CHAPTER 1
INTRODUCTION

Textile industry is one of the country’s largest industries earning a huge amount of foreign exchange and an easy bread winner even for penniless. The Indian Textile Industry has an overwhelming presence in the economic life of the country. Apart from providing one of the basic necessities of life, the textiles industry also plays a pivotal role through its contribution to industrial output, employment generation, and to emergence of auxiliary units. Currently, it contributes about 14 percent to industrial production, 4 percent to the GDP, and 17 percent to the country’s export earnings. It provides direct employment to over 35 million people and the second largest provider of employment after agriculture. Thus, the growth and all round development of this industry has a direct bearing on the improvement of the economy of the nation. The Indian textiles industry is extremely varied, with the hand-spun and hand woven sector at one end of the spectrum, and the capital intensive, sophisticated mill sector at the other. The decentralized power looms / hosiery and knitting sector form the largest section of the Textiles. The close linkage of the industry to agriculture and the ancient culture, and traditions of the country make the Indian textiles sector unique in comparison with the textiles industry of other countries. This also provides the industry with the capacity to produce a variety of products suitable to the different market segments, both within and outside the country (Annual Report of ministry of Textiles 2010 -11). At present textile industry is the top foreign exchange earning industry for India (Naik, 2001).

The textile units are scattered all over India; out of 21,076 units, Tamilnadu alone has 5285 units (Bal, 1999) and contributes well over one fourth of the country’s total textile manufacturing meant for domestic consumption as well as for exports.
Tirupur, the adjoining district of Coimbatore is well known for its hosiery and knitwear industries. Nearly every international knitwear brand in the world has a strong production share from Tirupur. It is known for its hosiery exports and provides employment for about 3,00,000 people. The annual exports of these items are worth over US $ 550 million (Thomson et al., 1999). It is the centre of Tamilnadu’s cotton knitwear industry and successfully markets its products in India and overseas.

Coimbatore is a major industrial city in Tamilnadu. There are about 450 foundries, 300 motor manufacturing units, 200 wet grinder manufacturing units, about 300 brick kilns and 210 textile dyeing and bleaching units in operation. In Coimbatore, as in other Indian cities, there is no separate zone for industrial/commercial activities. Therefore, some industries are located in residential areas. Urbanization and industrialization result in severe pollution problems, which is a major health concern. Coimbatore District is world famous for its Textile products. Most of the dyeing units of Coimbatore are located on the banks of the Noyyal river at Selvapuram, Telungupalayam and Perur. These units adopt high temperature, high pressure dyeing method, processing of cotton yarn or fabric using various dyes and chemicals.

Textile and dyeing industries consume enormous amounts of water and generate almost equivalent quantum of wastewater during the process. The typical water usage varies in the range of 150-170 l kg\(^{-1}\) of product depending on the type of bleaching and dyeing operations (Kurian Joseph and Ranganathan, 1999). The textile industry involves processing or converting raw material into finished cloth employing various operations. It consumes large quantities of water and produces polluting waste effluents (Karthikeyan and Venkatamohan, 1999). Due to the nature of various chemical processing (Dyeing) of textiles, large volumes of waste water with
numerous pollutants are discharged into the water bodies which affect the aquatic ecosystem in number of ways such as depleting the dissolved oxygen content or settlement of suspended substances in anaerobic condition (Rajmohan and Karthikeyan:1989).

Much of the chemicals and acids used for processing are discharged as waste material, which ultimately leads to high pollution load in the effluents. Textile industrial effluent and treatment plant sludge’s contain a number of pollutants especially the toxic heavy metals, which are non-degradable. The hazardous pollutants should be reduced to acceptable levels before discharging the waste into the environment, otherwise they could pose threats to public health and/or affect the aesthetic quality of potable water (Someshwara Rao et al., 1993; Dhanya et al. 2005).

Most of the textile dyeing wastewater treatment plants presently adopts methods of chemical precipitation and subsequent coagulation for removing the pollutants. The Dye-house sludge, which is an inevitable waste from the textile dyeing wastewater treatment processes, is categorized under hazardous waste by statutory authorities, Hazardous Waste (Management & Handling) Rules 1989. The sludge that is generated during the treatment processes is openly dumped in the treatment yard awaiting suitable disposal method.

Any material that is discarded as useless and unwanted is considered solid waste. At the surface level, the disposal of solid waste may seem to be a very simple and mundane problem. In an age of microcomputers and space fight, it hardly seems possible that “garbage disposal” should present any difficulty. But it is a unique and multifaceted problem with many difficulties that make solid waste disposal a complex, technical and environmental problem of huge proportions for our modern industrial society. There are
hundreds of recent incidents on record that show illegal or improper disposal of industrial solid waste which has caused considerable harm to the public and to the environment. Many of these cases involve contamination of groundwater that was used for public water supply. (Nathanson 1986).

During the last 30 years, the Indian industrial sector has quadrupled in size. The main source of industrial solid waste generation which has profound impact on the environment is the chemical industry. There has been a significant increase in the number of tanneries and units manufacturing pesticides, drugs & pharmaceuticals, textiles, dyes, fertilizers, paint etc., which have a major potential for generating solid waste containing heavy metals, pesticides, complex aromatic compounds and other chemicals which are toxic to environment. According to the standards of World Health Organization (WHO), the metals of most immediate concern are chromium, copper, zinc, iron, mercury, nickel and lead.

As the amount of sludge produced by wastewater treatment plants increases, effective reuse and safe disposal of sludge becomes more important (Baskar et al., 2006). The conventional disposal methods like land filling and incineration may not be suitable because the leachate from the land filling sites and the residues from the incinerators induce secondary pollution. Moreover such disposal options are not economically viable. The sludge as such cannot be applied to fertile lands because of its chemical contents. So there is a growing need to find alternative solutions for textile sludge management.

The research and literature reviews in the recent years clearly note immense economical, social and environmental impacts created by the industrial wastes. Many developed countries have developed strategies and
mechanisms to reduce the landfill deposits of solid wastes. Landfilling of hazardous wastes have been recognized as a threat to the environment, especially due to its impact on ground water quality.

Solidification/stabilization treatment is used to treat hazardous wastes for disposal and in the remediation/site-restoration of contaminated land. Solidification/stabilization is also an increasingly popular technology for industrial properties re-development. The treated waste can often be left on-site and improve the soil for subsequent construction. This treatment involves mixing and binding reagent in the contaminated media or waste. The treatment protects human health and the environment by immobilizing contaminants within the treated material. Immobilization within the treated material prevents migration of the contaminants to human, animal and plant receptors.

In the last decade, the use of supplementary cementing material has become an integral part of high strength and high performance concrete mix design. These can be natural materials, by-products or industrial wastes. Some of the commonly used supplementary cementing materials are fly ash, silica fume, ground granulated blast furnace slag, quarry dust etc. The rice husk ash is also used as a partial replacement of cement in mortar and concrete. (Alireza et al 2010) The non-crystalline silica and high specific surface area of the rice husk ash are responsible for its high pozzolanic reactivity. There are studies (Sata et al 2007, Sekar 1989) which show that the rice husk ash could be a partial replacement for Portland cement. Asna et al., (2010) conducted a study to solidify the petroleum sludge using Portland cement and rice husk. The hazardous waste of metal plating industry was claimed to be responsible
Introduction

Characterization, Leachability studies and Utilization of dye-house Effluent Treatment Plant Sludge in hollow blocks

for effective solidification (Hills et al 2007). The effect of mix proportions of portland, pulverized fly ash and blast furnace slag and cement mortar contaminating chloride has been contemplated to ascertain the durability of the concrete (Benjamin et al, 2000). Maria et al., (2011) used the sewage sludge as a raw material in ceramic industry and found no negative influence on mechanical strength and absorption of soft mud bricks. Concrete with automotive shredder residues showed good compressive strength (Vito Alunno Rossetti et al., 2011). The feasibility of construction and demolition wastes, with ceramic industrial waste, were tested in concrete materials by Silva et al., (2010). Thermoplastic rejects and foundry wastes in concrete blocks provide good mechanical strength (Salah & Lama 2009)

Other industrial wastes have been used in building materials as partial replacement of cement, as partial replacement of clay in bricks (Sharma and Laxmi, 2002), Singh (2002). Saxena et al., (2002) studied the use of copper tailings up to 50% in replacement of clay for manufacturing of bricks. Kavas (2006) carried out a research to use boron waste in red mud brick production. He found that the mechanical performance of bricks is enhanced considerably due to the addition of boron waste. The recent research studies revealed that waste tea (Demir, 2006), waste ceramic tiles, cotton and limestone powder wastes were also used. Hilary Nath (2006) has produced block bricks from the primary sludge generated in the garment washing process. Hema Patel and Suneel Pandey (2009) concluded that the use of sludge in structural applications fulfilling the criteria of some of the classes (C to K) as per the BIS standards of the bricks up to a strength of 25 N/mm²

The textile ETP sludge has a high calcium and magnesium content, which comes mainly from coagulation process of ETP where chemicals such as magnesium
and lime are used. The presence of these binding earth metals in textile sludge indicate the potential use as a construction material.

The use of sludge as construction and building material not only converts waste into useful product but also eliminates disposal problem. The benefits of using sludge, as an additive in the process of block making, is the immobilization of heavy metals and destruction of pathogens.

The traditional construction materials such as concrete, bricks, hollow blocks, solid blocks, pavement blocks and tiles are being produced from the existing natural resources. This damages the environment due to continuous exploration and depletion of natural resources. Moreover, various toxic substances such as high concentration of carbon monoxide, oxides of sulphur, oxides of nitrogen, and suspended particulate matters are invariably emitted into the atmosphere during the manufacturing process of construction materials. The emission of toxic matters contaminates air, water, soil, flora, fauna and aquatic life, and thus influences human health as well as their living standard. Therefore, the issues related to environmental conservation have gained great importance in our society in recent years (Xue et al., 2011). For this reason, the civil and environmental engineers face the challenge of converting the industrial wastes to useful building and construction materials (Turgut et al., 2009).

Against this background, an investigation of textile dyeing ETP sludge of Together Textile Mills India Pvt. Ltd. was used for partial replacement of cement, quarry dust and sand in hollow block making. This Mill is located at 11° 0’ latitude and 77° 0’ longitudes at an elevation between 290 + m and 305 m above MSL, which is situated in Kanuvai village, at a distance of 14 km to the North-West direction from Coimbatore city, Tamilnadu, India. This textile unit comprises winding, dyeing, weaving, fabric finishing and garment making, exporting to countries like Europe,
Introduction

America and Japan. The processing plant has a capacity of producing 2000 Kg of dyed yarn per day throughout the year. Reactive dyes and eco-friendly auxiliary chemicals are being used in dying process and consume 210 KL water. Around 200 KLD of dyeing effluent generated from the wet processing plant.

Thus generated effluent is collected and subjected to primary treatment by using chemical coagulants like lime, ferrous sulphate and polyelectrolyte. The chemically treated water is then taken to secondary biological treatment for reduction of organic pollutants using suspended and fixed culture growth.

The biologically treated waste water is further passed through sand filters for the removal of finer suspended solids. The waste water with less 5 SDI (Silt density index) is taken to Reverse Osmosis (RO) plant for removal of TDS and 80% permeate is collected and recycled in dyeing unit. The reject of 20% from RO plant is crystallized through Mechanical evaporator and the dried salts are used for dyeing dark shades.

The sludge generated due to chemical coagulation is collected in a separate tank and dewatered through plate filter process. The solid cakes with around 65% moisture content are collected in Low Density Poly Ethylene (LDPE) bags and stored as per Hazardous Waste (Management, handling) Rules 1989 for further disposal in the storage shed of the unit (TTMIPL). Approximately 800 to 1000 kg of sludge is generated per day depending on shade used and operation cycle of dyeing process.

To have an environmentally safe and economically viable sludge management, a laboratory study was conducted to examine the possibility of using TTMIPL’s dye-house waste water treatment plant sludge as a concrete mixture in the making hollow blocks along with cement, sand, quarry dust and blue metal chips.
Introduction

The objective of the current study is to realize this possibility of having the sludge as a resource material for construction purpose. For this said purpose the waste water, treated water and sludge generated during the waste water treatment process of the textile unit, were tested for various physico-chemical parameters and toxic heavy metals.

An attempt has been made to utilize the textile sludge successfully in the making of concrete hollow blocks as a construction material. Thus made hollow blocks were subjected to the leachate study to refer to its conservancy.