CHAPTER IV

RESULTS AND DISCUSSION

The adsorption of phenol on fresh activated carbon is shown in figure 4.1. An equilibrium amount of phenol adsorbed can be estimated from a mass balance on the breakthrough curve. The activated carbon used this work, Filtrasorb-300, has the pore volume that corresponds to the volume of liquid contained in an adsorber bed filled with water of 0.80 mL/g carbon. The pore volume shown here was reasonable agreement with Bhummasobhana et al. (In press.), 0.85 mL/g carbon. The equilibrium amount of phenol adsorbed obtained for 10, 20, and 30 mg/L of phenol loading were 5.282 g or 91.07 mg/g carbon, 5.262 g or 90.72 mg/g carbon, and 6.016 g or 103.72 mg/g carbon. This adsorbed amount was not much distinction comparing with Pobb and Cohen's work (1980) for 40 mg/L of phenol filled in the same condition that was presented for 105 mg/g carbon of phenol adsorbed and Bhummasobhana et al. (In press.) observed a loading of 85 mg/g carbon.
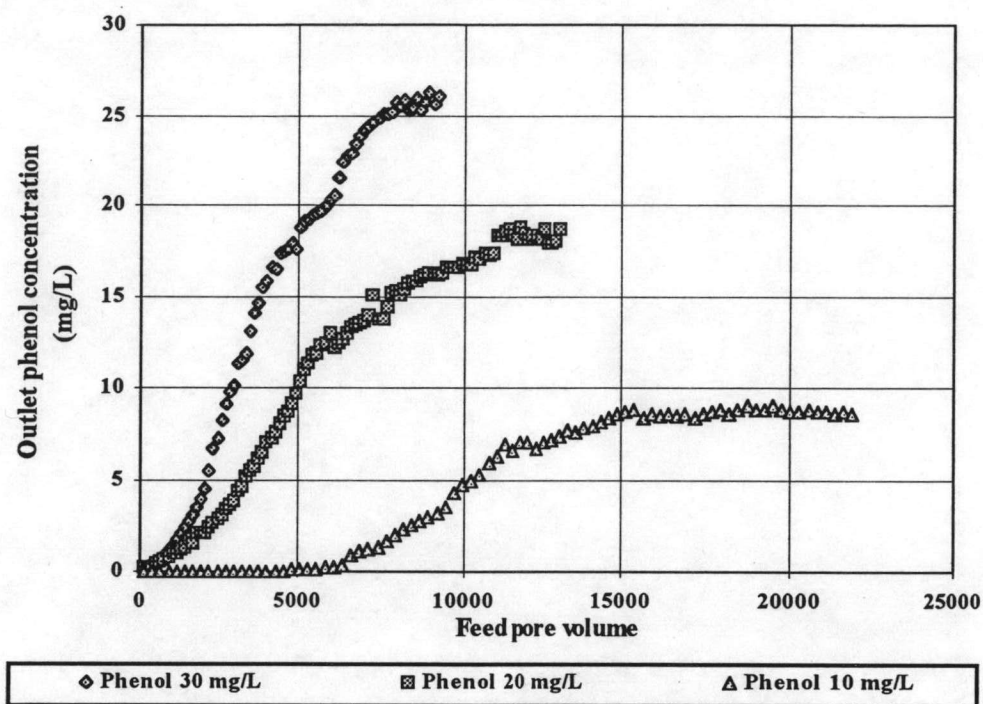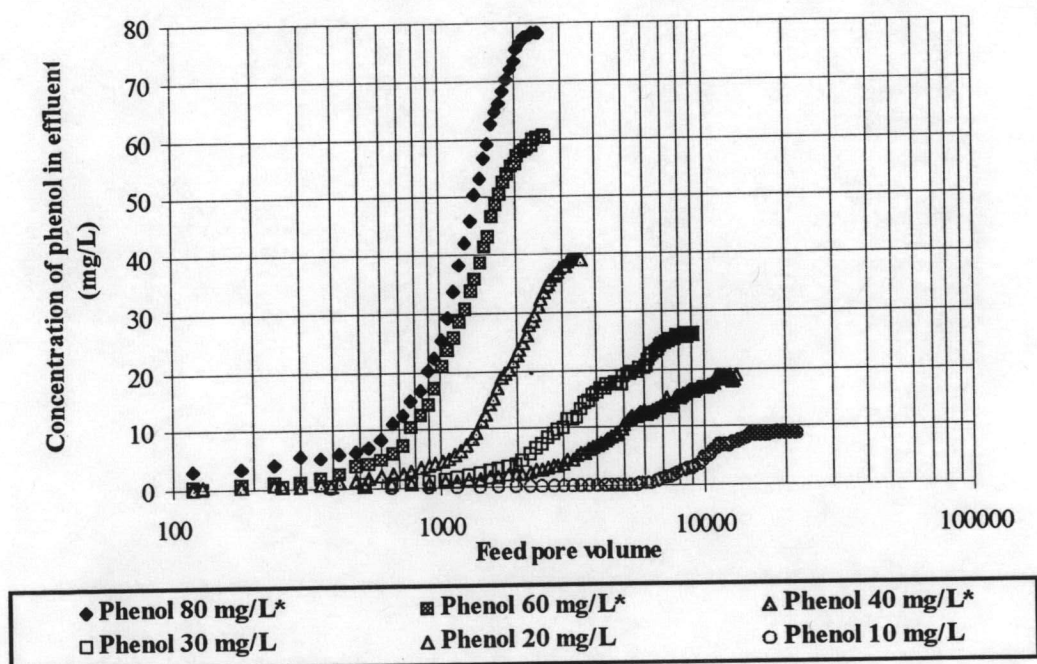
Figure 4.1 The breakthrough curves of phenol loading in adsorption step.

Due to the high flow rate of phenol loaded on the carbon, the breakthrough curves in figure 4.1 are not as sharp as should be expected in a commercial carbon bed utilization. In obviously, there is no significant difference in the equilibrium loading of a phenol concentration feed of 10 and 20 mg/L of phenol, while the higher amount of phenol adsorbed was shown for 30 mg/L of phenol in the feed. This is probably due to more severe non-equilibrium or rate effects on adsorption at higher concentrations of phenol.

The phenol adsorption breakthrough curves of Bhummasobhana et al.(In press.) were obtained under the same conditions as this work except the feed phenol concentration was higher and their results are compared with this work in figure 4.2. When the concentration of phenol decreases the time required to attain a given fraction of the feed phenol concentration in effluent

increases and non-equilibrium effects appear to be more severe at higher concentrations. The carbon pretreatment procedure of these two work was not quite the same. There was a difference in the amount of water used for washing the carbon. Bhummasobhana et al. (In press.) used 10 L of water while in this work the conductance of a water supernatant from washing determined wash solution volume as mentioned in the Experimental section. The particle size distribution also has an effect adsorbed amount. Because the carbon was not treated by a screening process either in Bhummasobhana et al. (In press.) or this work, there may have been a difference in particle sizes used in two works.

The effect of regenerant solution on phenol removal from the bed is shown in figure 4.3 and figure 4.4. The concentration of phenol in effluent

* From Bhummasobhana et al. (In press) work

Figure 4.2 Comparison the breakthrough curves of this work with the previous work done by Bhummasobhana et al. (In press.).

solution was illustrated in figure 4.3. The last portion of adsorbed solute was removed difficulty as a result of chemisorption of phenol on carbon.

The percentage of phenol recovery, which was regenerated by a solute of 0.1 M of SDS at a flow rate of 50 mL/min. in countercurrent operation is illustrated in figure 4.4. The phenol recovery never exceeds 40% even though over 3,000 pore volumes of regenerant solution is used. The percentage removal was quite low in each phenol concentration comparing with Bhummasobhana et al. (In press.). They observed approximately 90% phenol
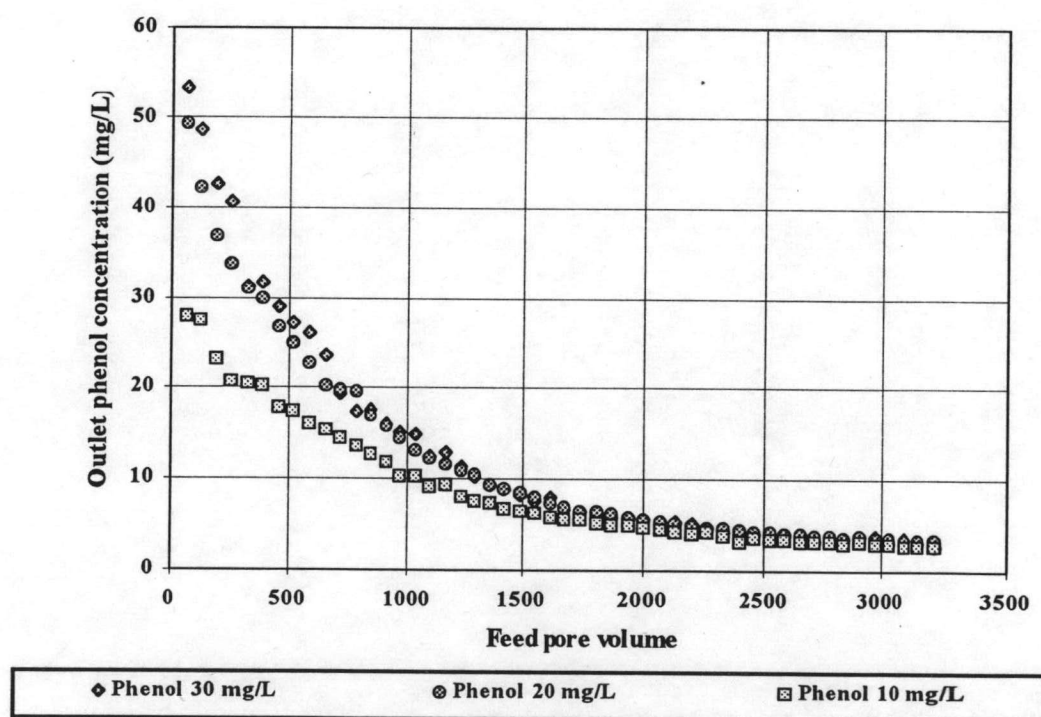

Figure 4.3 The effect of SDS regenerant solution on phenol removal.

removed from the bed by introducing a 0.1 M. SDS regenerant solution at a flow rate of 40 mL/min. in the cocurrent direction. In this work, it was observed that when the regenerant solution was introduced for a long time, there was precipitation appeared in the column. The precipitate would cover the surface of the carbon and presumably block the active sites. This was probably due to some impurities in either the surfactant or the water used since both were from a different source than those used by Bhummasobhana et al. (In press.).
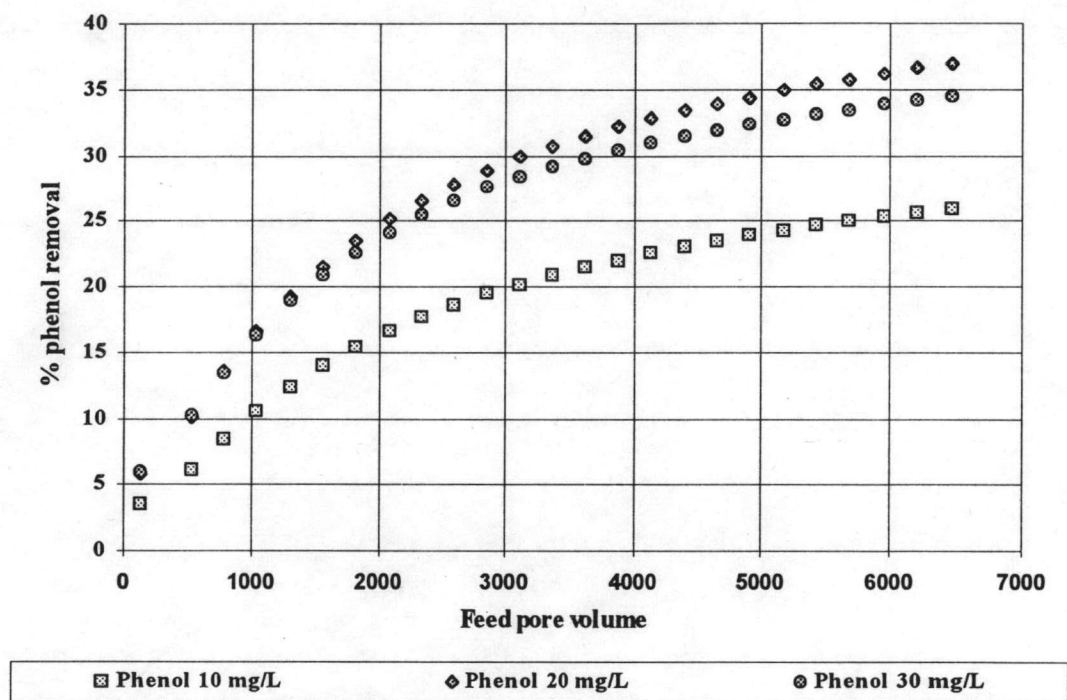

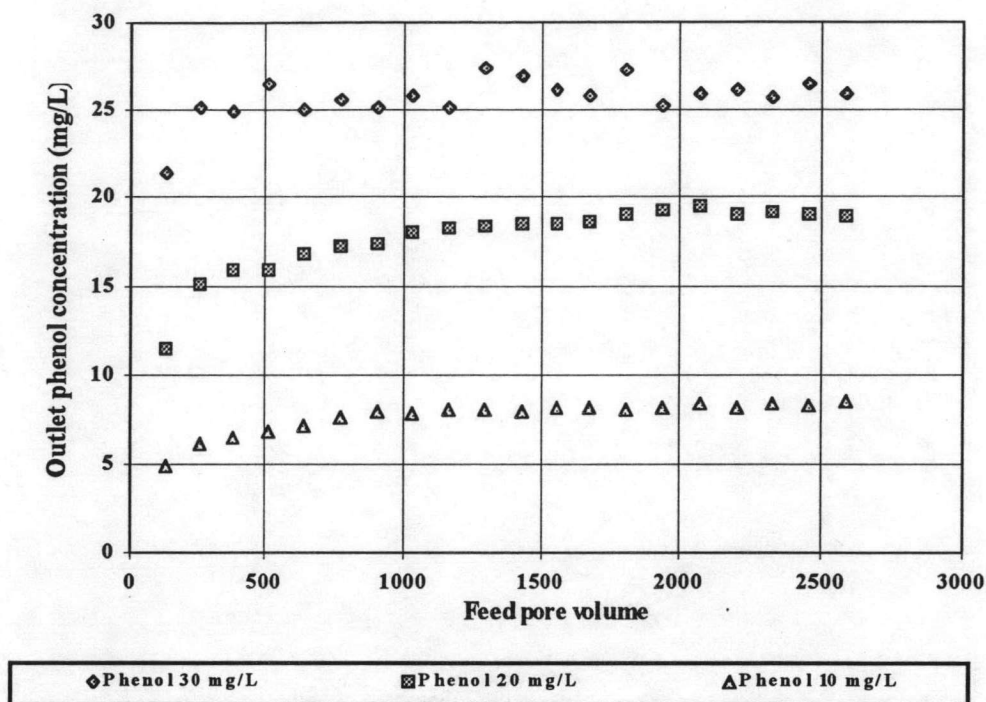Figure 4.4 The percentage of phenol removal in regeneration step.

Figure 4.5 The breakthrough curves of phenol in subsequent adsorption
/readsorption step for each phenol concentration loadings.

The breakthrough curves for subsequent loading/readsorption following SECR are shown in figure 4.5. The differences in adsorption on fresh carbon and regenerated carbon are shown in figure 4.6, 4.7, and 4.8. Rapid breakthrough curves occurs and a very low effective adsorption capacity is observed. This is qualitatively consistent with the results of Bhummasobhana et al.(In press.) where the effective adsorption capacity was shown to decrease with high residual solute loadings following regeneration, a situation observed in this work.
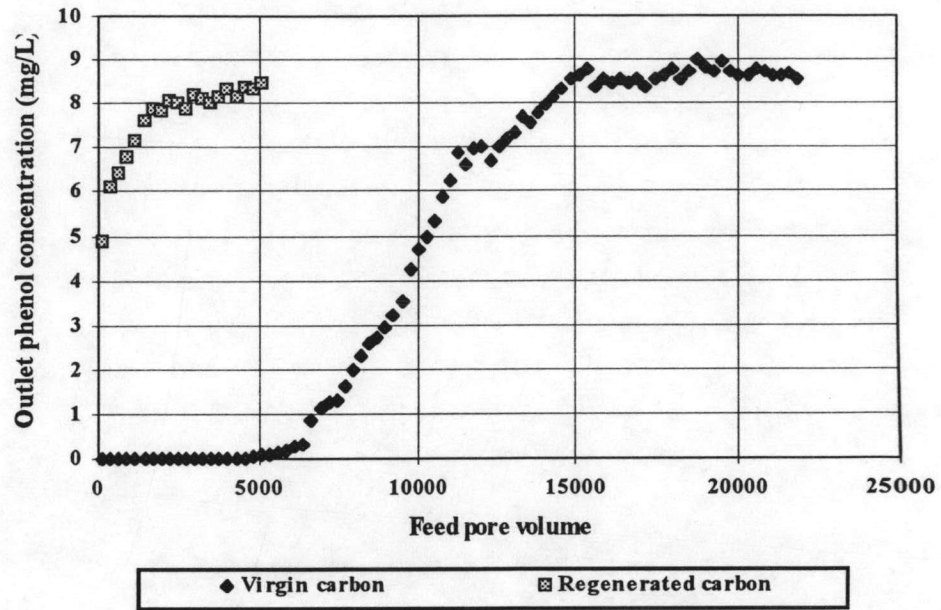
Figure 4.6   Effect of SECR technique on subsequent loading for 10 mg/L
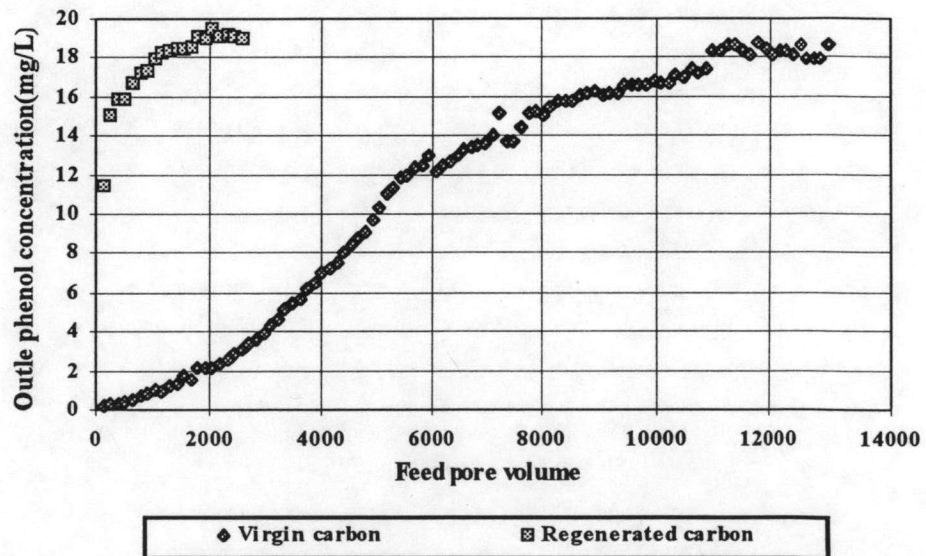of phenol loading.

Figure 4.7   Effect of SECR technique on subsequent loading for 20 mg/L
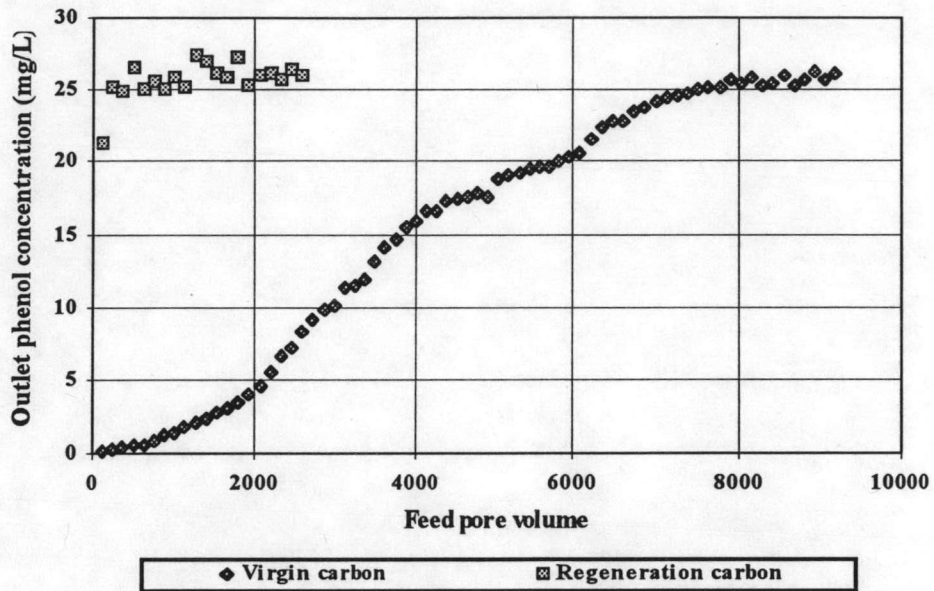of phenol loading.

Figure 4.8 Effect of SECR technique on subsequent loading for 30 mg/L of phenol loading.

Figure 4.9 illustrated the comparison of adsorption, regeneration, and subsequent adsorption/readsorption for the three feed phenol concentrations.
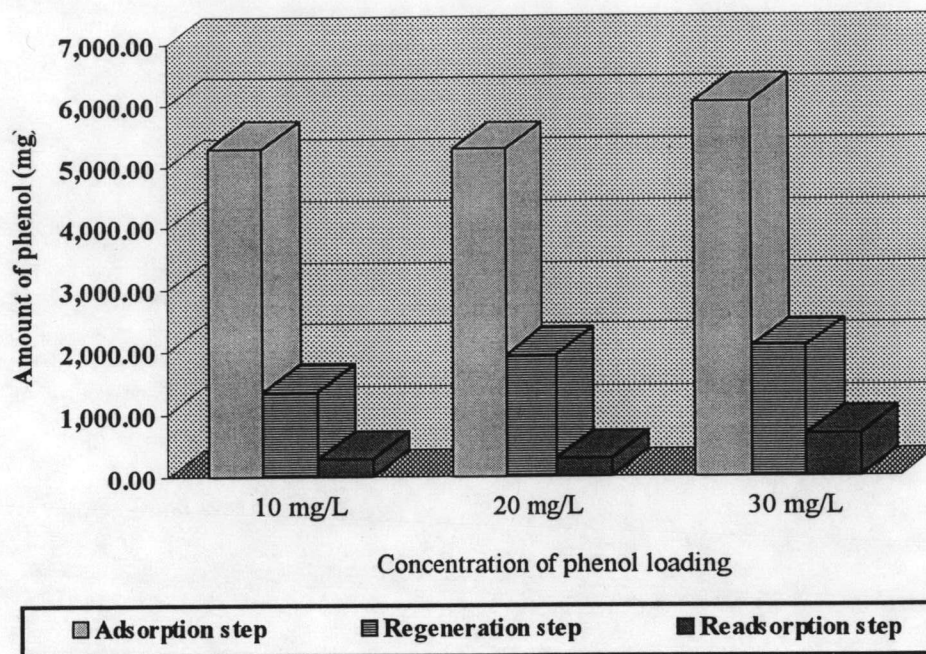
Figure 4.9 The comparison of phenol amount concerned in each step.