CHAPTER 1

Introduction

1.1 Statement and Significantly of problem

There are many activities that release toxic heavy metals. These include primarily industrial, mining and agricultural activities (Volensky, 2000). Heavy metals cannot be decomposed in living organisms. Moreover, they accumulated in food chain and continue contaminating in that area (Ruangsomboon, 2004). Heavy metals contamination in the environment leads high rates of accumulation in aquatic living organisms (Tudor *et.al*, 2006). Heavy metals can be transferred and increased through the food chain (Menesveta, 1976). The contamination of Cadmium (Cd) in Mae Sot district, Tak province, was reported in 2004 by a group of academics and standards, Bureau of Environmental Remediation, Department of Primary Industries and Mines in Thailand. The high concentration of Cd (49 to 430 mg / kg) was found both in colluvial plain soil and alluvial plain soil (37 to 90 mg / kg). There are higher than the standard level for living and agriculture soil standard (37 mg / kg). The Cd contamination is below the standard value in areas of distances of 4 km from zinc mine. Most areas in Mae Sot district are for agricultural land and living population. That is the reason why, there are many reports of Cd exposure in the population and agricultural products from Mae Sot district.

Cadmium is a highly toxic metal and released into groundwater 8,000 tons/year (Masae, 1997). Moreover, Cd exposure may cause of many symptoms such as renal damage (Satarug and Moore, 2004), osteoporosis (Staessen *et al*., 1999; Järup and Alfvén, 2004), prostate and renal cancer (Waalkes *et al*., 1991a, 1991b) and negative bone effect (Staessen *et al*., 1999; Järup and Alfvén, 2004). The Cd toxicity leads to the attempts of Cd removal from the environment. The conventional physical and chemical treatments used for the removal of Cd from water is precipitation (Esalah *et al*., 2010), liquid-liquid extraction (Komjarova and Blust, 2006), flocculation (Amuda *et al*., 2006), ion exchange

(Bai and Bartkiewicz, 2009), coagulation (Huang *et al*., 2009), absorption (Essiett *et al*., 2011) and membrane processes (Mortaheb *et al*., 2009). However, those applications are not widely used because of the high cost of management, needed technicians for running, and isn't effective in low level of metal concentration and economic constraints (Sombatjinda, 2004). Considering the weakness points of physical and chemical treatments, biological treatment may offer an alternative option of Cd removal. Therefore, plant and bacteria are used for remediation.

Effect of Cd occurs on every living organism in the food chain. The effects of Cd on bacteria include a decrease their number combined with changes in their metabolism and community structures (Wei *et al*., 2008). However, there are some tolerant Cd species that can resist and detoxify Cd such as *Acidiphilium symbioticum* (Chakravarty and Banerjee, 2012), *Bacillus*, *Psudomonas* and *Streptomyces* (Vijayaraghavan and Yum, 2008). Active efflux, extracellular complexation, extracellular precipitation, crystallization, intracellular complexation and transformation are the mechanisms which resistant bacteria have to resist and detoxify Cd. Hence, biological treatment by microbes is an interesting option. This method is effective, no problems for large surface area and no toxic sludge generation (Volensky, 2007) and low cost running (Krishnani *et al*., 2008; Ahluwalia and Goyal, 2007).

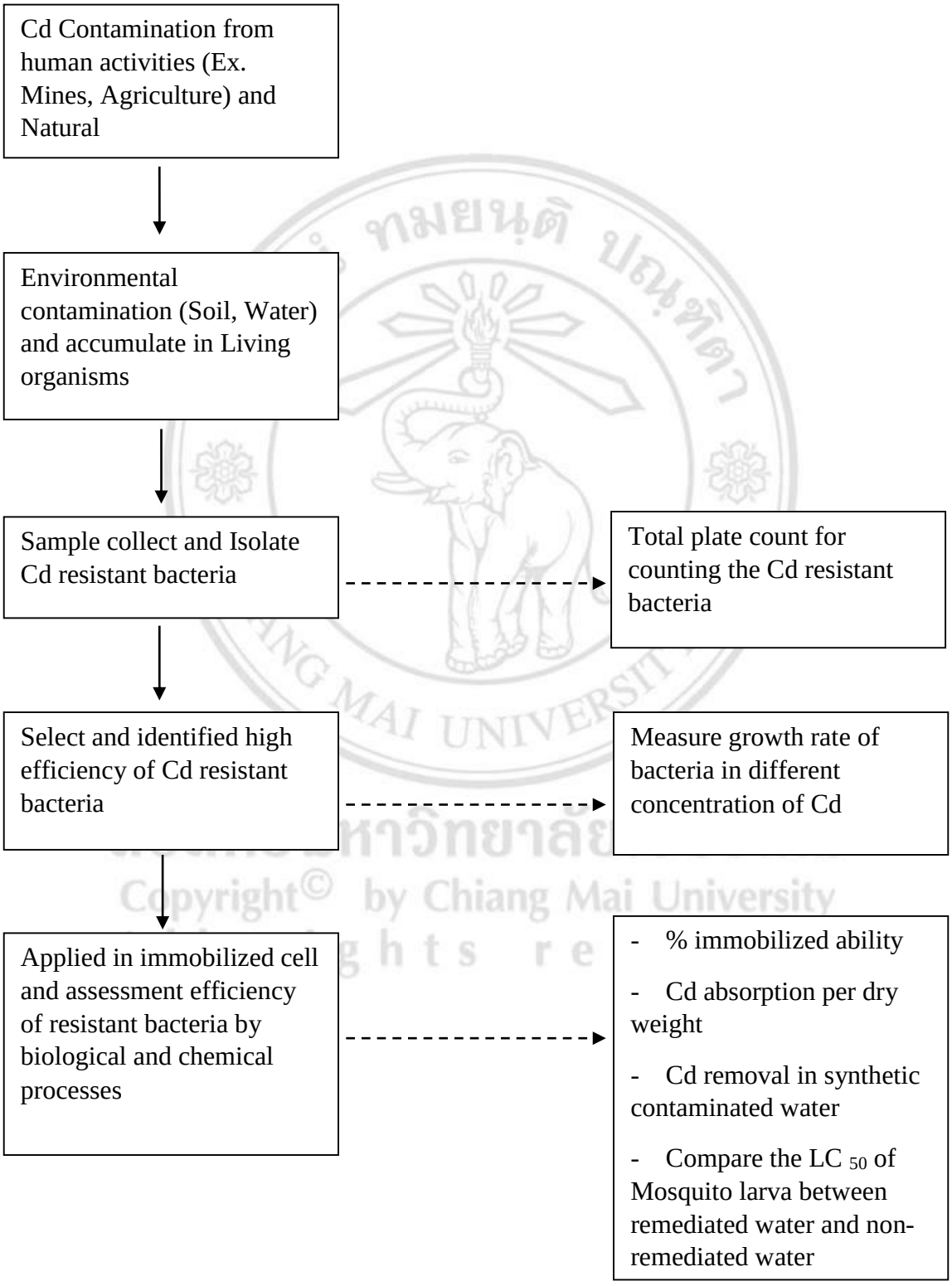
Considering the risk of the Cd contamination in the environment, the toxicity assessment of Cd is important. Nowadays, the ecological toxicity assessment is popular. The distributed organism in sample sites will be used for the assessment incorporated with chemical methods. This method is simple, low cost and more accurate than assessment with exclusively chemical method only (Iwai, 2005).

In this study, we determined the problem by observations, literature review and suggested with the villagers at Mae Sot District, Tak Province, Thailand. A high level of Cd was found in ground water, soil and agricultural products (National Research Center for Environment and Hazardous Waste Management, 2005). Moreover, some evidences of Cd toxicity symptoms were observed in villagers (Satarug *et al*., 2013).

The aims of this research are isolated and characterized the Cd resistant bacteria found in Cd contaminated soil from Mae Sot District, Tak Province, to develop a Cd

treatment model by using the immobilized cells and to assess the possibility of applying this model in Cd contaminated areas in the future.

1.2 Conceptual framework



1.3 Scopes of the study

In this work, Cd resistant bacteria will be isolated from the soil sample collected at Mae Sot district. Sampling sites will be selected according to by the high Cd contamination area report (Simmon *et.al*, 2004). The selected bacterial isolates will be developed in form of immobilize cell and measuring the ability of this immobilized bacterial remediation model.

1.4 Research Objectives

1. To isolate the Cd resistant bacteria by screening from Cd contamination soil sample collected from Mae Sot District, Tak Province, Thailand.

2. To select the high Cd removal and high immobilized ability bacterial strain for development bacterial treatment model.

3. To measure the efficiency of bacterial treatment by using chemical and biological toxicity assessment.