CHAPTER I

INTRODUCTION

1.1 Motivation

Industrialization in many regions has increased the discharge of industrial wastewater, especially those containing heavy metals. Heavy metals are used in large quantity as industrial raw materials for several types of industries such as automobile batteries, printing processes, matches and explosives etc. The uncontrolled release of such contaminants into water bodies or on land has resulted in many problems for both human health risks and ecosystems. Heavy metals such as copper, lead, cadmium, etc., are hazardous to the environment, and therefore, it is necessary that they are appropriately removed from the waste stream before being discharged into the environment. In fact, a total recycle of heavy metals is an ultimate goal that all industries should be aiming at. However, this might not be achieved in the near future due primarily to the limitation in available recovery technologies. Meantime, it is of primary importance that contaminated wastewater be properly treated before discharge. Heavy metal bearing effluents can be treated effectively by several methods. Conventional techniques for removing dissolved heavy metals include chemical precipitation, carbon adsorption, ion exchange, evaporation and membrane processes (Apiratikul, 2003). However, these technologies are only practical and cost-effective when applied to low strength wastes with heavy metal ion concentrations more than 100 ppm (Volesky, 1990). In other words, low strength heavy metal containing wastewaters generally cannot be treated successfully with such methods. Biosorption of heavy metals from aqueous solutions is a relatively new technology for the treatment of industrial wastewater (Volesky, 1990). Sorbent materials (biosorbents) derived from suitable biomass can be used for the effective removal and recovery of heavy metal ions from wastewater streams even at low concentrations. The major advantages of biosorption technology are its effectiveness in reducing the concentration of heavy metal ions to very low levels and the use of inexpensive biosorbent materials. Biosorption processes are particularly suitable for the treatment for wastewater streams containing dilute heavy metal ion concentrations, or when very low concentrations of heavy metals are required (Volesky, 1990). One of the most promising biosorbents is "algae" (Veglio and Beolchini, 1997). Different algal species often had

different sorption characteristics, and external factors such as pH, metal ion concentration, temperature, other metal ions, etc., were always found to influence the sorption (Kojima and Lee, 2001).

Caulerpa lentillifera is a marine green macroalga cultivated as food for animals and humans, and also commonly used to treat wastewater from shrimp farms. Due to its rapid growth rate, farmers often have trouble with the over populated biomass. Turning excess *Caulerpa lentillifera* into biosorbent could be viable answer to this problem.

Our previous works had focused on the biosorption of heavy metals by *Caulerpa, lentillifera* where various factors such as pH, particle size, concentration of algae and heavy metals were investigated (Sungkhum, 2002). The efficiency of various treatment techniques on the enhancement of the sorption capacities of *Caulerpa, lentillifera* was also examined (Suthiparinyanont, 2003). In addition, the competitive sorption using *Caulerpa lentilliferra* with multi-component heavy metal mixture aqueous solution (i.e. copper(II), cadmium(II), lead (II),and zinc(II)) was also analyzed (Apiratikul, 2003). However, all the previous works have not given details regarding the effect of initial heavy metal concentrations, biomass doses, sorption temperature, and also the shaking rate, on kinetics and equilibrium of the sorption processes. Therefore these become the main objectives of this present work. Still, copper, cadmium and lead are selected as modeled heavy metals employed in this study.

1.2 Objective

This work is set out to study kinetic parameters and isotherms for the biosorption of heavy metals by *Caulerpa lentillifera.*

1.3 Scopes of this work

1.3.1 Cu, Cd, and Pb are modeled heavy metals for the sorption experiments. The range of concentration for each heavy metal for this investigation is :

- Cu from 6.35 to 635 mg L^{-1}
- Cd from 11.24 to 1,124 mg L^{-1}
- Pb from 20.72 to 2,072 mg L^{-1}.

1.3.2 The effect of buffer on biosorption of such heavy metals is examined. The buffer of interest is CH_3COOH and CH_3COONH_4 and the investigation will cover the buffer range of 770.8 to 15,416 mg L^{-1}.

1.3.3 Study kinetic and isotherm with variable heavy metal concentration, biomass doses, shaking rate and temperature on biosorption by *Caulerpa lentillifera.* Each parameter will be investigated within the following range:

- biomass dose: 0.1-1 g
- shaking rate: 0-200 rpm
- temperature: 21-40 ^{O}C

1.3.4 Only batch experiment is carried out.

1.4 Benefits from this work

Establishments of the basic knowledge on the use of *Caulerpa lentillifera* in heavy metals sorption are significant for the future application of this technology. The results from this work will supplement the preceeding dataset obtained from the previous researchers in the laboratory which, not only will fulfill the current intellectual deficiency in the biosorption field, but will also help facilitate the design and scale up of the actual sorption unit.