CHAPTER I
INTRODUCTION

1.1 Motivations

For decades, dyes and pigments have been used for coloring in textile industry. Several types of dyes are available for the usage with various types of textile materials. Among these many types, "cationic dyes" or commonly known as basic dyes are widely used in acrylic, nylon, silk, and wool dyeing. In textile dyeing step, a large volume of dye-contaminated effluent is discharged, and it was estimated that 10-15% of the dyes is lost in the dye effluent (Zollinger, 1987). US EPA (1996) reported that 1,000 mg/l of dye was used in a typical dyebath and 100 mg/l of dye was left in the spent dyebath. The presence of dyes in the effluent at a very low concentration could be highly visible and undesirable (Nigam et al., 2000). The colored wastewater damages aesthetic nature and reduces the light penetration through the water surface, and also photosynthetic activity of aquatic organisms. They can cause long-term adverse effects in the aquatic environment (Kouba and Zhuang, 1994).

Textile dyes are relatively resistant to microbial degradation due to their complicated structures (Yesilada, 2002). In particular, due to the presence of metals in their structure, basic dyes are considered one of the most toxic (US EPA, 1996). Consequently, the removal of dyes from effluents is required. This is usually achieved through physio-chemical means (Robinson et al., 2001). The various treatment methods are oxidation using, for example, Fenton reagent (Pak and Chang, 1999) and ozone (Lin and Lin, 1993), adsorption using synthetic or natural adsorbents. Adsorption has been found to be superior to other techniques for wastewater treatment in terms of cost, simplicity of design, ease of operation and insensitivity to toxic substances (Garg et al., 2004). The use of natural materials for dye removal is advantageous as they are often available in large quantity. Examples of these materials are bagasse pith for adsorption of basic blue 69, basic red 22, acid red 114, acid blue 25 (McKay et al., 1987), banana pith for adsorption of wastewater containing basic violet (Namasivayam and Kanchana, 1992), palm-fruit bunch for adsorption of basic yellow, basic red and basic blue (Nassar and Magdy, 1997), wheat straw, corncobs and barley husks for adsorption of Cibacron Yellow C-2R, Cibacron Red C-2G, Cibacron Blue C-R, Remazol Black B, Remazol Red

RB (Robinson, 2002), duckweed for adsorption of methylene blue (Waranusantikul et al., 2003), and date pits for adsorption of methylene blue (Banat et al., 2003).

Algae division is an alternative biosorbent of growing interest. In many cases, algal cell walls consisting of proteins and carbohydrates (Crist et al., 1981) provides functional groups that could form bonds with cations such as metals and basic dyes. A macroalga *Caulerpa lentillifera* grows rapidly in rainfed agricultural areas and it is often required that farmers remove and dispose of this over-grown alga as an unwanted material. Turning this alga into an adsorbent for basic dyes is therefore presented as an alternative, low cost, management of the unwanted agricultural materials

1.2 Objective:

To investigate the adsorption characteristics and mechanisms of basic dyes in the synthetic wastewater using the dried green macroalga *Caulerpa lentillifera*.

Sub-objectives:

- To determine adsorption isotherms and adsorption kinetics of the biosorption of basic dyes.
- To compare the adsorption behavior between *Caulerpa lentillifera* and activated carbon.
- To characterize the biosorption in the continuous adsorption column system.
- To study the light absorption behavior of binary mixed dyes and the sorption of binary mixed dyes.

1.3 Scopes of the study:

- The modeled basic dyes investigated in this work included commercial dyes namely Astrazon® Blue FGRL, Astrazon® Red GTLN, Astrazon® Golden Yellow GL-E and methylene blue.
- The experiments were conducted at neutral pH (7±1) (except for the study of the effect of pH on the adsorption).
- The range of initial dye concentration was 20-1,800 mg l^{-1}.
- Only fixed-bed and down flow adsorption column were investigated in the continuous flow experiments.

1.4 Hypothesis

The biosorbent prepared from *Caulerpa lentillifera* could remove basic dyes from aqueous solution with high efficiency.

1.5 Research benefits

This research results contribute to the understanding of the sorption of basic dyes by natural biosorbent. This work provided the optimum sorption conditions in batch experiments and also the useful parameters in continuous flow experiments which can be used in the design of scale-up experiments or even for the actual wastewater treatment. Major benefits are not only the removal of basic dyes which are hazardous pollutant from aqueous solution, but also the alternative use of unwanted agricultural waste, *Caulerpa lentillifera*.