CHAPTER I

INTRODUCTION

In Thailand, the evidences of heavy metal contamination in the environment have been found frequently, e.g., lead poisoning, arsenic poisoning and etc. Similar to other countries, those metals that are increased both in uses i.e., for industrial or agricultural purposes, and releasing into the environment by man-made seems to be more serious than natural phenomenon (Albright et. al., 1972 and Brener, 1974). However, removal of those metal ions (copper, Cu^{*}, is included) from industrial wastewater and drinking water by physico-chemical methods, i.e., ion exchange, reverse osmosis, evaporation and precipitation, or even by conventionally biological treatments, i.e., aerobic and anaerobic technologies or the combination, are shown to be expensive, difficult to operate and not effective because some methods may produce unattractively hazardous waste which more expensive treatment is needed (Brierly, Brierly and Davidson, 1989).

Alternatively, special methods of biological treatment of low amount of heavy metal ions in wastewater is technically more effective and less cost than physico-chemical treatment (Bihop and Jaworski, 1988). It has been known that some bacteria strains can accumulate or be

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* The abbreviations used were shown alphabetically on page vii.

resistant to heavy metal ion(s), e.g., ***Bacillus* sp.** (Hutchin et. al., 1986) and ***Zoogloea* sp.** (Gadd, 1992) were able to uptake Cu, i.e., 15.2% and 34% dry weights, respectively. Bacteria have been received more attention in removal of heavy metals from wastewater due to their resistance capability. They can reduce certain amounts of heavy metals from wastewater efficiency, high quantity and reuse. It is believed that at least five mechanisms used by bacteria to remove heavy metal ions from solution, i.e., volatilization, extracellular precipitation, binding to cell walls, intracellular accumulation and binding to extracellular polysaccharide or exopolysaccharide, EPS, (Brierly, Brierly and Davidson, 1989). Certain bacterial strains are highly resistant to Cu (Horitsu et. al., 1978) by producing of EPS. The component is composed of uronic acid and sugar that contain hydroxyl and carboxyl groups. Those groups confer a net negative charge on EPS (Gressey and Jang, 1989). Bacterial exopolysaccharides act as natural chelators and also reduce metal toxicity in high efficiency. Otherwise, they are employing as thickening agents or exopolymers that are the subjects of much researches and various reviews (Ferroni and Boadi, 1990; Gadd, 1992; Kuhn and Pfister, 1989; Norberg and Persson, 1983). In activated sludge, ***Zoogloea ramigera*** was important in floc formation because of there extensively exopolysaccharide production (Sterritt and Lester, 1986). The exopolysaccharide ride of ***Z. ramigera*** has metal-binding property and removed approximately 3 millimole (mmol) Cu / < 1 gram dry weight / liter, g/L, (Norberg and Rydin, 1984).

In Thailand, some researches in the removal of soluble heavy metal ions by physico-chemical methods or by conventionally biological treatments were conducted. The study of certain Cu-resistant

bacterial strains isolated in Thailand, especially by EPS production, is still limited. Initially, this thesis was performed, i.e., isolation, screening and selection, growth conditions, resistance tests of Cu and other heavy metals by whole cells, crude EPS and cell without EPS, recovery of heavy metals and capability of regeneration. Two of 350 bacterial strains resistant to copper were selected and investigated the feasibility to remove soluble copper ions. The further studies or researches should be done to develope an appropriate technology of heavy metal removal to be used in Thailand.

1.1 OBJECTIVES

i) To isolate, screen and select copper-resistant bacterial strains in pure cultures;

ii) to examine the effects of pH and temperature on growth of the selected bacterial strains;

iii) to extract exopolysaccharide from the selected bacterial strains;

iv) to compare the adsorption capability between exopolysaccharide and living cells; and

v) to investigate the adsorption capability of copper removal by selected bacterial strains.

1.2 SCOPES OF STUDY

In this thesis, Cu-resistant bacteria were isolated from, at least, fifty soil, sludge and water samples collected from metal contaminated area or natural sources. Selected pure cultures of copper-resistant bacteria to future study such as exopolysaccharide production,

effect on growth factor, namely, pH and temperature and capability of copper adsorption.

1.3 ANTICIPATED BENEFITS

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

i) the primary data about removal capability of soluble copper by bacterial isolates;

ii) the application guideline of alternative method by using of those bacterial isolates for removal of copper in waste or drinking waters;

iii) the advanced researches may be done to develop higher yields and affinity to copper of exopolysaccharide by genetic engineering; and

iv) the research to develop new technology which is suitable to be used in Thailand.

1.4 COMPONENT OF THE THESIS

This thesis comprises five chapters including this introduction. Chapter 2 gives literature survey concerning copper, methods for metal removal, mechanisms used by microorganisms for copper-resistance, bacterial exopolysaccharide and application of microorganisms for metal accumulation. In Chapter 3, materials and methods. The results could be found in Chapter 4 and the Chapter 5 is the discussion and conclusion.