

CHAPTER V

CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

The mercury solubility in hydrocarbon systems was studied in the temperature range of 5-40°C and the experimental conditions were accurately and precisely controlled to avoid the unambiguous data. Two hydrocarbon systems were studied; single solvent system and simulated condensate. The equilibration time for mercury solubility was studied. It was found that the solution reached equilibrium at 17 hours, but every sample was left for more than 20 hours to ensure the equilibrium in this work. The effect of mercury concentration in headspace was tested by the high pressure solvent like *n*-pentane and *n*-hexane at 40°C and the suspended mercury was tested with 0.22 filters. The mercury concentration in headspace was lower than the mercury concentration in liquid hydrocarbon and it was found to be less than 10% of that in liquid phase. In filtration test, a small difference in mercury concentration between before and after filtering was noticed but within the deviation range. Therefore, it could be summarized that the headspace over the liquid phase and the suspended mercury in the solution had negligible effect on solubility results.

The mercury solubility in single solvent systems increased exponentially with temperature, yet the trend in solubility with carbon atom number in the series was not observed. The obtained results from this work were lower than previous works possibly due to the differences in experimental conditions (shaking speed, shaking direction, sampling technique, the pre-treatment of hydrocarbon solvents, and the employed analytical method). In the case of simulated condensate, the mercury solubility was located between mercury solubility in the individual hydrocarbons, but close to the cyclic aliphatic and aromatics even though the composition of the paraffins was 75%. This implies that "effect of mixing and hydrocarbon molecular structure" played important role on the mercury solubility.

The hysteresis study was conducted to see the difference in mercury solubility between increasing and decreasing temperatures. Hysteresis can be

interpreted based on the maximum 10% deviation range. Thus, hysteresis was observed in low carbon atom number *i.e.* *n*-pentane, *n*-hexane, *n*-heptane, and 2,2,4-trimethylpentane but not in high carbon atom number *i.e.* *n*-octane and *n*-decane. Three possible assumptions – kinetics of mercury precipitation, molecular association, and organomercury formation were drawn for interpreting the hysteresis phenomenon. For hysteresis study in simulated condensate, the difference in mercury solubility was clearly observed. The molecular association assumption and the organomercury formation assumption were likely to be possible explanation and the mixing properties might be considered as factors for the hysteresis study.

Transformation of elemental mercury in 3-methylpentane was changed from round and shiny drop to flat and rusty-looking shape, and the measured concentration was higher than usual when compared to other hydrocarbons at the same temperature. As it was dictated by the additional testing, the fine black particles were well soluble in toluene and could decompose at high temperature ($> 80^{\circ}\text{C}$). A reaction between elemental mercury and 3-methylpentane causing either organometallic compound or their intermediates may probably be the explanation.

5.2 Recommendations

For further studying, the author would like to suggest the following experiments.

1. Mercury solubility study on other branched paraffins in $\text{C}_5 - \text{C}_{10}$ range to get clearer picture of the effect of branching on mercury solubility.

2. Mercury solubility in binary or ternary solvent systems. This experiment can help disclosing the effect of hydrocarbon types and the fraction of hydrocarbon mixture on mercury solubility in simulated condensate.

3. Hysteresis study on mercury solubility with longer equilibration time during decreasing temperature. As described earlier, longer time for equilibrating might be required to confirm the equilibrium.

4. Hysteresis study on mercury solubility with filtration before sampling to analysis. This should be done in order to compare the mercury concentration before and after filtration. If the difference in mercury concentration before and after

filtration is insignificant, the measured solubility can be done without filtration and considered as a true solubility.

5. Mercury-free condensate is also interesting to study. Similar experiment to mercury solubility study in simulated condensate should be performed. The results can then be compared with the obtained value from mercury solubility study in simulated condensate.