CHAPTER V

CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

Silica and alumina were studied as representative of the major mineral components of natural soil environment. Porapak was used to represent the organic matter in the aquatic environment. The pharmaceuticals studied were acetaminophen nalidixic acid and 17-α-ethynylestradiol. Equilibrium sorption kinetic for nalidixic acid with alumina silica and porapak demonstrated that equilibrium was reached within 3 hours, while 17-α-ethynylestradiol required 3 days to achieve the equilibrium on porapak. Acetaminophen preferred the water phase to adsorbent materials while nalidixic acid sorbed by electrostatic force with alumina, and partially sorbed onto silica and the porapak. 17-α-ethinylestradiol strongly absorbed/partitioned onto the porapak, and show no significant adsorption onto alumina and silica. Sorption coefficient of Nalidixic acid with alumina silica and porapak were 4.14, 0.013, and 0.03 L/g, respectively. For 17-alpha-ethynylestradiol with porapak, the sorption coefficient was 0.66 L/g. pH is the important parameter governing sorption of nalidixic acid on alumina. The octanol-water partition coefficient (K_{ow}) of nalidixic acid is reported in this paper of about 0.8.

Typically, the natural water system has a pH range between 5 and 9. From these results, if acetaminophen enters into the environment, the major portion of acetaminophen will be in the water phase. Nalidixic acid can be in both water phase and organic phase depend on pH of the waters. It can interact with alumina oxide that is the component of aquifer rock bed as well. For 17-α-ethinylestradiol, the most

hydrophobic molecule will be sorption readily into organic materials or aquatic organisms.

In conclusion, Pharmaceuticals that have high solubility will dissolve in water phase. For the pharmaceuticals that can ionize, they will sorb well to the adsorbent that has an opposite charge. And, pharmaceuticals that are more hydrophobic may adsorb on soil containing organic matter or penetrate quickly in organism tissues.

5.2 Recommendations

This research work is the part of U.S. EPA Science to Achieve Results (STAR) program. All experiments were performed in the laboratory of The University of Oklahoma. Although a wide range of pharmaceutical active compounds (PhACs) and personal care products (PPCPs) have been detected throughout Europe and US waters, in Southeast Asia, especially in Thailand, pharmaceuticals and personal care products in the environment have not yet become a topic. For future research works, the study of more pharmaceuticals and the different classes is required, along with other media. The lower concentration, down to ng/L level, will be evaluated. Addition of surfactants to enhance the pharmaceuticals sorption onto sorbent will be evaluated. And, the parameters from batch and column experiments will be linked with transport models. Finally, the natural soil will be used as sorbent in order to evaluate fate and transport behavior of pharmaceuticals.