

Textile Industry and Its Environmental Impacts: A Review

Momita Konwar and Rickey Rani Boruah*

Assistant Professor, Department of Textiles and Apparel Designing
College of Community Science, AAU Jorhat

*Corresponding Author E-mail: rickey_boruah@rediffmail.com

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ABSTRACT

Textile manufacturing is one of the largest industrial process that uses water, many hazardous chemicals like formaldehyde, azo dyes chlorinated compounds and man power. Many of these chemicals are poisonous and damaging to human health directly or indirectly. Synthetic dyes have provided a wide range of colorfast, bright hues. However their toxic nature has become a cause of grave concern to environmentalists. Dyeing process in various industries has generated a lot of attention lately because of the emerging concept of sustainability and eco-friendly variants. Due to the toxicity of the dyes and inappropriate discharge of such waste has led to skin diseases and respiratory problems among many factory workers. This has given an impetus to the rising demand for producing textile, paper, cosmetics products through sustainable dyes and processes.

Keywords: Textile industry, Air, Water, Noise and Soil pollution, Health hazards etc.

INTRODUCTION

The Textile industry is the second largest employment generating sector in India after agriculture. It is the only industry that has generated huge employment for both skilled and unskilled labour in textiles. It is the one of the oldest industries in Indian economy dating back several centuries. The Indian textiles industry, currently estimated at around US\$ 150 billion, is expected to reach US\$ 250 billion by 2019. India's textiles industry contributed seven per cent of the industry output of India in 2017-18. It contributed 2 per cent to the GDP of India and employs more than 45 million people in 2017-18. The sector contributed 15 per cent to the export earnings

of India in 2017-18. (Ministry of Textiles, *Indian Textile Journal*, Department of Industrial Policy and Promotion, Bureau) The dyeing of textiles is usually understood to mean giving them a colour which is of comparative permanence. This implies that it should not be possible to wash the colour out easily in laundering, nor should it fade rapidly when exposed to light. There is probably no dye which can be guaranteed not to alter shade under all conditions. There are great variations in the fastness of different dyestuffs but, there have been many significant milestones in the search for better fastness during the last hundred years.

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Textile industry is one of the most pollutants emitting industries of the world. Almost 2000 different types of chemicals are used in this industry. It consumes as well as contaminates fresh water.

It is estimated that over 10,000 different dyes and pigments are used industrially and over 7×10^5 tons of synthetic dyes are annually produced worldwide. Till the mid of nineteenth century all the dyes used for textile products were procured naturally, until the invention of mauvine in 1856 by Perkin. Since then there has been no looking back in the production of synthetic dyes because they were affordable, available in a lot of different colors, good color-fastness, and most of all were easy to produce. The textile industry is accountable for using and producing 1.3 million tons of dyes and pigments, most of which are made synthetically.

The textile industry is one of the largest sectors globally and produces an astonishing 60 billion kilograms of fabric annually, using up to 9 trillion gallons of water. 10-25% of textile dyes are lost during the dyeing process, and 2-20% is discharged as aqueous effluents in different environmental components.

In particular, the discharge of dye-containing effluents into the water environment is

undesirable because of their color, released directly and breakdown products are toxic, carcinogenic or mutagenic to life forms mainly because of carcinogens such as benzidine, naphthalene and other aromatic compounds.

Environmental impact of Dyes:

Air pollution- Most processes performed in textile mills produce atmospheric emissions. Gaseous emissions have been identified as the second greatest pollution problem for the textile industry. These emissions normally consist of pollutants such as suspended particulate and sulphur dioxide. Regulations often specify the type and composition of the fuel to be used and the minimum chimney height for satisfactory pollutant dispersal. (Chavan, 2001) Other significant sources of air emissions in textile operations include, fabric preparation, dyeing, resin finishing, printing waste water treatment plants. Apart from this in spinning mill, the process of removing trash from cotton fibers by opening and beating process results in liberation of fiber fluff in the surrounding environment. The amount of fiber fluff liberated varies from section to section, being highest in blow room and minimum at the cone winding section.

Table 1: Concentration limits of dust in air stream

Process	Limit (mg/m ³)
Blow room to Speed frame	0.50
Spinning (Ring Frame)	0.20
Twisting	0.20
Winding	0.20
Warping	0.20
Sizing	0.75
Weaving	0.75
Nonwoven	0.50

Water pollution- The textile dyeing and finishing industry has created a huge pollution problem as it is one of the most chemically intensive industries on earth, and consumes a substantial amount of water. (Kant, 2012)

More than 3600 individual textile dyes are being manufactured by the Industry today. The industry is using more than 8000 chemicals in various processes of textile manufacture including dyeing and printing. Textile

wastewater is a major source of Pollutants. Textile industries consume large amount of water and chemicals for wet processing of textiles. After processing, these industries discharge generally untreated effluents into the adjoining drains. During the course of movement of the effluents, there is considerable amount of infiltration and percolation of toxic chemicals into the soils thus polluting soil, underground water, pools and vegetation. The chemical reagents used are very diverse in chemical composition, ranging from inorganic compounds to polymers and organic products. (Banat et. al., 1996).

Typical textile processing operations can include the use of several non- process

chemicals such as machine cleaners, biocides, insecticides and boiler treatment chemicals. If any of these non- process chemicals enter the effluent, they would greatly increase the pollution load. The pollution load of the effluent can be characterized by the ratio between BOD and COD, which generally represents the degree to which the wastes are easy or difficult to biodegrade. Ratio ranging between 1:2 and 1:3 should imply good potential biodegradability. For most textile effluents, the ratio lies in this range. For scouring effluents, the ratio may be as high as 1:5 indicating difficult biodegradability due to the presence of high suspended solids and grease content. (Chavan, 2001)

Table 1: Major chemicals and dyes used in synthetic textile mills (Source: Kant, 2012)

Sr No.	Chemical	Quantity Kg/month
1	Acetic Acid	1611
2	Ammonium Sulphate	858
3	P V Acetate	954
4	Wetting Agent	125
5	Caustic Soda	6212
6	Softener	856
7	Organic Solvent	247
8	Organic Resin	5115
9	Formic Acid	1227
10	Soap	154
11	Hydrosulphites	6563
12	Hydrochloric Acid	309
13	Hydrogen Peroxide	1038
14	Leveling & Dispersing Agent	547
15	Solvent 1425	321
16	Oxalic Acid	471
17	Polyesthylene Emulsion	1174
18	Sulphuric Acid	678
19	Disperse Dyes (Polyester)	1500
20	Vat Dyes (Viscose)	900
21	Sulphur Dyes	300
22	Reactive Dyes	45

Noise pollution: Preparation of material balances must be supplemented by carefully planned environment monitoring exercise. Parameters such as VOC in air from finishing operations and noise levels during weaving on looms should be done periodically to assess their impact on occupational health and safety. Noise is the environmental pollutant generated by any industry and spinning and weaving

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industries has no exception to this. The workers exposed to industrial noise of potentially damaging quality and intensity, suffer from impairment of hearing capacity of several degrees and other physiological disorders. Prolonged exposure to a noise level of > 90 dB may cause hearing disorders since maximum permissible noise level for 8 hour exposure should be around 96.5 dB. As we

know the term noise is the unpleasant sound with varying intensity. The machines are the main cause for this particular reason, and cannot be under direct control because we

cannot keep machine as it is as it generate the noise and secondly lot of cost is involved on the machines is very high.

Table 2: Noise level in textile industry (Texturing, spinning and Weaving)

Process	Noise level (dB)
Texturizing Plant	95-100
Spinning	
1. Ring Frame	80
2. Rotor spinning	84
3. Two for one twister	100-110
4. Weaving	100-120

Soil Pollution: Textile dyeing and printing units generated enormous volumes of effluent at different stages of textile processing as a result of use of copious amount of chemicals and dyes. It results in an ecological risk; as such soils become poor in physicochemical properties, susceptible to erosion, loss of productivity, sustainability and diminished the growth rate of plant.

Occupational health hazards of textile industry: Babel S. and Tiwari M. (2014) reported that occupational lung disease is first on the list. Occupational cancer to be the leading work related disease, followed by cardio-vision diseases, disorder of reproduction and neurotoxicity, noise in hearing loss, dermatological condition and psychological orders. The workers engaged in the processing and spinning of cotton are exposed to significant amounts of cotton dust they have suffered one common disease known as 'Byssinosis', also known as brown lung. The symptoms of this disease include tightening of the chest, coughing, wheezing and shortness of breath. Other diseases like Dermatitis (atopic eczma), Endotoxin induced effects, Obstructive lung disease (e.g. asthma, bronchitis), Other chronic effect (cough, dyspnoea, loss of lung function), Interstitial lung diseases (e.g. follicular bronchiolitis), Fibrosis of the lung (e.g. asbestosis), Cancers of the lung (e.g. lung cancer and mesothelioma) and Pulmonary disorders (byssinosis) have long been linked with dusts associated with the processing of raw cotton

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and flax fibres. In the long run, exposure to high noise levels coming from weaving looms, spinning machine etc. has been known to damage the eardrum and cause hearing loss. Other problems like fatigue, absenteeism, annoyance, anxiety, reduction in efficiency, changes in pulse rate and blood pressure as well as sleep disorders have also been noted on account of continuous exposure to noise. Musculo-skeletal disorder like carpal tunnel syndrome, forearm tendinitis, bicapital tendinitis, lower backpain, epicondylitis, neck pain, shoulder pain, and osteoarthritis of the knees are some of the occupational diseases that have been observed due to heavy weight lifting and moving heavy cloth rolls, warp beams and so on.

Climate Change

The different stages involved in the life of a garment, and each of them contributes to the problem of greenhouse gas (GHG) emissions, which hurt the environment. In recent research on the environmental impact of the global apparel and footwear industries done by Quantis, it was reported that these industries, currently, are responsible for 8 per cent of global GHG emissions, almost as much as that of the EU as a whole. The apparel industry alone generates 6.7 per cent of global greenhouse gas emissions, which is equivalent to around 3.3 billion metric tons of carbon dioxide.

It is important to note that over 50 per cent of emissions are brought about by these 3 stages — dyeing and finishing, yarn preparation as

well as fibre production. By the year 2030, the negative effects of the textile manufacturing process in the apparel industry alone have been predicted to be of nearly the same amount as the current total annual US GHG emissions (4.9 gigatonnes of carbon dioxide eq.).

Greenhouse gas emissions caused during apparel production on hard coal and natural gas for generating electricity and heat. It is important that the apparel industries use more of the renewable sources of energy than fossil fuels for energy generation, and adopt the use of eco-friendly, sustainable materials for garment production, clothing labels, and clothing tags. There's been a gradual shift recently where we see people adopting more eco-friendly products for their laundry and bath uses. Such development should be shifted to textile production and use. People should feel more at ease with wearing clothes, clothing labels, and tags that cost the environment little or nothing.

Legal laws governing dye industry:

Some of the Acts formed by Central Pollution Control Board for the limiting use of colour of the effluents, they are:

1. The Water (Prevention and Control of Pollution) Act, 1974- To provide for the prevention and control of water pollution and maintaining or restoring of wholesomeness of water.
2. The Water (Prevention and Control of Pollution) CESS Act, 1977-To provide for the levy and collection of cess on water consumed by persons carrying on certain industries.
3. The Air (Prevention and Control of Pollution) Act, 1981- To provide for prevention and control of pollution
4. The Environment protection Act, 1986- To provide for protection and improvement of environment.
5. The Public Liability Insurance Act, 1991- To provide for public liability insurance for the purpose of providing immediate relief to the persons affected by accident occurring while handling any hazardous substance and

for matters connected therewith or incidental thereto

6. The National Environment Tribunal Act, 1995- To provide for strict liability for damages arising out of any accident occurring while handling any hazardous substance and for the establishment of National Environment Tribunal for effective and expeditious disposal of cases arising from such accident.

Health and safety measures:

The release of improperly treated textile effluents into the environment can become an important source of problems for human and environmental health. It is well known that certain chemicals used in preparation, dyeing and finishing are dangerous if handled incorrectly or carelessly. So, the dye and chemical manufacturers have contributed significantly in preparation and presentation, ensuring that products are simple and safe to handle, packaging is easy to dispose of or recycle. Electrical equipment must be installed in accordance with standards currently in force and used within the limits specified by the manufacturer. Running machinery always involves some risk and it is therefore management's responsibility to train all operatives adequately and to ensure that they are fully conversant with all aspects of individual machines.

CONCLUSION

The textile manufacturing process is characterized by the high consumption of resources like water, fuel and a variety of chemical in a long process sequence that generates a significant amount of waste. Pollutants released by the global textile industry are continuously doing unimaginable harm to the environment. It pollutes land as well as air and water and makes them useless and barren in the long run. It has become utterly necessary to reduce the pollutants emitted by the textile industry. Contamination of the air, water, and land by textile industries and its raw material manufacturing units has become a serious threat to the environment. It

has endangered the life of human beings and various other species on Earth. The use of organic raw material can help in fighting the emission of pollutants by the textile units. Environment friendly methods of cultivation and manufacture should be resorted. There is a need to take actions in this direction, urgently. The various stages in textile manufacturing hurt the environment through the constant and relatively huge emissions of GHG, water withdrawal, the release of toxins into our ecosystem from pesticides and herbicides used in growing cotton, and many other effects.

To nip these problems in the bud, it is essential that global apparel industries use eco-friendly materials for garment production, ditch or reduce the use of fossil fuels for energy generation and adopt the use of renewable energy instead. Any product, manufactured, used or disposed of in a manner that reduces, significantly, the damage it would otherwise do to the environment, can be regarded as an eco-friendly product. Apart from helping to reduce the impact of textile manufacturing on the environment and making our world a better place to live in, the use of such materials will also prevent the adverse effects of harmful chemicals (pesticides, herbicides, etc.) on human health.

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