CHAPTER 1

INTRODUCTION

1.1 GENERAL

Textile industry plays an important role in the industrial development of India and is the second largest sector of Indian economy, next to agriculture. There is an ever-increasing demand for fabric in the world due to population growth. More than 7,00,000 tonnes of ten thousand different synthetic dyes are produced and used for dyeing of fabric annually worldwide (Prakash 1996).

A large number of textiles mills have mushroomed in our country to meet the demand for fabric. These mills are located mainly in Gujarat, Maharashtra, Delhi, Tamilnadu and Karnataka. These mills consume large volumes of water for various processes. It is estimated that 100 to 200 liters of water is required for processing one kilogram of fabric. The wastewater of dyeing process is highly coloured by the release of unfixed dye. It is estimated that 10-15 per cent of the dye is lost during dyeing process (Jiantuan and Jiuhui 2003).

The textile dyeing wastewater contains dyes of various intense colours. The coloured wastewater of dyeing processes is aesthetically objectionable. Extremely high doses of colour can interrupt photosynthesis and lower the dissolved oxygen content of receiving water, which may lead to fish kills. Dyes having functional group of alkenes, aromatic, -C-N, -S=O-, -N=N- are responsible for colour development in wastewater.

1.2 DISTRIBUTION OF TEXTILE PROCESSING UNITS IN TAMILNADU

The textile processing units are distributed throughout several districts and are usually found in clusters of small sized units. However, there are some large-scale units also in existence. Ayyampet and Muthiyalpet near Kancheepuram are the places where cluster of silk dyeing units are located. Small and medium scale bleaching and dyeing units are located in the above mentioned places, generating about 1,32,000 KLD of wastewater. Colour of the textile wastewater may vary from day to day or even several times a day depending on the dye stuffs used in the dyeing processes as required by the customer. The total number of units in the state is about 2866. The distribution of textile processing units throughout Tamilnadu, India is furnished in Table 1.1.

1.3 DYES

A dye is a material that absorbs strongly in the visible region and is capable of adhering to the surface of a fabric or any material to be dyed. Generally dyes are classified in two ways. One is based on application and the other one is based on chemical structure. Based on application they are classified as acid dyes, basic dyes, azoic dyes, direct dyes, reactive dyes, vat dyes, sulphur dyes and disperse dyes. Generally acid and basic dyes are used in silk dyeing processes. Acid dyes are sub classified into leveling dyes, milling dyes and super milling dyes. Based on chemical structure, dyes are classified into nitro, nitroso, monoazo, azo, disazo, azine, quinoline, ketoneimine, anthroquinone, di-phenylmethane, triphenylmethane, methine, acricline, xanthene, induline, oxazine, thiazine and thiazole groups.

Table 1.1 Distribution of Textile Processing Units in Tamilnadu

(Source :Industries Commissioner and Director of Industries and Commerce, Chennai (2000), India)

S.No.	Name of the District	Numbers of units in wool, silk and synthetic fibre textiles
1.	Chennai	25
2.	Kancheepuram	129
3.	Dharmapuri	386
4.	Vellore	130
5.	Cuddalore	**7**
6.	Karur	**7**
7.	Dindugal	53
8.	Salem	685
9.	Erode	217
10	Coimbatore	122

1.4 TREATMENT OF TEXTILE PROCESSING WATER

Textile dyeing wastewaters are extremely variable in composition due to large number of dyes and chemicals used in dyeing process. The disposal of wastewater causes significant environmental problems. Indeed these effluents are toxic and mostly non- biodegradable (Solpan et al 2003). Since the dye molecules are large structural polymers and hence it is very difficult to breakdown physically, chemically, biologically or by combination of these methods, but partial decomposition of dyes leads to an even more potentially harmful and toxic aromatic compound (Senthilkumar et al 2005). Hence the optimizing procedures for the treatment of dyeing wastewater become complex. Pretreatment process using chemical coagulants, oxidizing and reducing agents have offered varying degrees of success on the decolourisation of dyes. The required dosages are often too high to be economically feasible. Aerobic biological degradation is inadequate, since most dyes are resistant to biodegradation. This is due to the aromatic nuclei often included in the dye molecule. It becomes difficult to apply this technique, since the dyeing wastewaters require longer periods of acclimation and is slow to degrade (Uygur 1997). The anaerobic and aerobic sequence produced significantly greater colour reduction than aerobic treatment alone (Nandy et al 1998). Hence the conventional treatment methods employing various combination of physical, chemical or biological process are insufficient and ineffective for reusing the textile dyeing wastewater. All oxidative and photo oxidative advanced treatment techniques have both advantages and disadvantages. Thus the removal of unfixed dye from dying wastewater is a major environmental problem of the textile dyeing industry.

1.5 LIQUID-LIQUID EXTRACTION AND LIQUID MEMBRANE PROCESSES

Liquid-liquid extraction also known as solvent extraction is a mass transfer operation in which a liquid solution (the feed) is contacted with an immiscible liquid (solvent) that exhibits preferential affinity or selectivity towards one or more of the components in the feed. This is a well established technique for metals ions recovery from aqueous solution, being highly selective and an effective enrichment method based on the right choice of an appropriate extractant molecule for the desired constituent.

Membrane technology is one of the most important topics in today’s research. Liquid membranes (LM) have shown their tremendous potential and various configurations of LMs are being researched for different operations (Alguacil et al 2000). Liquid membranes have been developed and studied for the separation of toxic and valuable metals from their low concentration sources. This technique is based on extractive permeation process and has been implemented, using extracting agents as carriers for facilitated transport. Organic compounds have been employed as carriers both for organic compounds and metal ions. Liquid membranes have received considerable attention due to characteristics such as ease of operation, low energy consumption, high selectivity and high extraction capacity factors (Osman 2005).

1.6 SCOPE AND OBJECTIVES OF THE STUDY

A major source of release of colour into the environment is associated with the incomplete exhaustion of dyes from an aqueous dyeing process and the need to remove the residual dye in textile effluent has thus become a major concern in recent years. Hence it was felt that to develop and investigate liquid-liquid extraction and liquid membrane processes for removal and recovery of acid and basic silk dyes from textile wastewater by using cationic and anionic carriers such as Tri-n-butyl phosphate (TBP) and Di-(2-ethyl hexyl phosphoric acid) (D2EHPA).

Studies on recovery of metal ions by liquid membranes are extensive but that of organics are relatively less. So far, no work has been reported on transport of acid and basic dyes from textile wastewater using liquid membranes. In the present study, effluents from silk dyeing units containing acid and basic dyes have been analysed and evaluated in terms of characteristics and then transport of dyes from effluents through liquid membranes have been investigated.

The laboratory studies attempt to evaluate and optimize the liquid-liquid extraction, bulk liquid membrane (BLM) and supported Liquid membrane (SLM) system for effluents generated by silk dyeing units.

The main objectives of the present study are

1. To develop liquid-liquid extraction, bulk liquid membrane and supported liquid membrane processes for acidic and basic silk dyes recovery using the carriers TBP and D2EHPA and suitable diluent.

2. To optimize the operational parameters such as pH of the feed, stripping reagent concentration, aqueous/solvent ratio, carrier/diluent ratio, equilibration time and dye initial concentration in liquid-liquid extraction process.

3. To optimize the operational parameters such as pH of the feed, stripping reagent concentration, carrier/diluent ratio, equilibration time, mixing speed and dye initial concentration in liquid membrane processes.

4. To study the possibility of the reuse of solvent and liquid membrane.

5. To study the kinetic transport of dyes in liquid membrane processes and to evaluate mass transfer coefficient.

6. To test the developed methods for the removal and recovery of dyes from actual effluent.