Chapter 4
Conclusion

Methanol, a hydrophilic compound, and toluene, a hydrophobic compound, were successfully treated in biofilter consisted of a mixture of palm shells and activated sludge as the filter bed media without further inoculation. The adaptation periods of microorganisms were 37, 18, and 87 days for removal of pure methanol, pure toluene, and methanol in mixed system, respectively. The steady state for removal of toluene in mixed system could not be observed during 121 days of operation.

The optimum inlet loads were 100-250 g/m^3 bed medium/ h that VOCs could be treated nearly 100%. The maximum flow rates operated should be 0.24 m^3/h for removal of methanol in both pure system and mixed system and 0.18 m^3/h for removal of pure toluene. When the inlet loads were 1120 g methanol/m^3/h and 648 g toluene/m^3/h, the biofilters could remove as high as 711 g methanol/m^3/h in methanol system and 346 g toluene/m^3/h in toluene system. On the other hand, the mixed system could remove 703 g methanol/m^3/h and 222 g toluene/m^3/h when the inlet loads were 703 g methanol/m^3/h and 494 g toluene/m^3/h. The elimination capacity for mixed system was lower than the elimination capacity for pure system. The presence of methanol in the system significantly decreased the removal rate of toluene while the removal of methanol was not affected by the presence of toluene.

At VOCs concentration of less than 0.5 g/m^3, the optimum flow rates were 0.06-0.24 m^3/h. At VOCs concentration of 2.5 g/m^3, the optimum flow rates were 0.12 and 0.06 m^3/h for removal of methanol and toluene, respectively. In case of removal of methanol in mixed system, the optimum flow rates were 0.06-0.24 m^3/h for concentrations of 0.3-2.5 g/m^3. For removal of toluene in mixed system, the optimal flow rate could not be observed.

For long EBRT (71 s), corresponding to airflow rate of 0.06 m^3/h, high removal efficiencies of 100% for removal of pure methanol, pure toluene, and methanol in mixed system were observed. For the air flow rate lower than 0.45 m^3/h, the inlet concentration of VOC did not have significant effect on the removal efficiency of the biofilter. On the other hand, for short EBRT (9 s), correspondingly to air flow rates of 0.45 m^3/h, the removal efficiencies fell to value of less than 50%. For removal of toluene in mixed system, the removal efficiency was less than 30% at all EBRT (9-71 s).

At media height of 87 cm the biofilter could treat VOCs higher than 90% at flow rates of 0.06-0.18 m^3/h for methanol, 0.06-0.18 m^3/h for toluene, and 0.06-0.24 m^3/h m^3/h for mixed system. The bed temperature, pH, and medium relative humidity should be maintained at the optimum conditions (bed temperature $\approx$ 30^{o}C, pH $\approx$ 7, and medium relative humidity $\approx$ 97%). The medium bed pressure drop should not be too high (< 35 mm H_2O) to protect the clogging problem.