CHAPTER V
CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

In this study, the waste oil can be recovered from the API separator sludge prior to the pyrolysis process by using two methods. The first technique was to use surfactant and electrolyte solution while the other technique involved coagulation and flocculation processes which were used together with the flotation technique. From the experimental results, the oil recovery increases as the concentration of surfactant and electrolyte solution increases but decreases as the temperature increases. The highest oil recoveries, 62-64%, could be obtained at the optimum conditions which were 5000 ppm of surfactant with saturated NaCl and operating temperature of 30 and 40°C for Empilan KB-7 and Empilan NP-9, respectively. The addition of the positive charge of electrolyte, $CaCl_2$, improves the recovery but the system still required high concentration of $CaCl_2$. It was found that the surfactant solution can not be re-used because of the loss in surfactant during the process. It may be concluded that the surfactant solution could not recover the oil from the sludge without the addition of electrolyte. Moreover, this system required very high concentration of surfactant and electrolyte which resulted in the economic drawback and corrosion problems, respectively. On the other hand, the use of ferric salt and polyelectrolyte together with flotation technique provided higher oil recovery efficiency than the previous techniques. It was found that the optimum ferric chloride dosage at pH 9 was 50 mg/l which provided 84% oil recovery. However, the performance of ferric chloride depended on pH of the solution and this process required the pH adjustment. Therefore, the use of polyelectrolyte was more preferable for chemical treatment because the maximum recovery, 90-99.7%, could be achieved at very low concentration of polyelectrolyte. The optimum dosages were 5 mg/l for PF2525, 10 mg/l for FT2413 and FT2431, and 20 mg/l for PF2628 and FT2602.

After the sludge was treated by chemical method, the treated sludge was pyrolized at the same condition with the original sludge (untreated sludge). The TG data showed that the large fraction of oil was removed during the chemical treatment process which was a convenient and cost effective method. The DTG data indicated that the pyrolysis behavior of the treated sludge did not change significantly compared to the original sludge. In addition, the kinetic models of pseudo bi-component provided a good fit to the experimental data of the original and treated sludge. By using this model, the kinetic parameters of both reactions could be determined. It is obvious that the reaction orders of both reactions of the original sludge pyrolysis are different but the reaction orders of the treated sludge are approximately the same. The activation energies of the treated sludge pyrolysis are lower than that of the original sludge and other hydrocarbon materials. They are approximately 44-48 and 60-66 kJ/mol for the first and second reaction regions, respectively.

5.2 Recommendations

There are several ways to improve the recovery efficiency and reduce the cost of oil recovery.

1. Developing and applying the flotation unit which provides high flotation efficiency.
2. Applying different kinds of chemical with high performance to reduce the amount of chemical used in treatment process and recovery cost.