CHAPTER I

INTRODUCTION

1.1 Statement of Problem

Nowadays, tangerines are cultivated extensively in Fang, Chai-prakarn, and Mae-ai district, Northern Chiangmai. They cover more than 50,000 rais and are located near local villages (Chiangmai, 2003). Many pesticides are used in the area to enhance quality and quantity of tangerine growing. At the same time, these pesticides pose serious health and ecological risk from environmental contamination. One of the widely used insecticides in tangerine orchards is endosulfan (6,7,8,9,10,10-hexachloro-1,5,5a,6,9,9a-hexahydro-6,9-methano-2,3,4-benzo(e)dioxathiepin-3-oxide), a chlorinated hydrocarbon of the cyclodiene group. Technical endosulfan is a mixture of two isomers, alpha (α) and beta (β) endosulfan in a ratio of 7:3, and endosulfan sulfate is a derivative of parent endosulfan. Runoff water from agricultural areas that applied endosulfan has caused the die-off of various fish species and decreased the abundance of various invertebrates (Schulz, 2004).

Sludge amendment has been reported to affect binding, transport and ultimate distribution of various pesticides in soil profile (Jin and O'Corner, 1990; Bellin *et al.*, 1990). For example, Guo *et al.* (1993), studied the sorption of atrazine and alachlor on soils freshly amended with carbon-rich waste materials and found that the sorption coefficient (Kd) for these compounds increased in amended more than unamended soils. With increasing organic matter content, retardation of pesticide was increased, while desorption rate constant and the fraction of fast sorption sites decreased. This is resulting in greater sorption non-equilibrium (Graber *et al.*, 1997). The amendment of soil with sludge also changes soil structure and transport characteristics, including increased retention, and changes in pore size distribution (Metzger *et al.*, 1987; Tester, 1990). Meanwhile, the effect of Wastewater treatment sludge (WWTS) on endosulfan sorption in soil has never been studied.

In Thailand, the studies of pesticides mostly focus on their accumulation and contamination in the environment. Pesticide concentration levels in soil were much higher than those in water. For example, the maximum concentrations of endosulfan in water and soil from agricultural areas in 1997 were ranged from 0.001-0.460 μg/L and 0.011-8.818 μg/kg, respectively (Thapinta and Hudek, 2000). Endosulfan residue was also found at significant amounts in various vegetable and crops (Thapinta and Hudek, 2000). In Supanburi and Patumthani paddy fields, endosulfan residues were found in the soil for over 100 days after application (Agricultural Toxic Substances Division *et al.*, 2000). However, this is feasible for mitigating endosulfan contamination in the environment.

Our study was focus on the application of WWTS to enhance endosulfan sorption and consequently reduce its discharge from tangerine orchard soil into the environment. Batch partitioning experiment was used to identify sorption abilities of three WWTS, including pig farm, municipal, and food industrial-sweet corn canning factory WWTS. Each type of WWTS represents the difference sources of WWTS that would contribute to difference organic content, physical properties, and sorption coefficient. In the study, soil from Mae-ai District, Chiang Mai was used to represent tangerine orchard soil. The effect of sludge on the reduction of endosulfan movement was also determined in soil columns. The knowledge from this study would be essential for the development of soil amendment technique to prevent the environmental contamination of endosulfan and consequently reduce its adverse effects.

1.2 Objectives

The main objective of this study was to use WWTS as sobbent for reduction of endosulfan movement in tangerine orchard soil. The specific objectives were:

1.2.1 To study the sorption behavior of soil sample from tangerine orchard and WWTS from three different sources.

1.2.2 To compare the sorption coefficient (K_d) of each WWTS.

1.2.3 To study the amount of WWTS that can be used to reduce endosulfan movement in soil columns.

1.2.4 To determine the distribution of endosulfan in soil columns covered with WWTS.

1.3 Hypotheses

WWTS has high organic content, thus it would reduce the movement of endosulfan in soil by sorption process.

1.4 Scopes of study

The study was divided into 2 parts, batch partitioning experiment and soil column experiment. Three types of WWTS were studied, they are:

- WWTS from pig farm (HUASB-High suspension solid upflow anaerobic sludge blanket WWT plant).

- WWTS from municipal WWTP (Activated sludge WWT plant).

- WWTS from food industrial-sweet corn canning (Activated sludge WWT plant).

WWTSs were collected and analyzed for their physical and chemical properties. Then, the sorption coefficients of soil and sludge samples were determined by batch partitioning experiment. The results will be evaluated and the WWTS that has highest sorption coefficient value will be selected as sorbent for column experiment. The amount of WWTS that used to cover soil columns will be varied.

The effect of sludge on reducing endosulfan movement in soil columns will be determined.

The experiments were conducted as shown in Figure 1.1.

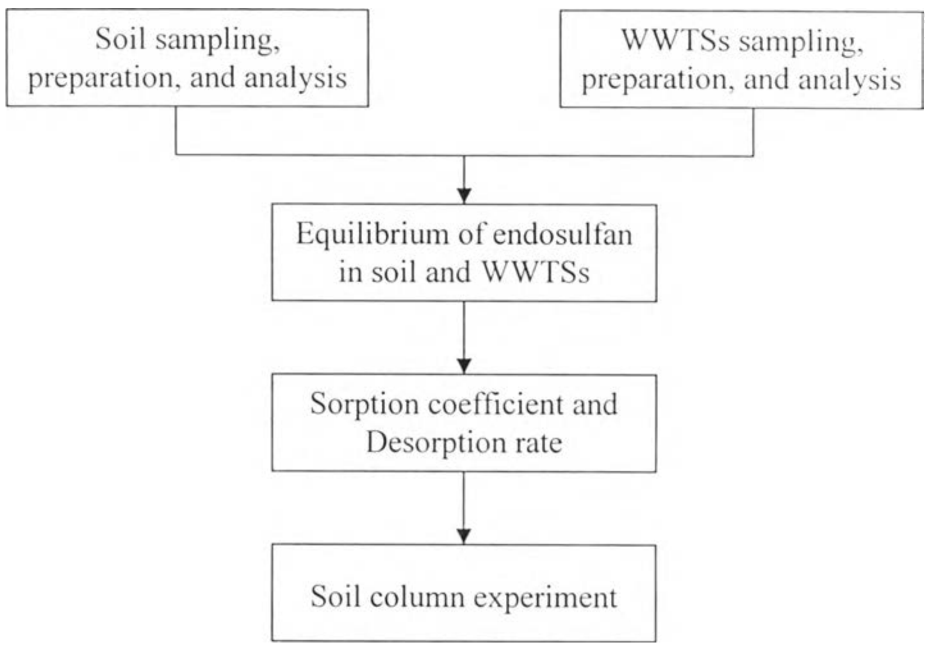

Figure 1.1 Scheme of the overall experimental procedure.