Chanidapa Danyuthapolchai 2012: The Solubility of Lubricating Oil in Supercritical Carbon Dioxide and Plastics Cleaning. Master of Engineering (Chemical Engineering), Major Field: Chemical Engineering, Department of Chemical Engineering. Thesis Advisor: Asscociate Professor Manop Charoenchaitrakool, Ph.D. 131 pages.

Rapid growth in industrial development leads to an increase in plastics waste generation, in particular, lubricating oil containers. Therefore, recycling of containers is desirable because it avoids accumulation in landfills and clean plastics are required in the recycling process for making new lubricating oil containers. Supercritical carbon dioxide (SC-CO_2) has been established as a good alternative solvent for cleaning since CO_2 is inexpensive, non-toxic and environmentally friendly. Prior to the cleaning process being undertaken, the solubility data are required. The effects of CO_2 flow rate, pressure and temperature on the solubility of the lubricating oil were investigated at 0.5–1 mL/min, in the pressure range of 120–190 bar and temperatures of 35, 40 and 45 °C. It was found that proper CO_2 flow rate was maintained at 0.5±0.2 mL/min and the oil solubility increased as the pressure was increased for all investigated isotherms. For 40°C and 45°C isotherms, the crossover pressure for oil–CO_2 system was observed at 165 bar. For a given pressure, the oil solubility at 35°C was found to be the highest compared to the other isotherms. Within the range of operating conditions studied, a maximum oil solubility of 12.36 g/kgCO_2 was obtained at 35°C and 190 bar. Then the empirical correlations purposed by Charstil, Del-Valle and Aquilera and Adachi and Lu were evaluated to correlate the experimental solubility data. It was found that the best correlation of the solubility data of lubricating oil was obtained using the Charstil equation. Plastics cleaning by using SC-CO_2 with and without adding co-solvent (5 mol% of acetone) were then carried out at a temperature of 35°C and pressures of 120 and 180 bar. It was observed that adding co-solvent to the process could enhance plastics cleaning efficiency and reduce the cleaning time. Moreover, it was found that the melt flow rates (MFR) of the original waste plastics cleaned with hexane and the cleaned plastics using SC-CO_2 were not significantly different.

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