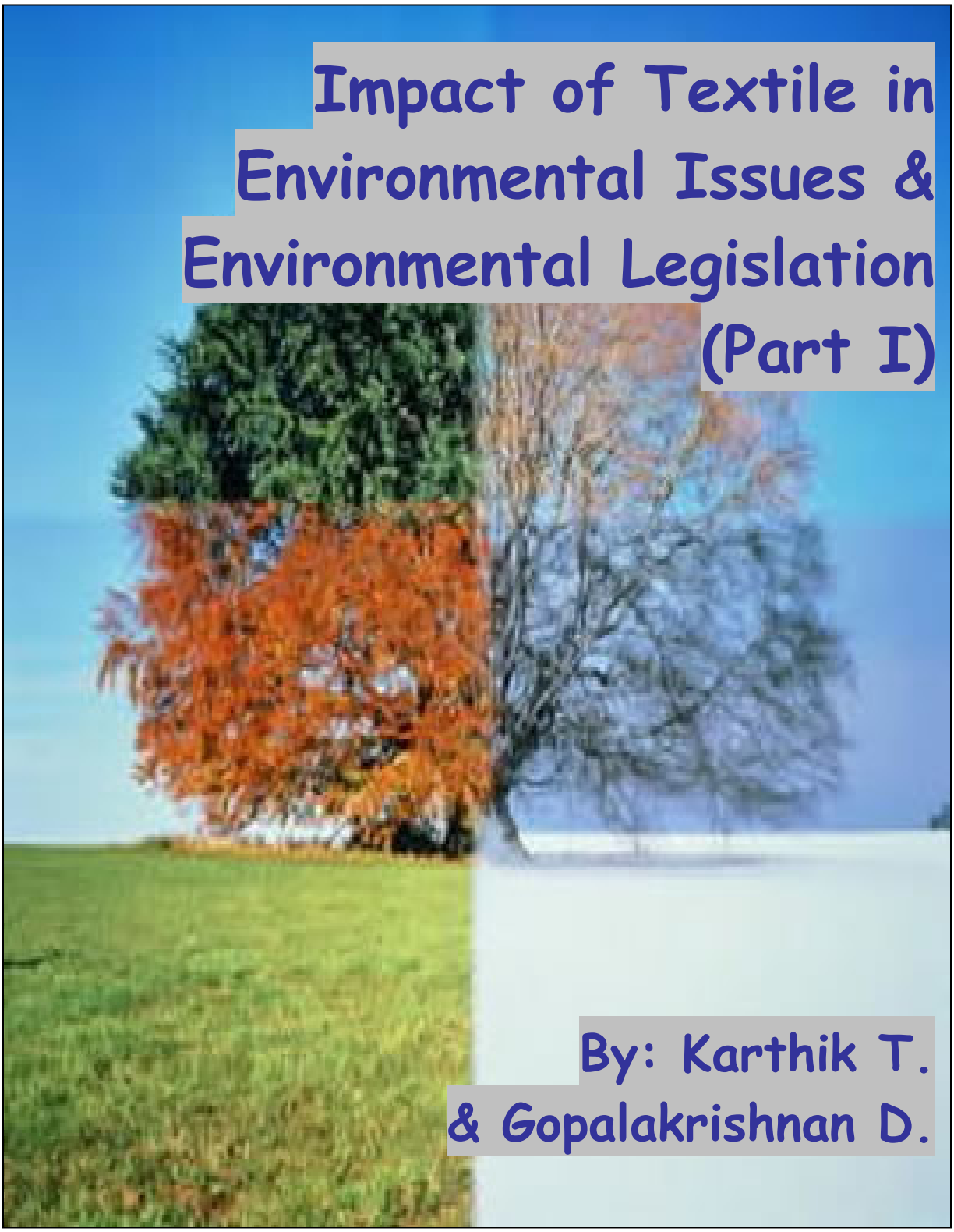

Impact of Textile in Environmental Issues & Environmental Legislation (Part I)

By: Karthik T.
& Gopalakrishnan D.

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Today people have started looking for "Green Products" everywhere. In terms of textile products, the purchasing decision of consumers were previously based upon comfort, style, aesthetic appeal, etc, but now more on eco-friendliness of the products. Many clothing companies have started providing clothes made from eco-friendly fabrics, and the demands for these green products are also increasing.

Clothing is something that is required by all human beings. It is one of the most fundamental requirements needed to survive. As it is the biggest economic activity the textile industries are to satisfy the ever growing demands in terms of quality, variety, fastness and other technical requirements. But the use of dyestuff has become increasingly a subject of environmental concern. Therefore, it is essential to evolve regulations designated to improve health, safety and the human and natural environment. Living in an environmental conscious era, consumers have demanding requirements in many areas. Being aware of environmental issues, nowadays consumers look upon eco friendly products. Today people have started looking for "Green Products" everywhere. In terms of textile products, the purchasing decision of consumers were previously based upon comfort, style, aesthetic appeal, etc, but now more on eco-friendliness of the products. Many clothing companies have started providing clothes made from eco-friendly fabrics, and the demands for these green products are also increasing. The criteria to judge any material as "environmental friendly" are renewability, ecological footprint of the resource, usage of any chemical to grow/process the same to make it ready for use. If textile producing companies embrace these trends, they can not only capitalize by increasing profits, but also sleep better knowing that they are doing their part to protect our environment. Adopting friendly practices such as reusing and recycling wastewaters is a great start for accomplishing these goals.

Main environmental impact categories are,

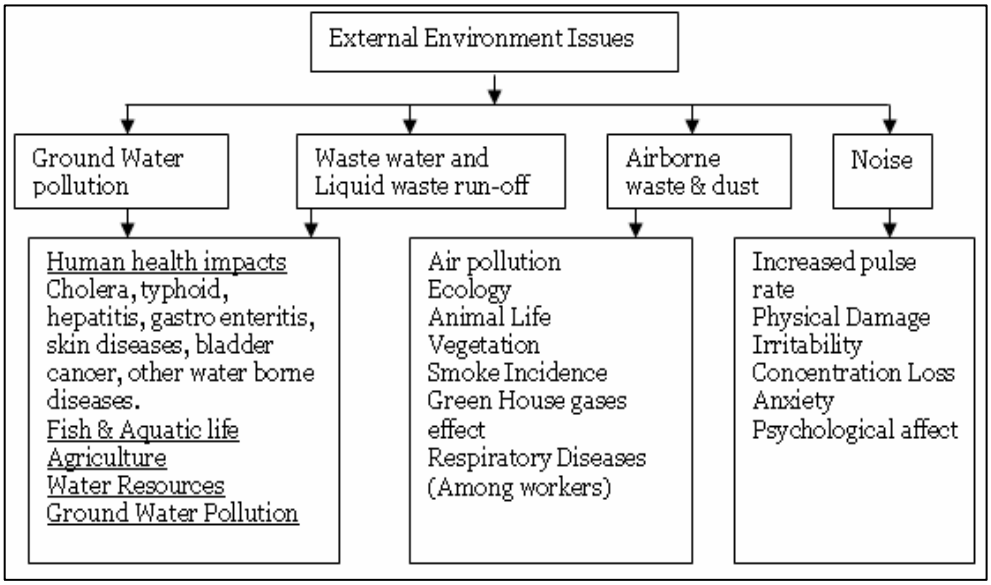
- Raw material consumption
- Energy consumption
- Emissions to air water and wastes
- Toxicity potential
- Risk/ misuse potential
- Area use

Environmental Issues

Another factor which acts as major market potential indicator and most concentrating sector is the environment impact created by the textile industry. It is a fact that the textile industry has grown many times during the last decades to meet global and domestic demand. This tremendous growth of it also led to parallel growth in environmental problems, which were left unnoticed. Any industrial activity accounts pollution in one form or the other. Similarly the textile industry also released a wide

spectrum of pollution into the environment. The practice of age-old processes ranging from raw material input to final products compounding major environmental impacts. Besides the old techniques, the chemicals used, un-skilled labour, logistics employed, untreated effluent disposal, erroneous working methods and improper sanitation are generating wastewater, noise, dust, toxic waste, gaseous waste, hazardous chemicals, heap of solid waste.

Figure 1: External Environmental Issues and their impacts



Wastewater and Liquid Waste Run-off

The manufacturing of textiles involves usage of water, chemicals and other solvents. The wastewater generated during these processes is highly polluted and dangerous, especially when it gets mixed with other chemicals and disposed untreated. The characteristics of waste water generated from Indian textile processing is highly polluted with high concentrations of pH, Total dissolved solids (TDS), suspended solids (SS), biochemical oxygen demand (BOD), chemical oxygen demand (COD), chlorides, sulphates and phenols. All in all mostly exceeding the limits of Indian standards. Liquid wastes from textile mills arise mainly from wet-finishing treatments, where large volume of water and chemicals are used in textile baths. If the bath is discharged directly to the surroundings, it becomes a major source of pollutants. Most dyes and chemicals used are synthetic and are not readily biodegradable.

South Indian Regions

The Bhavani and Noyal rivers which are now well known as the contaminated river from industrial effluents, originates in the upper regions of the Nilgiris of the Western Ghats. It crosses the Erode district where more than 100 textile industries use its water for processing units. Either directly or indirectly all effluents from these industries compound with other industries and cause severe pollution in the Bhavani river and Noyal also. The dioxins in the water have a feminizing influence and thus cause male infertility, menstrual irregularities, abortions, breast & uterine cancer in women, cause congenital deformities in new borns. And also water born diseases like cholera, typhoid, hepatitis, gastro enteritis are common among the residents. The effluents from the textile sector released into streams are generally hot, alkaline, strong smelling and coloured by chemicals used in the dyeing processes. High BOD and COD lower the dissolved oxygen of the water and threaten aquatic life and damage the aesthetic beauty

and water use quality. The suspended solids are mainly composed of carbonates, bi-carbonates, chlorides, sulphates, phosphates and nitrates of calcium, magnesium, sodium potassium, iron and manganese. All these constituents in water not only threaten the life of fish and aquatic life, but also burden human beings. The release of poisonous chemicals into the streams leads to natural water resources deteriorating flora and fauna. This has also resulted in a significant reduction in biodiversity. The resistance of light penetration due to high water turbidity is hampering the plant growth. At many places in the Indian state of Punjab, where most industries of textiles are located and usage of high quantity of non eco friendly chemicals and dyes is common, the effluent resulting during the end of process are disposed untreated in the vicinity streams.

North Indian regions

In places of Punjab, industrial effluent/sewage is being utilized for irrigation. The reason being non-availability of fresh water or a feeling that the sewage and some of the effluents, rich in organic matter, would restore the soil fertility. However, in addition to nutrients, sewage contains high concentration of heavy metals like nickel, chrome, organic substances and other compounds, which are toxic to plants, animals as well as human beings. The application of such water for irrigation will result in the uptake of pollutants by plants thereby reaching man and animals through the food chain. The same kind of impact has also been reported in the Trippur district of Tamilnadu state, where the effluent hampered the growth of coconut trees and cotton plants. India's rivers and streams suffer from high levels of pollution caused by municipal waste, industrial effluents and agricultural run-offs. It is estimated that according to WHO criteria about 70 percent of India's surface water is severely polluted. These other sources are mainly from chemical and textile industries.

As a consequence the country is suffering from water borne diseases which is affecting economic as well as social activities. Both population and pollution growth has caused a decline of the average annual availability of potable water per capita from 5,236 cubic metres in 1951 to 2,464 cubic metres in 1996. By 2007, further decline to 1,920 cubic metres, now it may decline severely. Like in many other developing countries the scarcity of clean water becomes a steadily growing problem to the Indian economy. The society and government can no longer neglect this perishing situation and quick measures have to be adopted.

Ground Water Pollution

An untreated textile effluent released from the industries on open land seeps into the aquifer and increases the concentration of total dissolved solids, sodium and chlorine contamination of ground water. This has been reported in various places because of a large number of dyeing and printing units within the city of Mathura (U.P) and in Pali (Rajasthan). In Tamil Nadu ground water pollution is reported in Ambur, Ranipet, Pernampet, Vaniyambadi, Karur and Tiruppur. The reckless dumping of effluent into low lying areas over the years has also affected the land and polluted the underground water, the sole source of drinking water supply of the cities. The tests carried out by experts in Punjab state in the vicinity areas of Budha Nala, revealed that the effluent discharge from the industries is severely affecting the ground water. The results of the experiments showed that:

- The concentration of most of the water quality parameters of Budha Nala exceed the in stream standards set for effluent discharged into rivers.
- The water of hand pumps in the adjoining area is having higher ammonium nitrogen, total solids and total hardness than maximum acceptable limits for potable water. Thus, the ground water in nearby areas is unfit for drinking.
- The pollution traverses from Budha Nala to the ground water on either side. Its area of influence is more on the right side than that of left of its flow. This might be attributed to the ground water flow direction.
- Because of perennial flow of pollutants in Budha Nala, it is found that it has polluted the ground water upto 1200 m on the right side and 250-300 m on the left. As the source of water for all the areas is the ground water, this dependency through bore wells, hand pumps is affecting the human health, through various water related diseases.

Airborne Waste

Gaseous wastes from the textile industry, containing solvent vapours like ammonia and formaldehyde, are normally diffused into the atmosphere. Another form of air waste originates from boilers. Most of the textile mills use coal or gas as fuel, and large amounts of gases are liberated into the atmosphere making the air quality heavily chemicals and poisonous. The release of cotton dust to the air from spinning operations can be a health hazard. It can cause acute respiratory diseases. The potential adverse impacts of other air emissions include damage to animal life, vegetation and incidence of smog. 60 per cent of the electric power generation in India is based on the burning of fossil fuels, mainly coal, which contributes about 16 per cent of the air pollution, followed by industry with 12 per cent. Air pollution in India produces not only a growing amount of greenhouse gases, affecting the global climate but also causes problems especially to the heath of the population. The average levels of suspended particulate matter in metropolitan cities exceed 360 gms/cubic meters while the WHO standard is 150 gms/cubic meter. Thus, there is growing concern about this increasing air pollution resulting into strict environmental legislation.

Noise

Excessive noise resulting from textile manufacturing industries is threatening the life of workers and the residential areas around them. For example Kanpur, one of the largest metropolitan and major industrial cities in the north of India has developed into a major armament and textile centre, with a wide range of textile industries. Now, the city is turning into stinking, decaying and dying city due to all major problems associated5 with its environment. Noise levels in the city are alarmingly high in commercial areas, far exceeding the prescribed limits. The urban atmosphere of Kanpur is surcharged with unpleasant and persistent noises. The dwelling tide of noise is one of the most vexatious problems that plague the people in this city. According to the Central Pollution Control Board (CPCB), Kanpur, the average noise levels in commercial areas during the day is 80 decibels, whereas according to standards it should not go beyond 65 decibels. In industrial areas, the average noise level is 75 decibels. Similarly, in residential areas, the day noise level is 60 decibels on an average, which is 5 decibels higher than the stipulated WHO limit. The silent zones are also not untouched by the scourge of undesirable and unwanted sound. In addition due to the extremely erratic and unreliable power supply the industries run on generators which are choking the city to

death, when generators start roaring and belching out noxious fumes and exceeding all limits of noise and air pollution. The studies carried out on Indian textile Industry shows that these high noise levels are causing psychological effects and physical damage, including irritability, loss of concentration, anxiety and increased pulse rate. The studies also showed that a one minute exposure to a sound level over 100db. It can cause permanent hearing loss. It also reports that a large number of textile workers, especially weavers, suffering from occupational hearing loss. Though machinery manufacturers made considerable efforts in keeping the noise emission as low as possible while improving the speed of their machines, but the measures are not adequate to protect the textile workers from occupational hearing loss. Small unit's still continuing with their roaring machines. Until the new technological methods under machinery and its servicing are not being adopted, this situation cannot be tackled.

Dust

The dust consists of particles that come directly from substances being handled during processes like fibre dust, coal dust, ash, saw dust and grain dust. The first victims in inhaling are the workers. Later this dust mixes with air and increases the suspended solids and pollutes the air. The inhaling of air polluted with cotton dust during blowing, drawing, carding, combing etc can cause health hazards like acute respiratory diseases. Even use of extraction equipment has been seen in some of the big textile industries, but still the small sector is lagging behind. There is a need of proper methods to suppress the dust and avoid reaching the air limits.

Toxic Waste

Toxic waste can be in any form effluent, in water, air, and dust as shown in the figure phenol, toxic organic compounds, phosphates, chlorinated solvents, non degradable surfactants etc., originating from various processes like fibre preparation, dyeing, printing, bleaching, cleaning etc. Some can even resist the treatment process and produce acute toxicity in effluent. Toxic dangers also exist in the dyeing and finishing sections of the textile industry. In dyeing and printing, workers are frequently exposed to dyes, which are a variety of acids such as formic, sulfuric and acetic acids, fluorescent brighteners, organic solvents and fixatives. Workers in the finishing operations are frequently exposed to crease-resistant agents, to flame retardants, and to a number of toxic solvents used for degreasing and spotting. The resulting impacts are skin diseases of the dermatitis type and are common with bleaching, dyeing and finishing, in the preparation of flax and in the use of solvents for making synthetic fibres. Certain dyestuff intermediates can produce bladder cancer. Occupational health effects include byssinosis, chronic bronchitis, dermatitis, and cancer of the bladder among dyers, nasal cavity among weavers and others. Due to lack of information about waste management these hazardous chemicals and solids are disposed off on unsecured landfills, which are totally harmful for air, soil, and ground water. These areas might later being used for residential purposes.

Internal Environmental Issues

The above described all about the environmental problems that are being caused by the Textile industry to its surrounding environment and cumulatively affecting the residential areas, water resources, plants and animals. The following describes the environmental issues related to the various internal processes from spinning and

weaving to processing (fabric finishing) stages. This section also describes the origin of waste and pollutants associated with it and health impacts caused to workers. (Ref. Table 1)

Table 1: Textile processes and Environmental Issues

Main process	Intermediate process	Environmental Issues
Spinning	Fibre preparatory	Process waste Controllable cause waste Solid waste Chemical additives Lint waste
	Yarn manufacturing	
Weaving	Fabric Production	
Chemical processing	Bleaching	Hazardous Chemicals Health Hazards Risk of Explosion
	Dyeing	
	Printing	
	Other processes	

Process Waste

The process waste is usually generated during fibre preparation and yarn formation. Washing and rinsing are common processes in textile processing during which impurity levels on fabric must be reduced to a predetermined level. Process-waste includes all waste generated during textile production, as shown in the figure 4.2.2 below, where the fibres are cleaned, straightened arid' aligned. Subsequently they are drawn out and twisted into yarn.

These stages produce waste like

- Reworkable Waste : Fibre scrap, yarn scrap, cotton scrap, wastewater, etc
- Non-Reworkable Waste: Results during processes like cleaning, carding, etc
- Hard Waste: During stiffening process of yarn

Most of the waste can be recycled or reclaimed. Treatment of very short mixed fibre waste of less than 12mm fibre length by mechanical means remains problematic. There is a need for a low cost method of recycling short fibre waste back in to fabric form, which is 'generic' and compatible with a wide range of fibre types. The physical properties of the recycled structure are therefore very important as this partly governs the suitability of the fabric for particular end-use applications.

Controllable Cause Waste

This kind of waste is usually generated right from raw material to textile production and is mostly being generated under the spinning and weaving processes. The waste is usually a result of the following factors:

- Erroneous working methods
- Rejected materials, off specification materials, failed quality control
- Equipment malfunctions
- Poor housekeeping techniques

Such kind of wastes is considered controllable because they can be avoided through closer attention to the above factors.

Solid Waste

The majority of this waste originates from other sources during operations like transportation, bale openings, servicing process, house keeping etc., the waste under this category includes,

- Tubes - Pallets
- Cones - Containers/drums
- Plastic wrap - Corrugated card-board
- Seam waste - Paper waste
- Bags-Shipping cartons

All the above waste can find their way for recycling and valuable products can be recovered.

Chemical Additives

The desizing and scouring are the main processes that are adapted to fibre and yarn formation/preparation. A size is a mixture of primary and auxiliary chemicals. These sizes are like natural products (starch), fully synthetic products, semi synthetic products (carboxy methyl cellulose, hydroxyl ethyl cellulose, etc), adhesives and binders. All these result into the waste stream from desizing operations. Scouring is a cleaning process that removes impurities from fibres, yarn or cloth. The impurities include lubricants, dirt and other natural materials, water-soluble sizes, antistatic agents and fugitive tints used for yarn identification. Scouring uses alkali to saponify natural oils and surfactants to emulsify and suspend non-saponifiable impurities in the scouring bath. All the above synthetic compounds, auxiliary chemicals have very high BOD values and the sizing agents are also responsible for up to 80% of total COD load in the wastewater.

Lint Waste

Lint can originate from many textile production steps, particularly from preparation, dying and washing operations. Usually removing lint is fairly easy using primary control measures such as filters, which can be placed in the circulation line of dyeing and other equipment. The filters must be maintained and cleaned out on a regular basis to ensure proper operation. The collected lint usually can be dried and then land filled or incinerated. Higher quality lint can be marketed.

Hazardous Chemicals

The processing stages involve intermediary processes like bleaching, dyeing, printing and other chemical treatments to furnish the cloth. All these processes include use of hazardous chemicals, which add up to the pollution. Bleaching is a chemical process that eliminates unwanted coloured matter from fibres, yarns or cloth. Bleaching decolourises coloured impurities that are not removed by scouring and prepares the cloth for further finishing processes such as dyeing or printing. The most common bleaching agents include hydrogen peroxide, sodium hypochlorite, sodium chlorite and sulphur dioxide gas. The dyes and chemicals used in dyeing process relate to many pollutants, which originate from the dyes themselves (e.g. salt, surfactant, levelers, lubricants, and alkalinity). Every chemical is associated with pollutant impact during dyeing, equipment maintenance and cleaning. Dyeing contributes to most of the metals and essentially all of the salts and colour in effluent from textiles operations.

Pollutants Associated with Various Processes

The major pollution problems presented by textile wet processing are water pollution problems. There are few problems with air pollution by chemicals, lint, etc, but these are minor. The largest impact, especially with respect to water pollution, may be made in the wet-processing operations. Primarily those steps taken after the construction of

unfinished fabric (commonly called grey goods), because these operations are the most water and energy-intensive and potentially the greatest waste-generating part of the textile industry. Because there is such a range of diverse products and application range of textiles today, the type of processing used is highly variable and depends on site-specific manufacturing practices as well as the type of fiber used and the final physical and chemical properties desired. Even for a constant product type, no two textile mills use exactly the same methods of production.

The textile industry consumes a vast quantity of water and the wastewater generated is also very high. The typical characteristics of wastewater, as gathered from a few textile processing units in India are given in the following table. The table shows distinctly that the waste water generated from textile processing is highly polluted and dangerous. Characteristics of Water generated from Indian Textile processing mills as against standard is given in the following table 2.

Pollutants Associated with Sizing, De-Sizing and Scouring

Size is a mixture of primary and auxiliary chemicals. Three main types of size are currently used.

1. Natural products (starch)
2. Fully synthetic products (PVA, PVAc, PAA, PEs)
3. Semi synthetic products (blends) (modified starch, starch ether, starch ester, carboxy methylcellulose (CMC), hydroxy ethyl cellulose (HEC), carboxy methyl starch (CMS).

Auxiliary used in sizing mixture include: Adhesives and binders: Natural gum, (locust bean gum, tragasol, gelatin, soya protein casien, acrylates, PVA, CMC)
Antistatic agents: To suppress static in high speed weaving. Anti sticking agents: To reduce fouling of dry cans and guide rollers (waxes, oil, sulfatedtallow, pine oil, kerosene, and stoddard solvent.
Biocides: (preservative) o-phenyl phenol (OPP)
Defoamers: Zinc and Calcium chloride, light mineral oil, isooctyl alcohol.
Deliquescent: Zinc and Calcium chloride, polyalcohol's (PEG), glycerin, polypropylene glycol, Diethylene glycol (DEG), Urea.
Emulsifier, dispersants and surfactants: Non ionic ethylene oxide compounds
Humectants: To protect against drying.
Lubricants and Softeners: Fasts, waxes, oils, tallow, sulfated tallow, butyl stearate, glycerin, mineral oil.
Thinning agents: enzyme, oxidizers, perborates, persulfats, peroxides, chloramides
Tints: To identify warps
Weighers: Clay

Any of these additives that are present in the size mixture will later be removed in wet processing and thus all of these materials will appear in waste streams from desizing operations. Most of these additives have very high BOD values and the sizing agents are also responsible for up to 80% of the total COD load in the wastewater. The toxicity of few of these additives has been recorded. In addition to size and desize chemicals removed from textile, sizing and desizing operations generate additional wastes that deserve attention, including-

Packaging material for size

- Dumps of unused portion of size mixes
- Machine cleaning and maintenance
- Fibre lint and yarn waste

Desizing

Manmade fibres are generally sized with water-soluble sizes that are easily removed by a hot water wash or in the scouring process. On the other hand natural fibres such as cotton are most often sized with water insoluble starches or mixture of starch and other size materials. Enzymes are used to break these starches into water-soluble sugars. Bacteria in waste treatment can easily attack the water-soluble sugars and these are very degradable and have high BOD.

Table 2: Waste Water generated from Indian Textile processing mills as against standards

Characteristics	Unit	Cotton	Synthetic	Wool Scouring	Wool dyeing/ Finishing	Standard
pH	-	8-12	7-9	3 -1 0	5 -1 0	5.5 -9.0
Alkalinity (as $CaCO_3$)	Mg/l	180-7300	550-630	80-100	240-300	-
Dissolved solids	Mg/l	2100-7700	1060-1080	10000-13000	800-1000	-
Suspended Solids	Mg/l	35-1750	50-150	5000-6000	500-700	100-600
BOD (5 days 20°C)	Mg/l/5days	150-750	150-200	5000-8000	500-600	30-350
COD	Mg/l/day	200-2400	400-650	10000-20000	1700-2400	250
Phenols	Mg/l	0.030-1.00	-	-	-	-
Oils & Grease	Mg/l	4.5-30.00	-	2000-2500	400-500	10-20
Chlorides	Mg/l	80-1500	100-200	200-350ppm	100-150ppm	-
Sulphates	Mg/l	30-350	50-100	-	10-20ppm	-

Scouring

Scouring is a cleaning process that removes impurities from fibres, yarn or cloth. The impurities include lubricants, dirt and other natural materials, water-soluble sizes, antistatic agents and fugitive tints used for yarn identification. Scouring uses alkali to saponify natural oils and surfactants to emulsify and suspend non-saponifiable impurities in the scouring bath.

Bleaching

Bleaching is a chemical process that eliminates unwanted coloured matter from fibres, yarns or cloth. Bleaching decolourises coloured impurities that are not removed by scouring and prepares the cloth for further finishing processes such as dyeing or printing. The most common bleaching agents include hydrogen peroxide, chlorine bleaching, sodium hypochlorite, sodium chlorite and sulphur dioxide gas.

Table 3: Pollutants Associated with Various Dyes

Dye class	Fibre	Type of Pollution
Direct dyes	Cotton	Salt, unfixed dye, copper salt, cationic fixing agents
Reactive dyes	Cotton	Salt, alkali, unfixed dye
Vat dyes	Cotton	Alkali, oxidizing agents, Reducing agents

Sulphur dyes	Cotton	Alkali, oxidizing & reducing agents, unfixed dyes
Chrome dyes	Wool	Organic acids, unfixed dyes, metals, sulphide
1:2 metal complex dyes	Wool	Organic acids, metals
Acid dyes	Wool	Organic acids, unfixed dyes
Disperse dyes	Polyester	Reducing agent, organic acids carriers

Pollutants Associated with Various Dyeing

Many pollutants are associated with the dyes and chemicals used in dyeing processes. These may originate from the dyes themselves (e.g. salt, surfactant, levelers, lubricants, and alkalinity). Pollutant impacts are also associated with chemicals used during dyeing, equipment maintenance and cleaning. Dyeing contributes most of the metals and essential all of the salts and colour in effluent from textiles operations, and these are priority areas for pollution prevention. There are certain reports stating that dyeing consumes 7% of the water and contributes 5% of the BOD in a typical cotton finishing operation. The table 3.2 details the pollutants associated with various dyes.

Pollutants Associated with Textile Printing

Textile printing, like dyeing also generates varying amounts and types of pollutants. The following table presents the main pollutants associated with printing and identifies their sources.

Printing produces high BOD and COD loads only if preparation operations (scouring) are done on site. Print application consumes less water and produces less BOD than preparation operations such as desizing, scouring and bleaching. It is reported that, in atypical print plant, printing contributed only 6% of the BOD to the total pollutant load and accounted for 7% of water consumption. Print washing, on the other hand, uses more than one quarter of the total water in the mill but produces only 1% of the total BOD load.

Table 4: Pollutants Associated with Textile Printing

Pollutant	Typical sources
Suspended solids	Discarded print paste and clear(pigment printing)
Formaldehyde	From binder
Urea	Print paste (Wet printing)
Air emissions	Drying/ curing oven emission (solvents, acetic acid)
Solvents	Non-aqueous oil/water thickeners, machine cleaning, screen cleaning
Aquatic toxicity	Surfactants, solvents
Colour	Discarded print paste, colour kitchen operations, implement cleaning
Metals	Discarded print paste, Photo operations, Reducing agents in discharge printing, screen making, engraving operations
Water (and Heat)	Washing of printed cloth Desizing operation
BOD	Back-coating operations carpet Printing

Pollutants Associated with Finishing

Finishing operation generates solid and liquid wastes as well as atmospheric pollutants. Pollutant categories include:

Solid wastes: Fabric scraps and trimmings from salvages and seams; fibre dust and fragments from napping, shearing and related operation, paper tubes and empty chemical drums.
Liquid: Discarded finishing mixes and rinse water from finishing implements and equipment as well as facility cleanup.
Vapours: Exhaust gases from drying and curing.
Apart from above pollutants in various processes the hazardous chemicals can cause health hazards to workers which are dealt below.

Health Hazards
The textile industries use synthetic organic dyes like direct dye, basic dye, vat dye, sulfur dye, nepthol dye, developed dye and reactive dye. The table 5 outlines the hazardous chemicals and their impacts.

The large variety of chemicals used in bleaching and dyeing process render them very complex. These chemicals are used in an attempt to make more attractive popular shades of fabrics for a competitive market. In India different textile processing units in Tiruppur use a number of chemicals that are likely to be from the Red List Group which are said to be harmful and unhealthy.

Hazardous Dyes
Some reactive dyes like reactive, vat and disperse are recognized as respiratory sensitizers. Breathing in respiratory sensitizers can cause occupational asthma. Once a person is sensitized, re-exposure to even very small amounts of the same dye may result in allergic symptoms such as runny or stuffy nose, watery or prickly eyes, wheezing, chest tightness and breathlessness. Some dyes can also cause similar allergic skin reactions. Other dyes can also relate to health hazards. Dyes based on benzidine are thought to possibly cause cancer.

Table 5: Hazardous Chemicals and their Impacts

Hazardous Chemicals	Hazards
Stain Remover: Carry solvents like CC14	Ozone depletion, capacity of ten times more than CFC
Oxalic acid: Used for rust stain removal	Toxic to aquatic organisms boosts COD
Printing gums: Preservative Pentachlorophenol	Dermatitis, liver & kidney damage, carcinogenic Banned
Fixing Agent: Formaldehyde and Benzindie	Harmful internationally banned
Bleaching: Chlorine bleaching	Skin diseases (itching), harmful
Dyeing: Amino acid liberating groups	Carcinogenic. Internationally banned

Risk of Explosion
As these dyes are oxidizing agents that may make an existing fire more intense by fuelling it with oxygen. Corrosive chemicals can cause serious burns and may react dangerously with other chemicals. Violent reactions may be caused by substances, which are dangerous when wet such as Hydros. Hot liquids can also lead to many scalding accidents. Fire hazards can also arise from the use of flammable liquids, which are easily ignitable.

Pollution Prevention Guidelines and Various Emission Limits

After getting the overview of the Indian textile industry structure, overall description of the textile process and the specific Indian textile industry environmental problems, now there is a need to give some pollution limits and specific standards which can be used by the Indian textile industry as guidelines. This chapter gives a brief summary of the pollution prevention guidelines from World Bank and the various standard emission limits for the textile industry. It furthermore explains the various threshold limits, legally allowed by various Indian emission and environmental laws for the ITI. One can easily compare the two different series of threshold limits.

World Bank Pollution Prevention Guidelines

Pollution prevention and control Pollution prevention programs should focus on reduction-of water use and on more efficient use of process chemicals. Process changes Might include the following -

- Match process variables to type and weight of fabric (reduces wastes by 10-20%J.
- Manage batches to minimize waste at the end of the cycle.
- Avoid non-degradable or less degradable surfactants (for washing and scouring) and spinning oils.
- Avoid the use, or at least the discharge, of alkayphenol ethoxylates. Ozone-depleting substances should not be used. And the use of organic solvents should be minimized.
- Use transfer printing for synthetics (reduces water consumption from 250 l/kg to 2 l/kg of material and also reduces dye consumption). Use water-based printing pastes, when feasible.
- Use pad batch dyeing (saves up to 80% of energy requirements and 90% of water consumption and reduces dye and salt usage). For knitted goods, exhaust dyeing, with a ratio of 1 0:1, where feasible.
- Avoid benzidine-based azo dyes and dyes containing cadmium and other heavy metals.
- Do not use chlorine-based dyes.
- Use less toxic dye carriers and finishing agents. Avoid carriers containing chlorine, such as chlorinated aromatics.
- Replace dichromate oxidation of vat dyes and sulphur dyes with peroxide oxidation.
- Use peroxide-based bleaches instead of sulphur and chlorine-based bleaches, where feasible.
- Control makeup chemicals.
- Reuse and recover process chemicals such as caustic (reduces chemicals costs by 30%) and size (up to 50% recovery is feasible).
- Replace non-degradable spin finish and size with degradable alternatives.
- Use biodegradable textile preservation chemicals. Do not use polybrominated diphenylethers, dieldrin, arsenic, mercury, or pentachlorophenol in mothproofing, carpet backing, and other finishing processes. Where feasible, use permethrin for mothproofing instead.
- Control the quality and temperature of water used.

- Improve cleaning and housekeeping measures (which may reduce water usage) to less than 1 50m3/t of textile produced).
- Recover heat from wash water (reduces steam consumption).

Target Pollution Loads
Implementation of cleaner production processes and pollution prevention measures can yield both economic and environmental benefits. The following production-related waste load can be achieved by implementing measures such as those described above. The figures are the waste loads arising from the production processes before the addition of pollution control measures.

Air Emissions
VOC emissions should be reduced to less than 1 kg carbon per ton of fabric (or 20 mg/N m^3) by implementing measures such as routing the extracted air from the solvent usage areas through a combustion system (such as a boiler).

Wastewater
Wastewater load levels should preferably be less than 100 m3 per ton of fabric; up to 150 cubic meters is considered acceptable.

Emission Guidelines
Emission levels for the design and operation of projects implemented with World Bank assistance must be established through the Environmental Assessment (EA) process, based on country legislation and the Pollution Prevention and Abatement Handbook as applied to local conditions. The emission levels selected must be justified in the EA and acceptable to the World Bank Group.

The following guidelines present emission levels normally acceptable to the World Bank Group in making decisions regarding provision of World Bank Group assistance; any deviations from these levels must be described in the World Bank Group project documentation. The guidelines are expressed as concentrations to facilitate monitoring. Dilution of air emissions or effluents to achieve these guidelines is unacceptable. All of the maximum levels should be achieved for at least 95% of the time that the plant or unit is operating, to be calculated as a proportion of annual operating hours.

Liquid Effluents
The following effluent levels should be achieved:

Effluent requirements are for direct discharge to surface waters. Mercury should not be used in the process. The liquid effluent should not be coloured. MPN, most portable number. The effluent should result in a temperature increase of no more than 3 °C at the edge of the zone where initial mixing and dilution take place. Where· the zone is not defined, use 100 meters from the point of discharge.

Sludge
Sludge containing chromium or other toxins should be treated and disposed in a secure landfill. Incineration of toxic organics should effectively destroy / remove over 99.99% of toxic organics.

Frequent sampling may be required during start-up. Once a record of consistent performance has been established, sampling for the parameters listed above should be done at least weekly. Only theses metals that are detected or are suspected to be present should be monitored.

Parameter	Maximum Value
pH	6-9
BOD5	50 mg/l
COD	250 mg/l
Total suspended solids	50 mg/l
Oil and greases	10 mg/l
Pesticides (each)	0.05 mg/l
Chromium(total)	0.5 mg/l
Cobalt	0.5 mg/l
opper	0.5 mg/l
Nickel	0.5 mg/l
Zinc	2 mg/l
Phenol	0.5 mg/l
Sulphide	1 mg/l
Temperature increases	<3°C
Coliform	400MPN/100ml

Table 6: World Bank Emission Limits for liquid Effluents

The key production and control practices that will lead to compliance with emissions guidelines can be summarized as follows:

- Avoid the use of less degradable surfactants (in washing and scouring operations) and spinning oils.
- Consider the use of transfer printing for synthetics. Use water-based printing pastes, where feasible.
- Consider the use of pad batch dyeing.
- Use jet dyers instead of winch dyers, where feasible.
- Avoid the use of benzidine-based azo dyes and dyes containing cadmium and other heavy metals. Chlorine based dyes should not be used.
- Do not use mercury, arsenic and banned pesticides in the process.
- Control the makeup of chemicals and match process variables to the type and weight of the fabric.
- Recover and reuse process chemicals and dye solution.
- Substitution less-toxic dye carriers wherever possible.
- Avoid carriers containing chlorine.
- Use peroxide-based bleaches instead of sulphur and chlorine-based bleaches, where feasible.
- Adopt counter current rinsing and improvement cleaning and housekeeping.

With the arousing global environmental concern worldwide, the Gol-MoEF is coming up with new legislation with an aim to protect the environment. Some are also the results of international pressure. Like the notification of March 1997 to ban use of certain dyes, which created a great impact on the small industries. Apart from this the inclusion of new standards and rules on water pollution, air pollution, noise pollution, hazardous substance management, ozone depleting substances etc which are all interrelated to the industries, making them difficult to adapt new processes to abate the pollution. The limited technological choices, lack of information and cost effectiveness hampers the growth of industries. Thus the growing environmental concern is pushing them to a new era of problems.

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