International Journal of Applied and Natural Sciences (IJANS)
ISSN (P): 2319–4014; ISSN (E): 2319–4022
Vol. 10, Issue 2, Jul–Dec 2021; 35–42

International Academy of Science, Engineering and Technology
Connecting Researchers; Nurturing Innovations

ENVIRONMENTAL CONCERNS RELATED TO TEXTILE INDUSTRY

Pooja & Sandeep Bains

Research Scholar, Department of Apparel and Textile science, College of Community Science, Punjab Agricultural University, Ludhiana, Punjab, India

ABSTRACT

The textile industry is one of the largest industries in the world, in context of its output or production and employment. The small and large scale operations in this sector contribute much to the economy, but also cause precarious effects on environment. A textile mill can cause pollution in the form of air pollution or water pollution or noise pollution. Among the three types water pollution is considered to be more hazardous as it is caused by the discharge of untreated effluents. Because of scarcity of land many textile industries are located nearby households. So any minor disaster will ultimately cause greater damage to large population near and far the unit. According to United Nations Environment Programme (UNEP, 2010) every year, 400-500 million tons of deadly chemicals like cyanide, sulphur and other radioactive substances are discharged into water.Other environmental issues of equal importance are air emission, notably Volatile Organic Compounds (VOC)'s and excessive noise or odor as well as workspace safety. Environmental pollution risk analysis and risk management in textile industry is vital in order to prevent chemical disaster which may lead to terrible results. It is also important to maintain production level at the same time. This paper aims to identify and analyze the pollution due textile industry and steps to reduce the risk which arises due to the pollution.

***KEYWORDS**: Textile Industry, Air Pollution, Water Pollution, Dyes, Pollutants, Control Measures*

Article History

***Received:** 11 Aug 2021 | **Revised:** 12 Aug 2021 | **Accepted:** 19 Aug 2021*

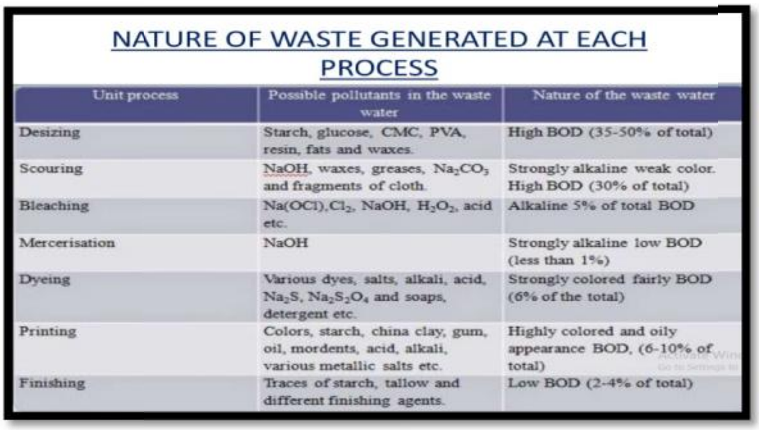
INTRODUCTION

TEXTILE INDUSTRY AND ITS IMPACT ON ENVIRONMENT

Any industrial activity causes pollution in one form or the other and so is the textile industry. This industry covers a wide spectrum of manufacturing activities and is diverse in terms of raw materials and techniques employed, chemicals used and the final products. The overview of the amounts of waste generated within the textile processes are summarized in Table 1. The impact of textile production on the environmental aspects such as air, water, land and human body must be considered. Recently, another dimension is introduced for the environment friendliness of the finished product (Chavan R B 2001).

The textile industry is responsible for wide variety of pollutants which are produced during all the stages in the processing of fibres and fabrics, which include liquid effluent, solid waste, hazardous waste, emissions to air and noise pollution. Also the consumption of energy is responsible for the same as the fuel used to provide this energy contributes to the pollution load.(Thapa P and Sodhi P 2014).

The textile industry has an important effect not only on the country's economy but on the economic and environmental quality of life as well. The textile industries are one of the major water consumers and discharge a considerable amount of effluent into the environment (Ding et al. 2010).Mechanical processes such as spinning and weaving consume less water while wet textile treatments consumes a great deal. The chemical (wet) treatment of textiles is responsible for the majority of water consumption i.e. 72 % (Juang et al. 1996). Water is necessary to prepare the fabric for dyeing, printing and finishing operations, intermediate washing / rinsing operations and cleaning of the machine. Huge amount of water (120–150 l/kg) is required for the wet processing of textile which varies from industry to industry depending on the type of fabric processed, the quality and quantity of fabric, processing sequence, and the source of water (Ghaly et al. 2014).The textile industries use a lot of water in their various stages of production (e.g., scouring, bleaching, mercerizing, dyeing, printing, and final finishing) and as a result they produce a lot of wastewater (Ramesh Babu et al. 2007). In general, the effluent released from these operations contains many contaminant loads, as many dyes and auxiliary chemicals are usedas part of the most complex phases of wet techniques (e.g., colouring and printing), which is typically released into water bodies half treated or untreated.These dyes, together with other chemicals, contribute significantly to the pollution of receiving water bodies. The colour is a substantial part of dye house effluent; it is the first contaminant in wastewater, and the presence of its amount in wastewater is highly visible and undesired (Gosavi and Sharma 2014).



NATURE OF WASTE GENERATED AT EACH PROCESS

Unit process	Possible pollutants in the waste water	Nature of the waste water
Desizing	Starch, glucose, CMC, PVA, resin, fats and waxes.	High BOD (35-50% of total)
Scouring	NaOH, waxes, greases, Na_2CO_3 and fragments of cloth.	Strongly alkaline weak color. High BOD (30% of total)
Bleaching	Na(OCl),Cl_2, NaOH, H_2O_2, acid etc.	Alkaline 5% of total BOD
Mercerisation	NaOH	Strongly alkaline low BOD (less than 1%)
Dyeing	Various dyes, salts, alkali, acid, Na_2S, $Na_2S_2O_4$ and soaps, detergent etc.	Strongly colored fairly BOD (6% of the total)
Printing	Colors, starch, china clay, gum, oil, mordents, acid, alkali, various metallic salts etc.	Highly colored and oily appearance BOD, (6-10% of total)
Finishing	Traces of starch, tallow and different finishing agents.	Low BOD (2-4% of total)

Figure 1

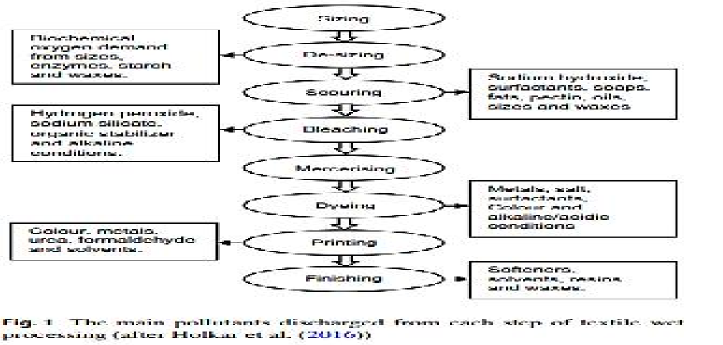


Figure 2

Characteristics of Textile Wastewater

Characteristics of Dye Effluent

It is well known fact that about half of the total volume of wastewater is generated from the textile dyeing process only. Dyeing is the most complex wet process involving hundreds of dyes and auxiliary chemicals such as binding agents, acids, alkalis, etc. Dye effluent is usuallycharacterized by its dark colour, high BOD, COD, suspended solids and dissolved solids. Some of the principal parameters of textile dye effluents are briefly addressed:

Color

The color is not included in the Rules of Conservation (1997) of the Environment but it is a subject in the textile effluents because contrary to other pollutants it is so visible.The colour of the effluent is thus important for the collective awareness of a factory.

BOD and COD

BOD is a measure of, the amount of oxygen that require for the bacteria to degrade the organic components present in water / waste water. COD or Chemical Oxygen Demand is the total measurement of all chemicals (organics & in-organics) in the water / waste water; COD is a measure of the oxygen equivalent of the organic material chemically oxidized in the reaction and is determined by adding dichromate in an acid solution of the wastewater.

DO

Dissolved oxygen measures the amount of gaseous oxygen (O_2) dissolved in an aqueous solution. Oxygen acquires into the water by circulation from the surrounding air, by aeration (rapid movement), and as a waste product of photosynthesis.

TDS and TSS

Wastewater can be analyzed for total suspended solids (TSS) and total dissolved solids (TDS) after elimination of abrasive solids such as rags and grit. A sample of wastewater is filtered through a standard filter and the mass of the deposit is used to calculate TSS. Total solids (TS) are found by evaporating the water at a specified temperature.

EC

Electrical conductivity is generally used for demonstrating the total concentration of the ionized components in an aqueous environment. Since the electrical conductivity is a measure of the capability of water to conduct electrical current (Dey and Islam, 2015).

pH

pH is a measure of the negative logarithm of hydrogen ion concentration in the effluent and gives an indication of acidity or alkalinity of the textile dyeing effluent. This factor is important because aquatic life such as most fish can only survive in a narrow pH range between roughly pH 6-9 (Islam and Mostafa, 2018)

Pollutants of Textile Dyeing Effluents

Textile printing and dyeing processes include pretreatment, dyeing, printing and finishing. These processes produce huge amounts of effluents containing starch, waxes, Carboxyl Methyl Cellulose (CMC), polyvinyl alcohol, wetting agents, sodium hypochlorite, Cl_2, NaOH, H_2O_2, acids, surfactants, Na_2SiO_3, sodium phosphate and short cotton fiber. The potential specific pollutants come out from the textile printing and dyeing processes. The pollutants are dissolved solids (DS) of starch, strongly colored, high BOD_5, DS, low SS, heavy metals, oily and slightly alkaline (Ghaly et al.,2014).

Impact of Dyeing Effluents on Environment

Environmental problems associated with the textile industry are traditionally related to water pollution caused by the release of untreated effluent.Certain chemicals, such as dyes and pigments, are harmful or may reduce the dissolved oxygen content of receiving water bodies, endanger aquatic life and ruin the overall quality of downstream water. Acetic acid (used in disperse dyes on polyester, cationic dyes on acrylic fibers and acid dyes on wool, silk, and nylon) produces a high BOD5 and is responsible for 50- 90 % of dye house BOD5. Dyes can remain in the environment for a prolonged period because of their high thermal stability and photo stability to withstand biodegradation. Untreated textile dye effluents affect all environmental components such as soil, water, air and human health in the environment (Shaikh, 2009) and are discussed below.

Effect on the Water

Effluents from textile dyeing represent the source of external water pollution.Ground water pollution has been a major source of drinking water.There is evidence that groundwater is still not polluted (Sayed 2015).Mills discharge an enormous volume of textile dye effluent in the form of toxic hazardous waste, full of colours and organic chemicals from dye and finish salts.The presence of sulfur, naphthalene, vat-based dyes, heavy metals and some auxiliary chemicals makes the effluent jointly extremely toxic. Other hazardous chemicals in water can be formaldehyde-based dyes, oil-based softeners, and non-biodegradable dyes.In the textile industry, as many as 200,000 tonnes of dyes are lost each year during dyeing and finishing operations due to the inefficiency of the dyeing process.Colloidal matter increases turbidity and gives water a ruthless appearance and a common smell due to the presence of dyes and oily scums (Kant, 2012).

Effect on the Soil

Soil is the natural body composed of inorganic and organic components.The ground is the foundation of farming.Textile waste causes soil pollution.When this effluent is allowed to circulate in fields, it obstructs soil pores, resulting in a loss of soil yield.The consistency of the soil is hardened and root permeation is not permitted.Today, day-long effluent from textile dyeing industries is not safe for soil.One researcher stated that the effluent from the textile plant Modi Ltd.Modinagar, Uttar Pradesh in India was alkaline and reddish brown in color, contained huge amount of solids (dissolves, suspended and volatile) and large values of BOD5, COD besides these effluents contains NH4-N (32 mg/L), P (17 mg/L), chloride (780mg/L), SO4-2 (400 mg/L), Na (195.5 mg/L), Ca (280mg/L), Mg (140mg/L). Several studies have found that adding textile effluents to soil, even for a short time, causes a decrease in the soil's water-soluble salts, organic matter, Na, Ca, Mg, K, NH4-N, and P content when compared to normal water-irrigated soil (Chhokor et al., 2000). Many scientists expected that high concentrations of various effluents, such as textiles, would result in decreased germination (Nagada et al., 2006; Raman et al., 2002and found that germination and sapling growth were higher in lower concentrations of effluents than in the control, but that germination and sapling growth were lower in higher concentrations of effluents. (Wins and Murugan, 2010). The best germination and sapling growth was observed in 25 % concentration. So they concluded that textile effluents could be safely used for irrigation after proper treatment and dilution at 25 %. The seed germination of Cicer arietinum is harmed by the presence of very dilute industrial waste (5 %). (Dayama, 1987; Swaminathan and Vaidhecswarn, 1991)

Effect on the Human Health

The usage of dyestuffs and pigments in the textile and dyeing industries may have a number of negative health impacts. Optical brighteners, dyes, heavy metals, crease-resistance agents, antimicrobic agents, solvents, insecticides, and flame retardants are among the chemical compounds utilised in the textiles industry. (Mahmud et al., 2011). Around 40 % of the world's colourants contain organically linked chlorine, which is a recognised carcinogen. (Malik and Khan, 2013).Due to the toxic nature of the textile dyeing effluent, the normal functioning of cells is disrupted, which may cause changes in the physiology and biochemical systems of animals, resulting in injury to vital functions such as respiration, osmoregulation, reproduction, and even mortality. Textile materials can cause allergic reactions. After extended exposure to reactive dyes, workers developed dermatitis, asthma, nasal difficulties, and rhinitis. (Elango et al., 2016).

Treatment of Textile Dyeing Effluents

Some international environmental protection bodies have imposed a set of legislation aimed at protecting human health and protecting the environment from pollution caused by textile dyeing effluents. The discharge requirements for effluents are observed to differ from country to country. Textile dyeing byproducts must be treated according to discharge criteria. It takes part in three different treatment processes: primary, secondary, and tertiary. Primary treatment removes suspended particles, excessive amounts of oil and grease, and gritty elements from effluents. (EswaraMoorthi et al., 2008). Secondary treatment under aerobic or anaerobic conditions is used to reduce BOD, phenol, and oil content, as well as to manage colour in effluents. Electro dialysis, reverse osmosis, and ion exchange are only a few of the technologies used in tertiary therapies. (Adin and Asano, 1998)

Energy Conservation

As with water conservation, reductions in energy use can result in substantial savings and lower emissions from boilers or generating plants. They include optimising compressed air generation, installing compressor control systems, and general housekeeping

Reduce cooling loads, decrease condensing temperature (as a guideline, reducing condensing temperature by 1oC will yield savings of between 2 % and 4 % of annual refrigeration cost); Increase evaporating temperature (as a guideline, increasing evaporator temperature by 1oC will yield savings of between 2 % and 4 % of annual refrigeration cost); Compressor control, incorrect control of compressors can increase costs by 20 %, or more; Boiler blowdown, economisers, insulation, flash steam recovery, good housekeeping, installing heat exchangers, optimising plant environmental conditions, shutting off of lighting, air-conditioning, etc. (Karthikeyan N and Joshuva A J, 2008)

CONCLUSIONS

The textile and dyeing industry is one of the major industries in the world. It offers employment and plays a foremost responsibility in the economy of many countries. The textile dyeing industries produce large amounts of effluents, dirt slurry and solid waste ingredients every day. A complex mixture of dangerous chemicals both organic and inorganic discharges into the aquatic bodies from all these industries. Further, the continuous deterioration of water quality due to effluents discharged into surface water bodies also has impacts on human and aquatic life in water bodies. The need of the hour is that textile units should continuously monitor their effluents and properly treat the wastewater before their disposal to water bodies. This will save the already depleted/depleting natural water resources. It is further recommended that proper legislation; its implementation and monitoring should be ensured for all quality parameters of wastewater regularly.

ACKNOWLEDGEMENTS

The authors would like to acknowledge with deep appreciation and gratitude for funding this research project of the Indian Council of Social Sciences Research, New Delhi. I would like to thank the ICSSR, for selecting me as the recipient of a Post-Doctoral fellowship.

REFERENCES

1. *Holkar CR, Jadhav AJ, Pinjari DV, Mahamuni NM, Pandit AB (2016) A critical review on textile wastewater treatments: possible approaches. J Environ Manag 182:351e366*
2. *Adin, A. and Asano, T.1998. The Role of Physicochemical Treatment in Wastewater Reclamation and Reuse. Wat. Sci. Tech., 37:79-90*
3. *Challa L (2017) Impact of clothing and textiles industry on environment: approach towards eco-friendly textiles. www.fibre2fashion.com*
4. *Chavan R B (2001) Indian textile industry- Environmental issues. Indian J fibre& Text res**26**: 11-21.*
5. *Chhokor, P.K., Datta, S.P., Joshi, H.C. and Pathak, H.2000.Impact of Industrial effluents on Soil Health and Agriculture-Indian experience, part-2- Tannery and Textile Industrial effluents. Journal of Scientific and Industrial Research59:447-449*
6. *Dayama, O.P. 1987. Influence of dyeing and textile water pollution on nodulation and germination of gram (Cicer Arietinum). ActaEcolo. 9(2): 34–37.*
7. *Dey S and Islam A(2015) A Review on Textile Wastewater Characterization in Bangladesh. Resources and Environment, 5(1):15-44*
8. *Ding S, Li Z, Wang R (2010) Overview of dyeing wastewater treatment technology. Water ResourProt 26:73–78*
9. *Elango, R. G. and Elango, S.2016. Physico-Chemical Parameters of Textile Dyeing Effluent and Its Impacts with Case study. International Journal of Research in Chemistry and Environment, 7 (1): 17-22*
10. *EswaraMoorthi, S., Dhanapal, K. and Chauhan, D.2008. Advanced in Textile Waste Water Treatment: The Case for UV-Ozonation and Membrane Bioreactor for Common Effluent Treatment Plants in Tirupur, Tamil Nadu, India. Environment with People's Involvement & Coordination in India. Coimbatore,https://www.scribd.com/document/26 08600/Advances-in-Textile WastewaterTreatment: 1-1*
11. *Ghaly, A. E.,Ananthashankar R.,Alhattab, M. and Ramakrishnan,V.V.2014. Production, Characterization and Treatment of Textile Effluents: A Critical Review. Journal of chemical engineering and process technology.5(1):5-11*
12. *Islam M R and Mostafa M G (2018) Textile Dyeing Effluents and Environment Concerns - A Review. Journal of Environment Science & Natural Resources, 11(1&2):131-144*
13. *Jaganathan V, Cherurveettil P, Chellasamy A and Premapriya M S (2014) Environmental pollution risk analysis and management in textile industry: a preventive mechanism. European sci J**2**: 323-329.*
14. *Kant, R.2012.Textile dyeing industry an environmental hazard. Natural Science 4(1):22-26*
15. *Karthikeyan N and Joshuva A J (2008) Waste minimisation in textile industry , The Indian Textile J, http://www.indiantextilejournal.com/articles/FAdet.*
16. *Malik, A. and Khan, S.2013.Environmental and Health Effects of Textile Industry Wastewater: 55-71 DOI: 10.1109/GTEC.2011.6167665*

17. *Mani S Chowdhary&BharagavaR N (2019). Textile wastewater dyes: toxicity profile and treatment approaches. In Emerging and Eco-Friendly Approaches for Waste Management (pp. 219-244). Springer, Singapore.*
18. *Nagada, G.K., Diwan, A. M. and Ghole, V.S. 2006. Seed germination bioassays to assess toxicity of molasses fermentation based bulk drug industry effluent. Eur. J. Environ. Agri. Food Chem. 5:1598-1603*
19. *Parvathi C, Maruthavanan T and Prakash C(2009) Environmental impacts of textile industries Indian Text J, http://www.indiantextilejournal.com/articles/FAdet*
20. *Parvathi C, Maruthavanan T and Prakash C (2009)Environmental Impacts of Textile Industries Indian Text J, http://www.indiantextilejournal.com/articles/FAdet*
21. *Raman, S., Biswas, A.K., Kundu, S., Saha, J.K. and Yadava, R.B. 2002. Effect of distillery effluent on seed germination in some vegetable crops. Bio resource. Technol. 82(3): 273-75.*
22. *Sayed, A. 2015. Impacts of textile effluents and their possible measures. Environment.Ppt1-12 Retrieved fromhttps://www.slideshare.net/abusayed52/impacts-of-textile-effluent-on-environment-and-theirpossible-remedial-measures*
23. *Shaikh, M. A. 2009. Environmental issues related with textile sector. PTJ: 37-40*
24. *Singh K, Singh D &Mathur A (2013) Urbanization and its Impact on Groundwater and Natural Drainage: A Case Study of Ludhiana City. Indian Journal of Ecology, 40(1), 1-8*
25. *SivakumarK K, Balamurugan C, Ramakrishnan D & Bhai L H (2011). Assessment studies on wastewater pollution by textile dyeing and bleaching industries at Karur, Tamil Nadu. Rasayan Journal of Chemistry, 4(2), 264-269.*
26. *Swaminathan, K.andVaidhecswarn, P. 1991. Effect of dying factory effluents on seed germination and seedling development of groundnut (Arachis hypogea). Journal of Environmental Health. 19(3):165–175.*
27. *Wins, J.A. and Murugan, M. 2010. Effect of textile mill effluent on growth and germination of black gram Vigna mungo (L.) Hepper. Int. J. Pharma. Bio. Sci., 1: 1-7*
28. *Juang RS, Tseng RL, Wu FC, Lin SJ (1996) Use of chitin and chitosan in lobster shell wastes for colour removal from aqueous solutions. J Environ Sci Health Part A Toxic/Hazard Subst Environ Eng 31:325–338*
29. *Ghaly AE, Ananthashankar R, Alhattab M, Ramakrishnan VV (2014) Production, characterization and treatment of textile effluents: a critical review. J ChemEng Process Technol 5(1):1–18*
30. *Ramesh Babu B, Parande AK, Raghu S, Prem Kumar T (2007) Textile technology- cotton textile processing: waste generation and effluent treatment. J Cotton Sci 11:141–153*
31. *Gosavi VD, Sharma S (2014) A general review on various treatment methods for textile wastewater. J Environ Sci- Computer SciEngTechnol 3(1):29–39*