CHAPTER V
CONCLUSIONS AND RECOMMENDATION

5.1 Conclusions

Phet crude consists of hydrocarbons with carbon numbers in the range of C_{11}-C_{24} they contains macrocrystalline wax (*n*-paraffins) more than microcrystalline wax (branched paraffins). Both analytical grade (EVA) and commercial grade (EVAFLEX) of poly(ethylene-co-vinyl acetate) were investigated. Pour point temperature reduction and ROB were measured, and an economic assessment of the EVAFLEX wax inhibitor was also performed. At high concentrations (1000 ppm), EVA with high percent of vinyl acetate content (40%) was the most effective polymer since it could reduce the pour point upto 16.3°C, while at low concentration (200 ppm), low vinyl acetate content (25%) showed the best effect on pour point reduction upto 21°C. Similarly, high concentration of EVAFLEX (1000 ppm) with 33% and low concentration (400 ppm) with 28% vinyl acetate content showed good effect on pour point reduction. An attempt to experimentally determine correlation between the pour point and ROB using a semi-pilot scale steel container with the capacity of 1.6 liters showed that the ROB decreased as the pour point decreased. The results from the lab could not be compared with the actual ROB from a rail tank wagon (RTW) operation, because in the lab experiment, the crude oil in the presence of inhibitor was a fluid, but could not be pumped out due to incompatible pump power. Therefore, the ROB reduction reported in this work using gravity drainage was just used as a guide to select EVA or EVAFLEX before testing in the rail tank wagon. In the RTW test, the results showed that when adding EVAFLEX with 33% vinyl acetate content at 400 ppm, the amount of ROB was higher than that without inhibitor, which could be explained by two reasons. First was a different preheating condition, where it was at 48°C in the RTW, while 60°C in the lab. The effect of preheating temperature also confirmed that in order for the inhibitor to work, the temperature must be above 52°C (Figures 4.23-4.24). Second, it can be explained by the result from the simdist GC chromatogram, which showed inhomogeneous mixing of the inhibitor solution with the crude in the RTW at 48°C as indicated by the

presence of higher molecular fraction (Figure 4.18). The distribution of the inhibitor in oil and ROB fractions could be determined using DSC. The enthalpy changes of oil and ROB fractions decrease with increase of EVAFLEX concentration, which indicates that the inhibitor decreases the energy (heat) required for wax dissolution, *i.e.* wax could be fluidized at lower temperature (Figure 4.29-4.30). The relationship of enthalpy change with EVAFLEX concentration was linear that can be used as a calibration curve to determine the EVAFLEX distributing in the oil and ROB fractions. The economic assessment based on the working amount of ROB (total ROB – dead stock ROB) at least 2500 tons/year and the 200 ppm EVA (28%VA) in the heavy aromatics solution give the company an income surplus.

5.2 Recommendations

It is suggested to perform a field test using the inhibitor in a heavy aromatic solution at other crude loading point where crude preheating temperature is at least 55°C, for example at loading bay. Also, if it is feasible, the crude and the inhibitor should be well mixed.