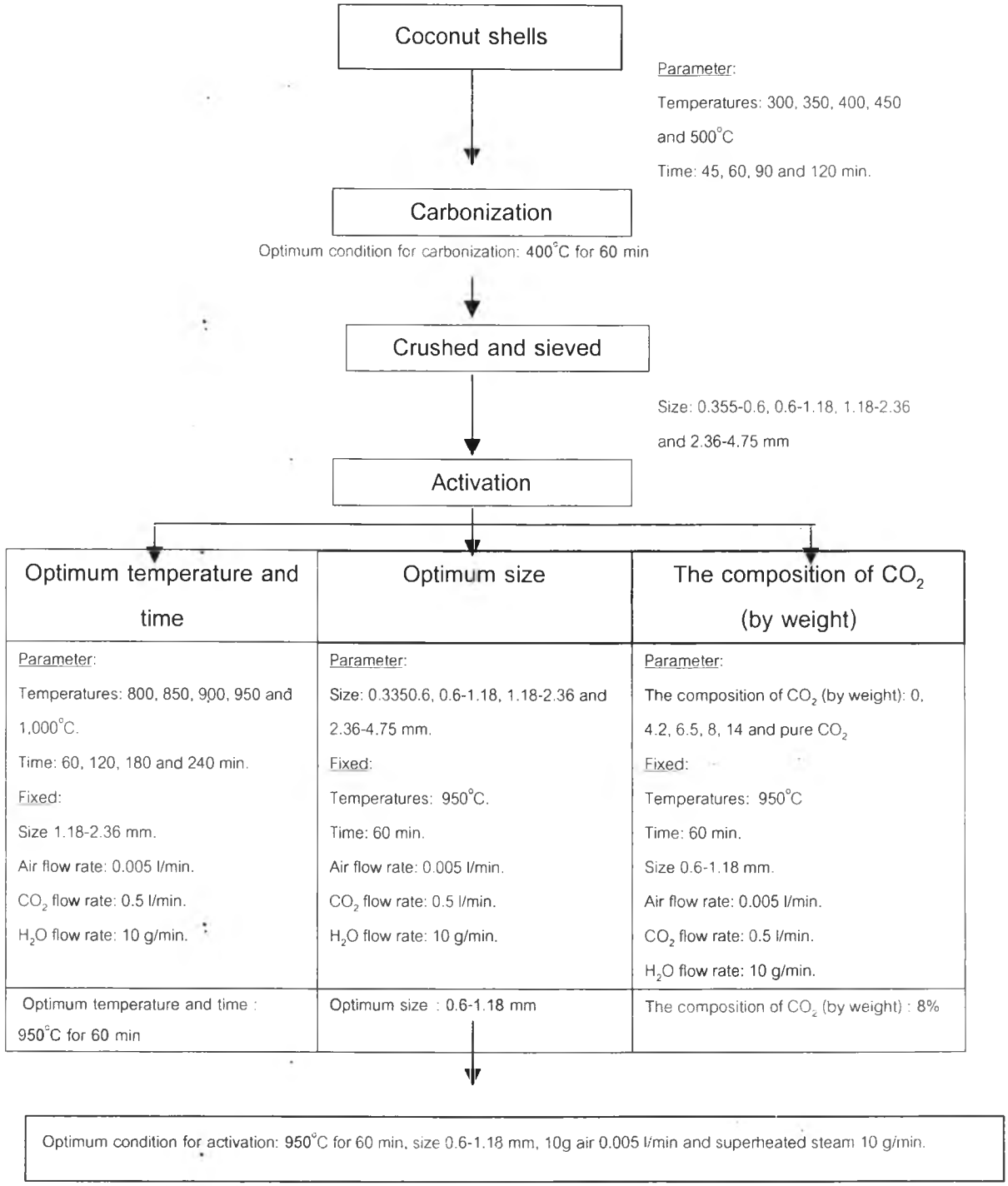


Figure 5.1 The optimum condition of the production of activated carbon from coconut shells by carbonized following by superheated steam and carbon dioxide