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A CASE STUDY ON -TEXTILE INDUSTRIAL PROCESS, CHARACTERIZATION AND IMPACTS OF TEXTILE EFFLUENT

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ABSTRACT

This paper presents water pollution is the introduction into fresh or ocean waters of chemical, physical, or biological material that degrades the quality of the water and affects the organisms living in it. This process ranges from simple addition of dissolved or suspended solids to discharge the most insidious and persistent toxic pollutants such as pesticides, heavy metals, and non degradable, bio accumulative, chemical compounds. Water pollution is caused due to Mining, Agricultural Wastes and Industrial affluent such as paint, dying units etc. In textile production, opportunities exist for the release of potentially hazardous compounds into the ecosystem at various stages of the operation. These pollutants are produced in an effort to improve human standard of living and fashion but ironically, their unplanned intrusion into the environment can reverse the same standard of living by impacting negatively on the environment. Hence this present case study is placed in this context to examine the textile pollutants and their intensity on rural environment with respect to the socio economic and demographic background. This case study has captured all available data and understood that while a lot has been done to reduce pollution load in water bodies, more work needs to be done both in terms of policy and implementation.

KEYWORDS: Water Pollution, Textile Industry, Effluent Characteristics, Environmental Impacts.

The degradation of the environment due to the discharge of polluting wastewater from industrial sources is a real problem in several countries. This situation is even worse in developing countries like India where little or no treatment is carried out before the discharge 1-3. In spite of the many steps taken to maintain and improve the quality of surface and groundwater, the quantities of wastewater generated by these industries continue to increase and municipalities and industries continue to increase and municipalities and industries are confronted with an urgent need to develop safe and feasible alternative practices for wastewater management.

Textile industries are large industrial consumers of water as well as producers of wastewater. Increased demand for textile products, leads to increase in the generation of textile wastewater, which makes the textile industry as a main sources of severe pollution problems worldwide. The process of adding colour to the fibers is known as dyeing which normally requires large volumes of water not only in the dye bath, but also during the rinsing step. The process of dyeing involves the use of different chemicals like salts, metals, surfactants, sulphide and formaldehyde. There are more than 8,000 chemical products associated with the dyeing process and over 1,00,000 commercially available dyes exist with over 7×105 metric tons of dyestuff produced annually. nearly 1,000-3,000 m^3 of water is let out after processing about 12-20 tones of textiles per day. These effluents are rich in dyes and chemicals, some of which are non-biodegradable and carcinogenic and pose a major threat to health and the environment if not properly treated.

Wastewater generated in different production steps of a textile mill have high pH, temperature, detergents, oil, suspended and dissolved solids, dispersants, leveling agents, toxic and non-biodegradable matter, color and alkalinity. Important pollutants in textile effluent are mainly recalcitrant organics, color, toxicants and surfactants, chlorinated compounds (AOX). The textile wastewaters are characterized by extreme fluctuations in many parameters such as chemical oxygen demand (COD), Biochemical oxygen demand (BOD), pH and colour.

Color in the effluent is one of the most obvious indicators of water pollution and the discharge of highly colored synthetic dye effluents is aesthetically displeasing and can damage the receiving water body by impeding penetration of light. Dyes are recalcitrant molecules which are difficult to degrade biologically. Some of azo dyes are either toxic or mutagenic and carcinogenic. Azo dyes are designed to resist chemical and microbial attacks and to be stable in light and during washing.

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STATUS OF TEXTILE DYEING INDUSTRY

Textiles exports contribution is 16.63% of India's total exports earnings, and the country's share in the global textiles and apparel market is 3.9% and 3% respectively.

Status In India

The Indian Textiles 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 the export earnings of the country. Currently, it contributes about 14 percent to industrial production, 4 percent to the GDP, and 16.63 percent to the country's export earnings. It provides direct employment to over 35 million. The textiles sector is 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 close linkage of the industry to agriculture and the ancient culture and traditions of the country make the Indian textile sector unique in comparison with the textile industries of other countries.

Status In Tamil Nadu

Tamil Nadu is one of the major textile exporting regions in the country. The total number of units in Tamil Nadu is 2267. In places like Tiruppur (729), Erode (694), Coimbatore (60), Karur (487), Salem (254), Namakkal (270) and Kanchipuram (68) where the dyeing units are located in clusters, Common Effluent Treatment Plants (CETPs) and Individual Effluent Treatment Plants (IETPs) are provided for the treatment of wastewater. The three Tamil Nadu Pollution Control Board (TNPCB) insists that all the textile processing units provide zero liquid discharge system so as to avoid further contamination of fresh water resources and also to avoid ground water exploitation.

Textile Dyeing Wastewater

Textile dyeing industry is one of the major industries consuming large amount of water for its various operations and also discharges vast quantity of wastewater. The dyeing wastewater is strongly colored due to the utilization of various dyestuffs. Colour is imparted to the dyeing effluents by the spent dye bath and unfixed dyes wash off during the washing process. The discharge of effluent contaminates the ground water and the soil (CPCB 2000).

The textile industries use large volumes of water in their operations and therefore discharge large volume of wastewater into the environment, most of which is untreated. The wastewater contains a variety of chemicals from the various stages of process operations which include desizing, scouring, bleaching and dyeing.

The textile industry is distinguished by the raw material used and this determines the volume of the water required for production as well as the wastewater generated. The production covers raw cotton, raw wool and synthetic materials. The industries studied in the present report are raw cotton based. In this type of production, slashing, bleaching, mercerizing and dyeing are the major sources of the wastewater generated. The main products of the industries are super print, guarantee super print and minibrocade.

The industries consist of various World Health Organization (WHO), each of which carried out different operations and produces one type of specific wastewater. The wastewater contains acid used in desizing, dyeing bases like caustic soda used in scouring and mercerization. It also contains inorganic chlorine compounds and oxidants, e.g., hypochlorite of sodium, hydrogen peroxide and peracetic acid for bleaching and other oxidative applications. Organic compounds are also present, e.g., dyestuff, optical bleachers, finishing chemicals, starch and related synthetic polymers for sizing and thickening, surface active chemicals are used as wetting and dispersing agents and enzymes for desizing and degumming. Salts of heavy metals are also present, e.g. Copper and zinc, and iron (iii) chloride used as printing ingredients. All these wastes are passed into an effluent tank and then drained into a drainage system.

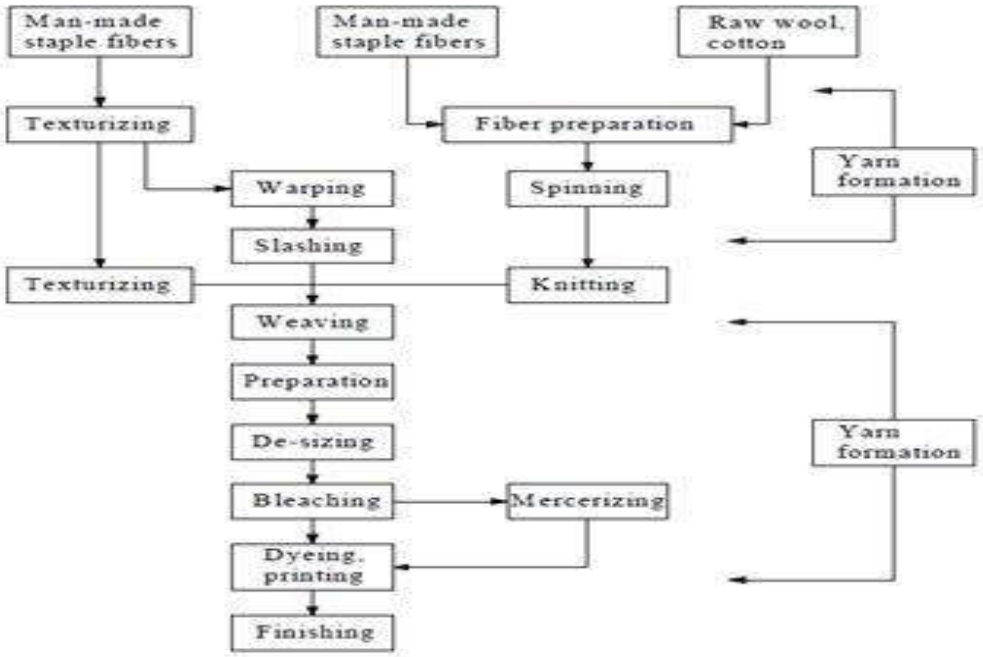

Figure 1: Textile dyeing process in a cotton mill

Average dyeing rate is about 90 percent which implies that about 10 percent is the residual dyeing rate in the finishing wastewater, which is the main reason of contamination. pH is another factor in the wastewater; it is usually in the alkaline range because of the alkali used during the finishing process.

The main pollutants in the liquid effluent are organic matters which mainly come from pre-treatment, dyeing and printing processes. Among all the pollutants in the wastewater, the most important components are COD (Chemical Oxygen Demand), BOD (Biological Oxygen Demand), pH, fats, oil, nitrogen, phosphorus, sulphate, and SS (Suspended solids). COD is one of the most significant pollutants in textile industry wastewater. In the pre-treatment processes of cotton, the average concentration of COD can reach 3000mg/L. In the dyeing/printing processes where the main pollutants are auxiliaries and the residual dyes, the concentration of COD is still as high as 1000mg/L. The Table-1 below represents specific pollutants from each process of textile and dyeing. And the concentration of some major pollutants is established in Table-2.

Table 1: Specific pollutant from different processes of textile and dyeing

Process	Compounds
Desizing	Size, enzymes, starch, waxes, ammonia.
Scouring	Disinfectants and insecticides residues, NaOH, surfactants, soap, fats, waxes, pectin, oils, sizes, anti-static agents, spent solvents, enzymes.
Bleaching	H_2O_2, AOX, sodium silicate or organic stabilizer, high pH.
Mercerizing	High pH, NaOH
Dying	Colour, metals, salts, surfactants, organic processing assistants, sulphide, acidity/alkalinity, formaldehyde.
Printing	Urea, solvents, colour, metals.
Finishing	Resins, waxes, chlorinated compounds, acetate, stearate, spent, solvents, softeners.

Table 2: The main pollutants and concentration from textile industry

Parameters	Values
pH	7.0 - 9.0
Biochemical oxygen demand (mg/L)	80 - 6,000
Chemical Oxygen Demand (mg/L)	150 – 12,000
Total Suspended Solids (mg/L)	15 – 8,000
Total Dissolved Solids (mg/L)	2,900 – 3,100
Chloride (mg/L)	1,000 – 1,600
Total Kjeldahl Nitrogen (mg/L)	70 – 80
Colour (Pt-Co)	50 – 2500

ENVIRONMENTAL PROBLEMS DUE TO DISCHARGE OF EFFLUENT

The discharge of effluent contaminates the ground water and the soil. Discharge of effluent into water bodies can upset the penetration of sunlight and biological activity in the water body. It affects photosynthesis of the phytoplankton, retarding the self-purification capacity of the water body. The dye is visible even at small concentrations and the transparency of streams would also be reduced. Colour being an indicator of pollution, hampers the use of water for certain industrial and recreational purposes. Colored industrial wastewaters are considered to be toxic. Most of the dyes are non-biodegradable and toxic. Azo dyes are considered to be carcinogenic. Many amino substituted azo dyes have been found to be mutagenic as well as carcinogenic. Sulphated azocompounds, which are used as dyes for textiles are reported to be xenobiotic in character.

ENVIRONMENTAL PROBLEMS

Tamilnadu's textile city, Tiruppur, which has nearly 729 dyeing units, is ranked topmost in terms of generating hazardous waste. The bleaching and dyeing units use large quantities of water, but most of the water used by these units is discharged as effluent, containing a variety of dye and chemical (acids, salts, wetting, agents, soaps, oil etc.). These units discharge nearly 90 MLD of effluents on land or into the Noyyal River, leading to contamination of the ground and surface water and soil in and around Tiruppur and downstream. A number of mechanical, thermal and chemical processes are involved in the textile industry and each process has a different impact on the environment. This impact starts with the use of pesticides during the cultivation of natural fibers. During the past few decades, there has been growing awareness of the environmental problems which have become an important issue in the textile trade, thanks to the various environmental and health legislations. Environmental policy is increasingly dictated by market forces.

CONCLUSION

The central pollution control board in coordinating with state board is planning to dump all dying effluents into deep sea through pipe line from Tirupur and working out the cost analysis. Our state government may possibly involve in feasible studies and may allot funds for the proposal which may a permanent solution for both the people of Tirupur area and manufacturers of garments. This case study has captured all available data and understood that while a lot has been done to reduce pollution load in water bodies, more work needs to be done both in terms of policy and implementation.

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