CHAPTER I
INTRODUCTION

In past several years, the large amounts of volatile organic compounds (VOCs) have been disposed to wastewater, which impact to environment and human health. Therefore, there is an effort to extract the VOCs from contaminated water by using surface active agent (surfactant) (Pramauro *et al.*, 1990; Scamehorn *et al.*, 2000; Kouloheris, 1989). Coacervate phase extraction or cloud point extraction (CPE) is one of the effective processes to separate the VOCs from water using nonionic surfactant. In this process, the nonionic solution is separated into two phases by heating solution above the cloud point. After phase separation, a micellar-rich phase, or coacervate phase, and a micellar-dilute phase, or dilute phase are occurred. The cloud point temperature (CPT) is depending upon the structure of surfactant and also other chemicals that is presenting, such as NaCl, aliphatic alcohols, etc. (Li *et al.*, 2003; Hung *et al.*, 2007; Taechangam *et al.*, 2008)

During phase separation in CPE, the VOCs will be solubilized into surfactant micelles and then be concentrated in the coacervate phase. The coacervate solution containing concentrated VOCs can be treated further for recycle and reuse of surfactant.

Therefore, the CPE requires the contaminant removal technologies to make it more feasible in terms of economy and efficiency. There are several techniques to recover surfactant; for example, spraying, pervaporation, flash vacuum stripping, stream stripping, or air stripping using a packed column. The advantages and limitations of each technique are described in theoretical background and literature review section.

Currently, the impact of nonionic surfactant on the environment should be concerned. Two major categories of nonionic surfactants being used are alcohol ethoxylate (AE) and alkyl phenol ethoxylate (APE). In case of APE, although they are widely used in many applications, many researches have recently indicated that they are also readily absorbed to suspended solids and can later be biodegraded to chemicals that possibly cause endocrine disruption that linked to a decreasing in male sperm and carcinogenic effects to aquatic organisms (Scott *et al.*, 2000). On the

other hand, AE have gained more attention to replace APE since they are more environmental friendly and biodegradable to harmless compounds. Thus, the AE, are interested to be used in this study.

The purpose of this work is to study the removal of VOCs from concentrated nonionic surfactant solution obtained from CPE by using co-current vacuum stripping in a packed column. For batch experiment, the volatilization and solubilization of each VOCs are observed and reported in coacervate solution are reported in terms of Henry's law constant (H), apparent Henry's law constant (H_{app}), and solubilization constant (K_S), respectively. For continuous experiment, the efficiency of vacuum stripping is measured in term of VOCs removal (%) and the overall liquid phase volumetric mass transfer coefficient (K_xa). Two series of studied VOCs are aromatic hydrocarbons (benzene, toluene, and ethylbenzene) and chlorinated hydrocarbons (1,1-dichloroethylene, trichloroethylene, and tetrachloroethylene). The hydrophobic properties of the VOCs are elucidated by using an octanol-water partition coefficient (K_{ow}). Moreover, Tergitol 15-S-7, a secondary AE is utilized as a nonionic surfactant instead of using Triton X-114 (APE) or polyethylene glycol *tert*-octylphenyl ether, which is studied in previous work (Kungsanant *et al.*, 2008).