

# CHAPTER I

## INTRODUCTION



### 1.1 Background

Water pollution by organic compounds such as PAHs, many of which are known to be toxic or carcinogenic, has caused considerable and worldwide concern. US EPA has identified 16 unsubstituted PAHs as priority pollutants, some of which are considered to be possible or probable human carcinogens, and hence their distribution in the environment and potential risks to human health have been the focus of much attention. PAHs are mainly introduced into the environment mainly via natural and anthropogenic combustion processes. Volcanic eruptions and forest and prairie fires are the major natural sources of PAHs. Important anthropogenic sources include combustion of fossil fuels, waste incineration, coke and asphalt production, oil refining, aluminum production and many other industrial activities. PAHs can also enter natural water via atmospheric fallout, urban run-off, municipal effluents, industrial effluents and oil spillage or leakage (Manoli and Samara, 1999).

Because of their low solubility and high affinity for organic carbon, PAHs in aquatic systems are primarily found sorbed to particles that either have settled to the bottom or are suspended in the water column (U. S. Department of Health and Human Services, 1995). The presence of colloidal particles or oil and grease microemulsion in water can enhance PAHs concentrations above their aqueous solubility and facilitate PAHs transport in aquatic environment (Smith et al., 2000). Several methods have been proposed for removal of PAHs from wastewater including chlorination, oxidation, ultrasonic irradiation, and sorption. The sorption process is widely applied to organic compounds removal in wastewater treatment with high removal efficiency. Although activated carbon is the most commonly used sorbent, it still has some limitations in application, such as ineffective for removing oil and grease, natural organic matter, and other large organic molecules. This is due to the fact that these large molecules blind the macroporous space on the activated carbon outer surface thus rendering the microporous space ineffective (Beall, 2003). In contrast to the activated carbon, organoclays could remove oil and grease at 5-7 times the rate of activated carbon, or 50% of it dry weight (Alther, 1995).

Organoclays are produced by the exchange of organic cations for inorganic cations on the internal and external surfaces of clays (Smith et al., 1990). The intercalation of organic cations into the interlamellar space changes the surface property of clay from hydrophilic to hydrophobic and it becomes a suitable sorbent for the removal of organic compounds from aqueous solution (Baskaralingam et al., 2006). Previous studies showed that organoclays were powerful sorbents for organic pollutant relative to conventional clays, such as tetrachloromethane (Smith et al., 1990), tannic acid, phenol, and 2,4,5-trichlorophenol (Dentel et al., 1995), naphthylamine, naphthol, nitrobenzene, and aniline (Zhu et al., 1997), 1,2,4-trichlorobenzene and tannic acid (Dentel et al., 1998), p-nitrophenol, phenol, and aniline (Zhu et al., 2000), fluridone (Yaron-Marcovich et al., 2004), and nitroaromatic compounds (Upson and Burns, 2006). The magnitude and mechanism of organic compound sorption depend on the molecular structure of exchanged organic cations, the amount of exchanged organic cations, the chemical properties of organic compounds, the molecular structure of organic compounds, the CEC of clay, and pH of aqueous solution (Smith et al., 1990; Sheng et al., 1997; Zhu et al., 1998; Bartelt-Hunt et al., 2003; Shen, 2004; Upson and Burns, 2006; Yildiz et al., 2005).

In this study, eight organoclays were synthesized by replacing organic cation on clay by cation exchange at cation loading level of 0.25-2.00 times the CEC. In addition, characteristics were measured for organoclays at each cation loading. The sorption capacities of eight organoclays for PAHs from synthetic wastewater were investigated. The objective was to determine the effect of the amount of organic cation exchanged onto clay on the characteristics of organoclays and the magnitude of PAHs sorption from synthetic wastewater by organoclays and to identify possible mechanism responsible for the observed results.

## 1.2 Objective

To determine the effect of the amount of organic cation added to clay on the characteristics of organoclays and the magnitude of polycyclic aromatic hydrocarbons (PAHs) sorption from synthetic wastewater to organoclays.

### 1.3 Study Scopes

1. The clay used in this study was a Na-bentonite which was obtained from Thai Nippon Chemical Industrial Co. Ltd. The cation-exchange capacity (CEC), data from the supplier, was 82 meq/100 g.

2. Eight organoclays, prepared by exchanging the inorganic cations on the surface of clay with dodecylpyridinium chloride (DPC) at DPC loading level of 0.25-2.00 times the CEC, were used for PAHs adsorption studies. PAHs used to prepare synthetic wastewater were naphthalene and phenanthrene.

3. Laboratory scale batch experiment was used to determine the adsorption of a cationic surfactant onto clay and the sorption of PAHs onto organoclays, at room temperature.

### 1.4 Anticipated Benefits

1. To know the amount of organic cation for preparation of organoclays that has the highest sorption capacity for PAHs from wastewater.

2. To provide valuable information of using organoclay as a sorbent for purifying PAHs contaminated water.