CHAPTER 1

INTRODUCTION

Metals are introduced into the environment during mining and refining of ores and from other sources, such as the combustion of fossil fuels, industrial processes, spraying of pesticides, and disposal of industrial and domestic wastes. However, metals have been mined and extensively used by human being. The rapid growth of industry and increases of domestic activities have caused a concomitant increase in the quantities of metal being released to the environmental. Natural recycling of some metals in biogeochemical cycles has been disrupted current entering of the huge contamination of metals and pollutants.

Similar to other countries including Thailand, arsenic (As)* is ranked among top 20 hazardous substances classified by Agency for Toxic Substances and Disease Registry (ATSDR) and US Environmental Protection Agency (USEPA). In addition to its natural occurrence in minerals, Arsenic is relatively abundant in the environment from a variety of anthropogenic sources. Physico-chemical methods, i. e., coagulation, adsorption, ion exchange and reverse osmosis, are available for removing of arsenic but they are quite expensive and still unsuitable for application on an industrial scale. Biological methods, the alternative treatments, may be able to make arsenic removal technology more effectively and possibly. Emphasized on certain groups of microorganisms, i. e., bacteria and fungi, would be used as the target organisms by their versatility and genetic to manipulation (Gadd, 1990; Brierley, Brierley and Davidson, 1989).

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* Abbreviation and symbols of any term used in the text was shown in ABBREVIATION, page xvi.

Besides, there is an increasing interest in the potentially biotechnological applications of bacterial sulfate reduction for bioprecipitation of toxic metals from aqueous waste. Soluble arsenic can be precipitated as arsenic sulfide,i.e. arsenic trisulfide (As_2S_3), iron sulfarsenide (FeAsS) and arsenous sulfide (AsS) by sulfate-reducing bacteria or SRB. (Rittle,Drever and Colberg, 1995; Uhrie et al.,1996; Adam, Pickett and Nilsen, 1999). ***Desulfotomaculum auripigmentum***, one of this group, is capable of arsenic precipitation as arsenic trisulfide (As_2S_3). The product, As_2O_3 , by this organism which resulted from its reduction of As(V) to As (III) and S(VI) to S(-II) was investigated (Newman et al., 1997 and Newman, Beveridge and Morel, 1997).

In the southern part of Thailand, at Amphor Ron Phibun, Changwat Nakhon Si Thammarat, arsenic has contaminated from mining and caused serious health problems in the community since 1987. The cost and benefit of remediation is uncertain and very expensive. The studies have focused on the reduction of arsenic concentration in the environment, soil and water of the area, by both physico-chemical and biological approaches, i.e., chemical precipitation and arsenic accumulation by certain kinds of both terrestial and aquatic plants and algae. The present study of the occurrence of arsenic-resistant bacterial isolates was conducted to define further the biologically arsenic precipitation of the selected bacterial isolates in Thailand. Although the results might indicate that the selected bacterial isolates in this study seems to be possibly applied in the remediation of arsenic contamination, but it is too early to do that, because the advanced researches should be needed more extensively.

Hopefully, the knowledge of this study may assist in the development of criteria for environmental management and bioremediation related to arsenic compounds.

1.1 OBJECTIVES

The objectives of the study were:

i) To perform the isolation, screening and selection of pure cultures of arsenic-resistant bacteria isolates;

ii) to investigate the capability of arsenic precipitation as arsenic sulfide forms in the arsenic-resistant bacterial isolates;

iii) to examine the effect of pH and temperature on growth and precipitation in sulfide forms of the selected bacterial isolates; and

iv) to investigate the precipitation capability of arsenic removal by the selected bacteria isolates.

1.2 SCOPES OF THE STUDY

In this thesis, arsenic-resistant bacteria were isolated from at least fifty samples collected from different sites. They were tested for highest concentration of arsenic resistance. Selected bacterial strains in pure cultures that were able to precipitate arsenic were further studied, i.e., effects of pH and temperature on the growth and precipitation. Capability of arsenic precipitation of the selected strains was tested under the optimal condition.

1.3 PLACE

Multidisplinary laboratory, Room 305-306, Department of General Science, Faculty of Science, Chulalongkorn University.

1.4 ANTICIPATED BENEFITS

This study may provide available results for some applications as following:

i) The use of the selected bacterial strains in arsenic removal by precipitation could be an alternative and benefit way for bioprecipitation;

ii) The selected bacterial strains could be used and applied to other treatment systems effectively;

iii) The advanced researches may be done to develop higher yields of arsenic precipitation by genetic engineering or modification of pilot scale or others; and

iv) Gaining more information concerning development of remediation technology which may be suitable to be used in Thailand was performed.

1.5 COMPONENT OT THE THESIS

This thesis comprises five chapters including this introduction. Chapter 2 gives literature survey concerning arsenic (sources, physical and chemical properties, uses and toxicity), physico-chemical methods of arsenic removal, arsenic resistance in some organism (arsenic-resistant microorganisms and mechanisms of arsenic resistance in microorganisms), utilization of arsenic by some bacteria (arsenic acts as electron acceptor in

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bacteria and biochemical model for arsenic respiration), and biological methods of arsenic removal. In Chapter 3, materials and methods were shown. The results could be found in Chapter 4 and the Chapter 5 is the discussion and conclusion.

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