CHAPTER VI
CONCLUSION AND RECOMMENDATIONS

6.1 Conclusions

Three types of alkyltrimethylammonium bromides (i.e. dodecyl-, tetradecyl-, and hexadecyl-trimethylammonium bromide or DTAB, TTAB, and CTAB, respectively) were used to remove a blue solvent-based ink, with epoxy resin being used as the binder, from printed surface of high-density polyethylene (HDPE) bottles. The critical micelle concentration (CMC) of CnTAB was found to decrease with increasing the alkyl chain length of the tail group. The deinking efficiency of these surfactants increased with increasing the alkyl chain length and the concentration of the surfactants. Complete deinking was achieved at concentrations about 3, 8, and 24 times of the CMC of CTAB, TTAB, and DTAB, respectively. For CTAB, ink removal started at a concentration close to its CMC and increased tremendously with increasing concentration beyond its CMC, while, for TTAB and DTAB, significant deinking could only occur at concentrations much greater than their corresponding CMC values. In analogy to the deinking efficiency of CnTAB in the CMC region, the zeta potential of ink particles was found to increase with increasing the alkyl chain length and the concentration of the surfactant which later leveled off at some higher concentrations. Wettability of these cationic surfactants on ink surface increased with increasing the alkyl chain length and the concentration of the surfactants. Lastly, solubilization of ink in the surfactants was found to increase with increasing the alkyl chain length as well as concentration of the surfactants (beyond CMC).

The effects of pH, temperature, and salinity on the removal of solvent-based ink from HDPE were also studied. The critical micelle concentration (CMC) values of these studied surfactants were found to increase very slightly with increasing temperature and decrease significantly with the addition of 0.1 M NaCl. Ink removal was found to increase with increasing surfactant concentration, increasing pH, decreasing temperature, and increasing salinity. The surface of ink became more positively charged with increasing pH as well as concentration and alkyl chain length

of CnTAB, suggesting that the adsorption of CnTAB molecules on ink pigment occur more readily with an increase in any of those parameters. The solubilization of epoxy ink binder was found to increase with increasing surfactant concentration, decreasing temperature, and increasing salinity of the CnTAB solutions. Without the NaCl salt addition, complete deinking was observed at a concentration equivalent to about 3xCMC, 8xCMC, and 23.5xCMC for CTAB, TTAB, and DTAB, respectively, while, with the salt addition, it was observed at about 40xCMC, 11xCMC, and 23.5xCMC for CTAB, TTAB and DTAB, respectively.

6.2 Recommendations

6.2.1 To elucidate the mechanism of ink removal by adding salt, the adsorption of surfactant should be done to clarify the process of ink removal when surfactant concentration less than CMC for all three surfactants.

6.2.2 The different types of printing ink should be investigated for illumination the adsorption and solubilization process of deinking mechanism.