CHAPTER 1

INTRODUCTION

1.1 GENERAL

Water is the source of life and energy and man cannot subsist without water. Water resources are of critical importance to both natural ecosystem and human developments. Water has two dimensions that are closely linked—quantity and quality. Water quality is commonly defined by its physical, chemical, biological characteristics. Water has the central role in mediating global scale ecosystem processes, linking atmosphere, lithosphere and biosphere by moving substances between them and enabling chemical reactions to occur.

Aquatic ecosystems are under increasing stress due to the rapidly growing population technological development, urbanization and economic growth. Human activities are causing aquatic species to disappear at an alarming rate. The process of urbanization and the rapid increase in the population provides enormous pressure on the surrounding environment. An uncontrolled and unplanned urbanization may cause serious damage to the physical-social-economic environment.

Next to food, the second basic need of humans is ‘clothing’ which is obtained by the processing of natural and synthetic fibres through textile industry. Increased population and modern civilization has given higher
importance to clothing and this has lead to the blooming of textile sector in India. The majority of Indian textile industries are concentrated in the states of Tamilnadu, Punjab and Gujarat. Consequently, the water resource that plays a prime role in the processing of textiles is likely to be affected by the dyes and chemicals used in this process and let out as effluents.

Based on the quality of water with reference to the pollution, industries have been classified into three categories namely orange, red and green. Many textile processing units in Tamilnadu use a number of unclassified chemicals that can be from Red List group which are harmful and highly hazardous.

Pollution is contamination of the natural environment with harmful substances often as a consequence of human activities. Water pollution is the introduction of chemical, biological and physical matter into a large bodies of water that eventually corrupt the quality of life that lives in and consumes such contaminated water.

Worldwide, millions of people are suffering with shortage of fresh and clean drinking water. The function and properties affecting the quality of water is of vital concern for humanity, since it is directly linked with human welfare.

India having one of the most degraded environments among the countries in the world and it is paying heavily through problems of health and economic growth. Environmental degradation is the result of the dynamic interplay of socio-economic and industrial technological activities. Hence, the environmental effects due to water pollution by various sectors are of growing concern to researchers of various fields.
Over last few decades, society has become increasingly sensitive towards the protection of the environment. Due to this problem, mankind now-a-days is seriously concerned about the potential adverse effects of the chemical industry on the environment. The response in some parts of the world has been much faster and more intense than in others. Though the colour manufacturing industry represents a relatively small part of the overall chemical industry, the intensity of its adverse effect is manifold when it gets mixed up with the water resources. Contamination of water bodies by textile, paint, solvent, pulp, paper, printing, food and cosmetic industrial effluents is considered a worldwide environmental problem. Major pollutants include a variety of organic and inorganic chemicals such as heavy metals and industrial compounds. It is well known that 70-80% of the illness in developing countries is related to water contamination, particularly of women and children (WHO/UNICEF 2000).

A major source for the release of colour into the environment is associated with the incomplete exhaustion of dyes during dyeing process. Reduction of the amount of residual dye in textile effluent has thus become a major concern in recent years. Dyes contain delocalized electron systems with conjugated double bonds as chromophores and electron withdrawing or electron donating substituents as auxochromes. Usual chromophores are –C≡C–, -C≡N, -C=O, -N=N-, NO$_2$ and quinoid rings and auxochromes are –NH$_3$, -COOH, -SO$_3$H and –OH.
intermediate degradation products are mutagenic and may become carcinogenic in anaerobic conditions.

In textile industry wastewater is changeable in terms of amount and composition. The first reason of pollutants in the wastewater is the impurity originated from fibres. The second is the chemical materials that are used in processes. A huge amount of dye, carriers, chrome, its derivations and sulphur are found in wastewater.

Price competition, demand for high quality products, new and innovative products that are highly durable put further pressure to the textile industry and eventually they have to use more dosage of chemicals and switch over to new chemicals to suit the market demand. This results in the complication in the wastewater that is discharged, ultimately.

Infact, textile industries consume two third of the dyes manufactured. During textile processing, upto 50% of the dyes are lost after the dyeing process and about 10-15% of them are discharged in the effluents (Yang et al 2009). The textile manufacturing industry alone discharges about 1,46,000 tonnes of dyes per year along with its wastewater which ultimately finds its way into the environment (Onal 2006). Hence, there is a need for continuous study and research on the wastewater treatment to find new methods of treatment in order to sustain this industry, and protect the environment as well.

With regard to controlling of water pollution, a number of methods and measures have been developed. Water treatment process selection is a complex task involving the consideration of many factors which include available space for the construction of treatment facilities, reliability of process equipment, waste disposal constrains, desired finished water quality, capital and operating costs, greater energy consumption etc. They are also of
varying degree of success in controlling water pollution. But, the matter consequently is the urgent requirement for development of innovative, but low cost processes, by which dye molecules can be removed. Hence, this research is interested in removal of textile dyes from aqueous solution by activated carbon and polymer coated saw dust composites of *Euphorbia Tirucalli* L wood.

1.2 **ADSORPTION AND ACTIVATED CARBON**

Adsorption is one of the most reliable and versatile physical treatment. Its effectiveness and economic sustainability are strictly related to the type of adsorbent. Adsorption is a process by which the dye molecules from the bulk of solution get transferred or accumulated onto the external and internal surfaces of the adsorbent.

The adsorption method is widely used for the removal of synthetic dyes from the industrial effluents (Calvet et al. 2009, Liang et al. 2010). The term adsorption was proposed by Bois-Reymond but introduced into the literature pertaining to this field by Kayser (Dabrowski 2001). Removal of dyes by adsorption technologies is regarded as one of the competitive methods because of its high efficiency, economic feasibility and simplicity of design/operation (Chen et al. 2010, Rafatullah et al. 2010).

Activated carbon is the most widely used adsorbent for the removal of pollutants from wastewater because of its high uptake capacity. Even though, its commercial applications are sometimes restricted due to its high cost and lack of reliable method for regeneration.

There is a growing need to find locally available, low cost and effective materials for the removal of dyes. Low cost alternative adsorbents can be prepared from wide variety of raw materials which are abundant and
cheap, that have high organic content and low inorganic content which can be easily activated (Moreno-Castilla and Rivera-Utrilla 2001).

A number of materials inclusive of agricultural wastes (apricot stones, maize, corn, sugarcane bagasse, and peanuts), industrial and municipal wastes (fly ash, red mud, and sewage sludge), zeolites, activated alumina, silica gel, biosorbents (chitosan, peat, biomass, orange peel) have been extensively investigated as adsorbents in pollution control.

But, the researcher feels that adsorptions using polymer composite is the more useful technique for the dye removal due to its high adsorption capacity, high abrasion resistance and more mechanical strength. Yet, studies on these lines are scanty and unsustantive.

1.3 ADSORPTION AND POLYMER COATED SAW DUST COMPOSITE

A great interest has been recently given to the adsorption of dyes from effluent using saw dust and polymer. Adsorption process by using polymer coated saw dust is one of the most efficient methods used for the removal of contaminants from wastewater. Polymer coated saw dust composite is a more economic alternative adsorbent and has been developed from various wood species and polymer. Adsorption of dyes by polymer coated saw dust is one of the most promising technologies involved in the removal of dyes from wastewater and there is growing research interest into the production of polymer coated saw dust composites.

In view of the environmental, ecological and health issues, it is necessary to provide an easy, feasible, economically reliable method for the removal of dyes. Hence, adsorption by locally available, alternative cost effective adsorbents have been explored and exploited for the removal of dyes.
1.4 SCOPE OF THE PRESENT INVESTIGATION

During the past few decades, the developments of Indian industries have contributed to considerable economic growth but at the same time, it has given rise to environmental degradation. According to Central Pollution Control Board (CPCB), there are approximately a million known dyes and dye intermediates in India and out of which 5,000 are produced commercially. Yet, they pose a formidable threat to the environment. Hence, prevention of water pollution is given top priority to protect the environment which is being supported by both government and individual citizens. To check the pollution of water various rules and regulations under various acts are imposed pertaining to different sectors of human activity particularly on industrial sector.

All industries have been brought under the strict guidelines of the Central Pollution Control Board (CPCB), but still the condition of the environment is not satisfactory. Pollution is a sign of inefficiency in monitoring the industrial production and it affects the environment to a great extent.

The textile industry plays a vital role in contributing to the Indian economy and it represents more than 10% of country’s revenue generation. On the other hand, in the last few decades, dye removal from textile effluents has been given great attention and researchers and scientists are concerned because of its potential toxicity and aesthetic inconvenience of dyes. The researcher feels that technologies based on polymer coated saw dust composites and activated carbons are among the best alternative method and that can be adopted ecologically friendly treatment processes.

The present investigation is undertaken to explore the feasibility of activated carbon and polymer coated saw dust composites prepared from *Euphobia Tirucalli L* wood saw dust for the removal of four categories of dyes.