CHAPTER I

INTRODUCTION

1.1 Cause of the problem and development

Recently there has been increasing anxieties concerning arsenic related problems. Occurrence of arsenic contamination has been reported worldwide. In Thailand, the main natural arsenic sources are mine operations which are the principal anthropogenic sources. Arsenic occurs in the natural environment in four oxidation state: As(V), As(III), As(0) and As(-III). The mobility and toxicity of arsenic are determinate by its oxidation state, thus the behavior of arsenic species will change depending on the biotic and abiotic conditions in water. Arsenic concentrations in natural uncontaminated soil and sediments range from 4 to 150 $mg.kg^{-1}$. In uncontaminated surface and ground waters, the arsenic concentration ranges from 0.001 to 0.005 $mg.L^{-1}$, As a result of anthropogenic inputs, elevated arsenic levels, above ten to thousand. More extensive studies will be required for building practical guidance on avoiding and reducing arsenic contamination. Bioremediation and hyperaccumulation are emerging innovative technologies for the remediation of arsenic contaminated sites. Natural attenuation may be utilized as a potential *in situ* remedial option. Further investigations are needed to evaluate its applicability.

Phytoremediation is a promising new method that uses green plants to assimilate or detoxify metals and organic chemicals. The term was first coined in 1991 to describe the use of plants to accumulate metals from soil and groundwater (Licht *et al.*, 1995). It is a relatively inexpensive form of ecological engineering that has proven effective in some cases (Raskin, 1994). Although microorganisms have also been tested for remediation potential (Gadd and White, 1993; Ahmann, 1997), plants have shown the greater ability to withstand and accumulate high concentrations of toxic metals and chemical (McGrath *et al.*, 1998).

Aquatic plants; *Canna* sp., *Typha angustifolia* (L.), *Colocasia esculenta* (L.), and *Cyperus papyrus* (L.) may accumulate large amounts of arsenic. To understand how aquatic plants take up, transport and transformation these arsenic species, it is essential to characteristic arsenic speciation in plant tissues. This research is

investigated to measure arsenic speciation in plant tissue and assesses the role of arsenic speciation in plants.

Thailand is one of several countries in Southeast Asia that mine for tin. The waste piles that result from this tin mining are high in arsenic (as arsenopyrite) which leaches out and contaminates local soil and groundwater (Williams *et al.*, 1996). The groundwater can serve as a water source for local people, as is the case in the Ron Phibun District (Nakorn Si Thammarat Province) and the Bannang Sata District (Yala Province) of these areas resulting from drinking arsenic-contaminated water include chronic arsenic poisoning (arsenicosis), skin cancer and bladder cancer. In 1996, more than 1000 people in the Ron Phibun District were found to be suffering from arsenicosis and the population "at risk" was estimated at 30,000 (Williams *et al.*, 1996; Choprapawon and Rodeline, 1997)

Another arsenic problem occurs in Thailand where is lignite mining and power generation at Mae Moh power plant, Lampang province. The excavated lignite, fly ash, streams sediment and surface water surveys were carried out to determine the arsenic distribution in the mining area. Arsenic-rich overburden waste and fly ash piles are scattered throughout the lignite mining area and these have increased the load of arsenic-rich sediment in the nearby streams.(Vladimir and Kanitta , 2002) The reasons for using emerged aquatic plants to remediate a large amount of arsenic because the highest arsenic concentrations are released from Mae Moh reservoir from bottom sediment (5,213 $mg.kg^{-1}$), Moreover the highest arsenic concentration are remained in sediment at RonPhiboon, Nakhon Si Thammarat province (513.50 $mg.kg^{-1}$). Therefore these situations are seriously harmful to man and environment of Thailand.

1.2 Objectives:

The main objective of this research is to determine the most effective accumulation and transformation of arsenic in four selected aquatic plants.

The sub objectives are as follows:

1. To study on the amount and efficiency of total arsenic accumulation in various organs of *Canna* sp., *Colocasia esculenta* (L.) Schott., *Cyperus papyrus* (L.), and *Typha angustifolia* (L.)

2. To compare the total arsenic removal efficiency from soil by the four species viz; *C. esculenta*, *Canna* sp., *C. papyrus*, and *T. angustifolia*.
3. To study the possibility of As(III) and As(V) transformation in four aquatic plants.

1.3 Hypothesis:

1. Efficiency of total As removal from soil by *C. esculenta*, *Canna* sp., *C. papyrus.*, and *T. angustifolia* were different in various arsenic speciation, and harvest times.
2. Efficiency of As(III) and As(V) transformation from soil by *C. esculenta.*, *Canna* sp., *C. papyrus.*, and *T. angustifolia* were different in various arsenic speciation, and harvest times.

1.4 Scopes of the study:

The following works were carried out. The determination of total arsenic, As(III) and As(V) accumulation in four aquatic plants, the specifically effective absorption and the transformation of As(III) and As(V) at root, stem, and leaf every two weeks for eight weeks will be performed.

1.5 Anticipated benefits

1.5.1 To encourage phytoremediation for arsenic in Thailand

1.5.2 To investigate the effectiveness arsenic hyperaccumulation of aquatic plants

1.5.3 To find out the new method of decrease arsenic toxicity by aquatic plants in wetland

1.5.4 To apply phytoremediation in risk area