Eco – Textiles: For Sustainable Development

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Abstract

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Textile industry is considered as the most ecologically harmful industry in the world. The eco-problems in textile industry occur during some production processes and are carried forward right to the finished product. In the production process like bleaching and then dyeing, the subsequent fabric make toxic substances that swell into our ecosystem. During the production process controlling pollution is as vital as making a product free from the toxic effect. The utilization of rayon for clothing has added to the fast depleting forests and opened the door to the development in natural sustainable fibres like organic Cotton, Hemp and Bamboo fibres. Petroleum-based products are harmful to the environment. In order to safeguard our environment from these effects, an integrated pollution control approach is needed. Luckily there is an availability of more substitutes. Textile industry has a heavy impact on the environment as the current practices are unsustainable; and companies, environmentalist and consumers are looking at strategies for reducing the textile carbon footprint. So, there is need to produce the textile materials which are eco-friendly through using different processes like enzyme technology, plasma technology, super critical carbon-di-oxide dyeing or foam technology etc.

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1. Introduction

Indian textile sector has been enjoying rich traditional reputation in the world market for a number of decades. The growth of this industry in term of its output and export tends substantiates this. In the recent years it has been the victim of many challenges that have come up in the context of industralisation. One of the most challenges problems for the human race today is the environmental problem. As a result, individuals, business organizations, the judiciary and the government all over the world have recognised the need of eco-friendly textiles so as to avoid or reduce environmental issues. Industries, on a global basis, have to decide to modify their technology and production process in order to have an environmental friendly output to satisfy their customer needs. Textile industry is committed to produce eco-friendly textiles in order to face the global competition. Any textile product, which is produced in eco-friendly manner and processed under eco-friendly limits (defined by agencies like oekotex, ifoam etc.) are known as eco textiles. It is simple practice of everyday life that makes India an effectively eco-friendly nation. Environmentally friendly (also eco-friendly, nature friendly, and green) are synonyms used to refer to goods and services, laws, guidelines and policies considered to inflict minimal or no harm on the environment. For good environment health people should engage in eco-friendly activities and should begin to look into more eco friendly ways of living and doing business. There are many ways to be eco friendly i.e. Use of low impact dying, azo free dyeing and bio processing of textiles etc.

But there are some problems that's why the textile industry is considered as the most ecologically harmful industry in the world. This has been condemned as being one of the world's worst offenders in terms of pollution because it requires a great amount of chemicals and water. As many as 8,000 different chemicals are used in the textile industry, from dyes to transfer agents. Some of the chemicals are carcinogenic or may cause harm to children in pre-natal stages, while others may trigger allergic reactions in some people. Water is used at every step of the process both to convey the chemicals used during that step and to wash them out before beginning the next step. Textile industry is one of the most chemically intensive industries on earth, and the biggest water polluter after agriculture.

According to a **Upadhyay & Dedodiya (2011)** "the population that is allergic to chemicals will grow to 60% by the year 2020."

According to **Madhur (2009)** Global consumption of fresh water is doubling every 20 years. Mills discharge millions of gallons of effluent each year, full of chemicals such as formaldehyde (HCHO), chlorine, heavy metals (such as lead and mercury) and others, which are significant causes of environmental degradation and human illnesses. The mill effluent is also often of a high temperature and pH, both of which are extremely damaging.

The eco-problems in textile industry occur during some production processes and are carried forward right to the finished product. During bleaching and dyeing, the subsequent fabric makes a toxin that swells into our ecosystem. Controlling pollution is as vital as making a product free from the toxic effect. There is need to produce the material which is

eco-friendly. So, the materials can be considered 'environmentally friendly for a variety of reasons'. First and foremost is the renewability of the products. Renewable resources are the items that can be replenished in a relatively short amount of time (an opposed to millennium). The second factor is the ecological footprint of the resource- how much land (usually measured in acres) it takes to bring one of the individuals (plants or animals) to full growth and support it. The third thing to consider in determining the eco- friendliness of a particular product is how many chemicals it requires to grow/process it to make it ready for market.

However, little is known about the long term effects of these chemicals. Hence it becomes absolutely essential to study uses of chemicals and there eco substitutes in details from environmental point of view.

2. Why Ecological?

The reason for eco-friendliness is not only for the exports but even for the domestic market also. It has been reported that about 8,000 various chemicals were used in textiles. The chemicals used which are responsible for polluting air are chlorine gas, acetic acid fumes, kerosene, diazodisation fumes, acid fumes etc. A new parameter that today increasingly vital is ecology. With respect to clothing & textiles the phrase 'Ecology' can be classified into three groups: (I) Production ecology, (2) Human ecology, (3) Disposal ecology.

Production ecology –This refers to the process of production and manufacture of fibers, textiles and garments which should be environmentally friendly, and should satisfy the rational conditions for the conservation of air purity, water purity, waste treatment, and for the protection against noise.

Human ecology -Effect of textiles have on the user, apparels next to skin on health. Concentration of substances which, according to the present knowledge, could induce dangerous effects on humans during normal use must be avoided in the textiles.

Disposal ecology -Effect of textile waste (solid as well as liquid) on clean environment.

Sustainable Textiles is a pattern of resource use that aims to meet human needs while preserving the environment so that these needs can be met not only in the present, but also for generations to come. Since, the very idea of sustainable development revolves around the progress which is being taking place in the present, keeping in mind the future, somewhere. Since, eco-textiles are the need of hour and also are of the primary goals of millennium development goals in sustainable environmental development.

3. Chemicals used in processing and their hazards: -

Process	Chemical used	Hazards caused
Cotton cultivation	Chlorine based pesticides such as phenoxy alkonic acids and hexachloro benzene.	Evolve pentachlorophenol (PCP) and polychlronated biphenyls (PCB) which are carcinogenic.
Sizing	Starch paste PCP from phenolic and chlorinated compounds as preservatives	Skin effect and "algal blooming" Carcinogenic
Spinning	Floating fibers	Air pollution & byssynosis
Desizing	Starches PCP as preservatives Pyridine based reactive softners	Algal blooming Carcinogenic Carcinogenic
Scouring and bleaching	Chlorine	AOC carcinogenic cancers mutants
Dying and printing	**Metals such as:-** • Arsenic • Cadmium, cobalt and copper • Lead • Mercury • Nickel, Zinc	Nervous disorder Heart failure, vomit, diarrhea Abdominal pain, anaemia Dizziness and death Impaired growth Anrexiia
Dye fixation	Formaldehyde(HCHO) containing fixing agents	Skin irritation
Pigment printing	Kerosene	Air pollution
Carrier dyeing	Phenol based carriers	Non biodegradable effluent & hence load
Finishing	Formaldehyde (HCHO) based cross linking agents	Release free HOCH due to unreacted HOCH, which causes skin allergies.
Garmenting and packaging	CCL_4 and CFC contain stain removers	Depletes ozone layer and thus induces cancer due to UV exposure.

3.1 Mechanism of harmful chemicals

- **Carcinogenic Amines:** Aromatic amines on reduction gives insoluble amine groups which on contact with skin and settles on bladder they affect the body metabolism and ultimately induces cancer.
- **Fatal Metals:** Metals present in dyes combines with hewn (iron) content of the blood and forms an amalgam. It gradually reduces the oxygen content in the blood and can even leads to death.
- **Ozone depletion:** Chlorofluorocarbon and carbon tetrachloride used in garmenting industries UV exposure by ozone layer depletion due to chlorine action. UV exposure is carcinogenic.
- **Algal Blooming:** Starches used in sizing increases the algal growth in river water and increases the Biological oxygen demand and Chemical Oxygen Demand of the water.
- **Chlorine:** Chlorine present in the bleaching agents releases AOX (Absorbable Organic Halides) which are carcinogenic.
- **German ban:** As per German legislation consumer goods ordinance "no articles of clothing or items which regularly come in contact with human body may be put into circulation, they can release harmful amines due to the use of azo dyes, which are either known or suspected to be allergic, poisonous or carcinogenic. These dyes should not hence forth be used by any supplier of textiles leather goods. So 20 amines were banned under two groups, Group A1, and GroupA2. Group A1 amines are definite cancer causing agents (eg. Benzedrine). Group A2 are suspected to be carcinogenic (e.g.: 0- Toludine).

Violator of the above regulation can be prosecuted for a criminal offence and those responsible for

violations will be punished either by imprisonment upto three years of imposing a fine or both. Approximately 70% of all dye being used by the textiles industry are azo dyes. But only 25 percent of the azo dyes are banned today .

Banned amines are listed below: -

Sr. No.	Group A1	CAS No.
1.	4 amino biphenyl/para amino diphenyl/xenyl amine	92-67-1
2.	Benzidine/paradiamino diphenyl/fast Corrinth B	92-87-5
3.	4 chloro-o-toluidine/2 amino 5 chloro toluene/Red TR base	95-69-2
4.	2 napthylamine/beta nepthylamine/fast scarlet B base	91-59-8
5.*	o-amino azotoluene/2 amino 5 azotoluene/fast garnet GBC base	97-56-3
	Group A2	
6.*	2 amino 4 nitrotoluene/ 4 nitro-o-toluidine/ fast scarlet G base	99-55-8
7.	p-chloroaniline/para amino chloro benzene	106-47-8
8.	2:4 diamiono anisole/methoxy meta phenylene diamine	615-05-4
9.	4:4' diamino diphenyl methane/ 4:4' methylene dianiline	101-77-9
10.	3:3' dichlorobenzidine	91-94-1
11.	3:3' dimethoxy benzedine/ o-dianisidine/fast blue B base	119-90-4
12.	3:3' dimethyl benzidine/ o-toluidine	119-93-7
13.	3:3' dimethyl 4:4' diamino diphenylmethane	119-93-7
14.	p-cresidine/2 methoxy 5 methyl aniline/ 5 methyl-o-anisidine	120-71-8
15.	4:4' methylene-bis-(2 chloroaniline)	101-14-4
16.	4:4' oxydianiline/ 4:4'diamino diphenyl ether	101-80-4
17.	4:4'thiodianiline/ 4:4' diamino diphenyl sulphide	139-65-1
18.	o-toluidine/ o- amino toluene	95-80-7
19.	2:4 diamino toluene/ 4 methyl 1:3 phenylene diamine	95-53-4
20.	2:4:5 trimethyl aniline/ 1:2:4 trimethyl 5 amino benzene	137-17-7
21.	o- anisidine/ 2 methoxy benzamine	90-04-4
22.	2:4 xylidine/ 2:4 dimethl bezamine	95-68-1
23.	2:6 xylidine/ 2:6 dimethyl benzamine	87-62-7
24.	p-amino azobenzene	60-09-3

* When tested for amines on textiles, o-amino azotoluene and 2 amino 4 nitrotoluene are detected as o-toluidine and 2:4 diamino toluene respectively. Nearly 2000 azo dyes are currently marketed and form major group due to their relative low cost. Some of these are prohibited from use as they form on reduction aryl amines which are carcinogenic. The banned dyes may belong mainly to Acid, Basic, Direct and Disperse class of dyes. Leagally permissible limits of banned amines on textiles are 30 mg/kg or 30 ppm.

Some of the measures to manage the ban on certain azo dyes and a few toxic chemicals used in the manufacture of various textile goods is to avoid their usage completely. These toxic materials are being used in the cotton cultivation, sheep culture, sericulture, sizing, bleaching, dyeing and finishing as under:

Textile process	Toxic substances to be avoided
Cotton growing	Banned pesticides such as DDT, Dieldrin, Aldrine

Wool sorting	Banned insecticides
Silk worm culture	Banned pesticides
Sizing	PCP as preservative
Scouring	Chlorinated products
Bleaching	Chlorine bleaching
Dyeing and printing	Azo dyes releasing harmful amines, Dyes containing traces of heavy metals, Formaldehyde as a mordant
Finishing	Formaldehyde as a finishing agent
Garment Manufacture	Stain removers containing chlorinated products

4. Eco-friendly fibres:

Organic cotton, Aloe Vera, Nettle, Pineapple, Milk protein, Bamboo, Banana, Eco spun fibre, Soy silk fibre, Recycled polyester fibre, Corn fibre etc.

5. Processes adopted for eco-friendliness: Some enlightened especially process have been developed to nullify (or) to reduce the toxic releases. This ensures the enhancement of Eco-friendly nature. Some of them are listed below.

1. Enzyme technology 2. Foam technology 3. Super critical carbon-di-oxide dyeing 4. Plasma technology

1) Enzyme Technology: - Enzymes are protein substances made up of nearly 250 amino acids. They can be prepared form pancreas, malt and bacteria. They are preferred due to the following reasons: Replace harsh chemicals, Biologically degradable, No pollution, Specific in action, Acts as a catalyst.

Different enzymes used for different processes:

Process	Type of enzyme used
Desizing	Amylase
Scouring	Pectinase
Bleaching • H_2O_2 • Bleach cleaner	Glucose oxidase Catalase
Reactive dying • wash off	Laccase
Finishing • Bio wash • Bio polish • Flax retting	Laccases + cellulase catalase Flaxzym and ultazym
Wool and silk • Shrink resistant on wool • Degumming of silk • Bleaching of wool • Antifelting of wool • Wrinkle recovery of wool • Absorbency & surface modification of polyster • Waste cotton treatment	Protease Degummase Protease Protease Polygalactoranase Lipases Cellulose

Hydrolases type *of* enzyme is mostly used in textiles. Bio washing which are conventionally done with the help of pumice stone. These stone create disposal problems. This non eco-friendly process is now being over headed by the use of enzymes. Effluent treatments are done through the use of several chemicals. As these chemicals are hazardous, they are being replaced by the use of enzymes. The applications of enzyme technology is more environmentally compatible process.

2. Foam Technology: Foam technology is the next ecofriendly process that is being adopted. It is being used in various fields of textile processing like pretreatments, dyeing, printing, finishing, etc. Foam is nothing but a colloidal system consisting of a mass of gas bubble in a liquid continuous phase. This is

the liquid dispersion, which uses low water. The foam finishing technology (FFT) process is a novel application system for treating porous substrates with foamed chemicals at very low wet pick-ups. It involves the use of a rapidly-breaking low-density foam or froth as the delivery medium for finishing chemicals, precise metering and flow control for delivery of foam to the substrate, pressure-driven impregnation of the foam into the substrate, and an applicator system designed to allow uniform high-speed application and collapse of the foam in a single step. The semi-stable foam is necessary to get spontaneous foam collapse and spreading though the substrate, and is in contrast to stable foams specified in various foam coating processes normally requiring a separate step to break and distribute the foam through the textile material. The other important salient features of foam technology:- Better colour yield**,** Superior levelness**,** Saving in energy**,** Minimum wash off**,** Very minimum (or) nil pollution, Negligible effect on fibrous material. Thus foam technology paves a new path to textile processing industry to lead a green life.

The foam applications techniques are as follows: Horizontal pad technique **,** Gaston county technique **,** Kiss roll technique **,** Vacuum suction technique

3. Super Critical Fluid Dyeing Technology: In this certain gases can replace water as solvating medium. High pressure and temperature are needed to dissolve the dyes. Of all the gases being possible of converted into super critical fluids, CO_2 is the most versatile and prominently used. Because of its high diffusion rates and low viscosities that allow the dye to penetrate into the fibre. Moreover, by reducing the pressure at the end of the process, dye and CO_2 can be recycled. Prominent substances exhibiting super critical phases are CO_2, H_2O and Propane, of which CO_2 is the second most abundant and second least costly solvent. Low temperature and pressure are needed to convert carbon dioxide gas into super critical fluid. In the supercritical state CO_2 exhibits very low viscosity and surface tension properties. Supercritical CO_2 is one of the most popular fluids currently used in manufacturing processes.

In dyeing field Carbon dioxide has so far been the most widely used as super critical fluids because of its easiness to use (T- 31.1°C, P- 73.8 bar), cheapness, no-explosiveness, non-toxicity, and its recycling capability. The advantage of this process is that contaminated wastewater streams are not produced, washing of dyed fabric is not necessary. Carbon dioxide can penetrate into fibres faster than water. A high One pressure and constant volume means the higher density of super critical carbon dioxide. Hence the dyes can be dissolved more easily, which means that the colour yield value may also be increased. This process is a potential replacement for the present method, which uses Chloro Floro Carbon production of which is now banned. It offers benefit such as the elimination of water and water pollution, elimination of other low auxiliaries, which enhances ecology.

4. **Plasma Technology**: Plasma treatment can be used for soil release and water repellent finishes in eco friendly manner. Plasma refers to a partially ionized gas that consists of ions, electrons and neutral particles. Exposing the fibres to gaseous plasma by two main procedures, which include depositing and non depositing plasma. Plasma treatment does not, involve handling of hazardous chemicals and thus there is no problem of effluents. Depositing plasmas i.e. (**Plasma-enhanced chemical vapors**) are applied

with the help of saturated and unsaturated gases like ethylene vapors and monomers like acetone and methanol. Plasma chemistry takes place under non equilibrium conditions and the physical interactions can occur while the gas or the parts exposed to it remain at relatively low temperature.

Applications

There are different methodologies to induce the ionization of plasma gas for textile treatment:

A. **Glow-discharge method**- Plasma gas is produced at reduced pressure. The methodology applies direct electric current, low frequency over a pair of electrodes.
B. **Corona discharge method** - Plasma gas is produced at atmospheric pressure by applying a low frequency or pulsed high voltage over an electrode pair.
C. **Dielectric barrier discharge method** - Plasma gas is produced by applying a pulsed voltage over an electrode pair of which at least one is covered by a dielectric material.

Advantages of plasma treatment

Plasma processing is a dry and environmentally friendly technique. It does not require vast supplies of water, heating and drying, and only minute amounts of chemicals are necessary to reach the desired functionality. Because the desired material behavior is achieved by modifying only the surface of fibers, bulk characteristics of the material, such as its mechanical strength, are unchanged. Further, plasma treatment allows achieving surface characteristics that are beyond the reach of traditional wet chemistry finishing.

6. Wet Processing- Environmental Concern

It is necessary to overview the important environmental concerns related to textile wet processing such examples are given below:

- Chemical intensive wet processing– scouring, bleaching, mercerizing, dyeing, printing etc.
- Heavy metals – iron, copper, lead etc, found in dyestuffs auxiliaries, binders etc.
- Residual dyestuffs, chemicals in water: due to poor fixation of colors.
- PVC and phthalates: used in plastisol printing paste.
- Formaldehyde: found in dispersing agents, printing paste and colorant fixatives.
- Dye effluent-wastewater issue is major concern

6.1 Fabric finishing stages:

The **fabric finishing stages** prepare the fabric to be dyed and/or printed. “Finishing is the chief cause of environmental impacts in the production phase, using significant quantities of water, energy and chemicals and producing substantial amounts of effluent". Chemicals used for finishing contain heavy metals like copper, chromium and cobalt which are known hormone disrupters.

6.1.1. Bleaching: - In order to achieve white fabrics, it is necessary to bleach fibres as natural fibres have an off white colour. Bleaching is also used prior to dying to achieve better colour results. In Europe hydrogen peroxide is used for the bleaching stage as chlorine – based bleach is toxic and has negative effects on the immune system and reproductive system. “This kind of (chlorine – based) bleaching is not permitted in Germany and has largely been substituted by other methods throughout the rest of Europe, but the practice is still common worldwide."

Bleaching with hydrogen peroxide is six times more expensive and is only active at temperatures above 60°C, which makes this bleaching process energy

intensive. After bleaching the fabrics or fibres are dyed. So that only sun drying technique is the best option and which is eco-friendly too.

6.1.2 Dyeing: - Before 1956, the majority of clothes were dyed using natural dyes, but technological changes, industrialization and population growth brought about a rapid increase in textile production due to the amount of land needed to grow the dyes, natural dyes could no longer fulfill the demands. Modern dyes are based on petrochemicals, a non renewable resource and there are many risks to human health and the environment from modern dyes. The dye bath contains processing chemicals and dye. Different fibres need different dyes and chemicals so the amount of dye varies between 2 and 80g per kg of textile. So that only those dyes are used which are eco-friendly i.e. azo free dyes, low impact dyes etc.

6.1.3 Washing: - After dying the fabrics need to be washed, which requires large amounts of water, which then turns into a highly coloured and polluted effluent. This effluent presents a great danger to the environment, as the global textile industry discharges 40,000 to 50,000 tons of dye into rivers etc annually. There are measures being taken in Europe but developing countries like India etc are far behind and textile mills dispose of untreated waste directly into waterways, leading to polluted fresh water and alkaline soil.

7. Steps towards sustainable textiles:

Sustainable processing of textiles:- There is need for ecofreindly wet processing that is sustainable and beneficial methods. Number of sustainable practices has been implemented by various textile processing industries such as Eco friendly bleaching; Peroxide bleaching; Eco friendly dyeing and Printing; Low impact dyes; Natural dyes; Azo Free dyes; Phthalates Free Printing. Sustainable Processing of Textiles also includes Bio Processing of Textiles.

7.1 Eco friendly bleaching: - A bleaching process that is most suitable and within the norms of eco labels standards is called Eco Bleaching. Peroxide bleaching is eco-friendly bleach which is used. Some of the useful tips to consider are: Use only APEO and NPEO (A solvent type of detergent for general purpose of prescouring and **bleaching** especially designed for removing) free wetting and scouring agents, do not use Ethoxylate based surfactants & phosphate containing surfactants, Instruct your sizing department to avoid using PCP, TCP and Copper Sulphate or Nickel salts as preservative for their size material, do Bio-scouring, no chlorine bleached is used, hydrogen Peroxide bleach is used on light or bright colors only, Enzyme scouring/bleaching and adopt the process at least for RFD quality fabric/yarn, & do not let out the processed liquor directly to ground. Emphasis and go to Zero discharge system of effluent treatment.

Chemicals used in bleaching and their eco-substitute: -

Non – ecofriendly chemical	Sodium hypochlorite, silicate and phosphate stabilizers
Hazards	Reacts violently with acids, ammonium compounds, phosphorus, sulfur, sodium dithionate, causing explosion hazard,

Eco-substitute	1) Peracetic acid, Glucose oxidase 2) BiofinaseBP-300(liquid-cellulase enzyme) Biopolishing , Peroxide bleaching, ozone bleaching, enzyme bleaching

7.2 Eco-friendly dyeing: - Dyes due to their eco-friendly nature create superior value to the textile substrate. Low impact dyes, Natural dyes and Azo Free dyes are all eco friendly dying.

7.2.1 Low-impact dyes

Low-impact dyes" implies a lower impact on the environment. Low-impact dyes are petroleum-based, synthetic dyes with a higher than average absorption rate (70%-80%, depending on the color). Natural components are water soluble. This means less water is required in the rinse process and less dye runs off in the water; therefore, the dyes have a lower impact on the environment. Low-impact dyes also typically do not contain heavy metals (like chrome, copper and zinc), nor do they require toxic chemical mordants to fix them to the fiber. The dye, and rinse water, are often recycled and used again. Additional auxiliaries and additives in the dye bath are biodegradable. Even though they are made from synthetic materials, low-impact dyes are generally considered eco-friendly and often preferable to natural dyes.

7.3 Eco finishing: - Finishing processes that is most suitable and with in the norms of Eco label standards is called Eco Finishing.

Eco-parameter and their permissible limits of chemicals used in finishing:-

S.No.	Eco parameter	Permissible limits
1.	Presence of the banned amines	< 30 ppm
2.	Presence of Pentachlorophenols (PCP)	< 0.5 ppm (Baby wear: < 0.005ppm)
3.	Presence of formaldehyde	< 300ppm- material not in direct contact with skin, <75 ppm material in direct contact with skin, <20ppm – baby bear
4.	Presence of heavy metals	Consumer specific
5.	Residual pesticides	< 1.0 ppm(Baby wear: < 0.5ppm)
6.	Allergenic dyes	Not to be used
7.	Carcinogenic dyes	Not to be used
8.	Chlorinated benzene & toluene	<1.0 ppm
9.	Presence of the Phthalate	<0.01 ppm
10.	Organic Tin Compounds	< 1.0 ppm
11.	pH value of Aqueous Extract	Should be nearly neutral (4.5-7.5)
12.	Colour fastness	As per specifications

7.4 Bio processing

Bio processing can simply be defined as the application of living organisms and their components to industrial products and processes, which are mainly based on enzymes. Bio-processing also offers the potential for new industrial processes that require less energy, less water and less effluent problems with effective results. **Enzymatic desizing, enzymatic scouring, enzymatic bleaching and bio polishing and enzyme based softeners** are few examples of bio-processing of textiles .

Eco-wash laundering system consists of a plastic disc with ceramic pellets. The activated ceramic pellets inside the disc are agitated within the machine to release ions. These ions reduce the surface tension of the water, allowing it to penetrate the fabrics and release the dirt. The result is clean clothes without the risk of chemicals which damage the garments.

While caring the fabrics -sunshine instead of bleach. Lemon juice and sunshine powerful combination for stubborn stain.

8. **New textile finishes respond to eco-friendly demand: -** Producers of textiles, chemical finishes and finishing equipment are responding to demands for environmentally-friendly finishes by coming up with novel multi functional treatments. Innovation in chemical finishing has capitalised on a host of new developments in the world of science and engineering, according to a report from Textile Outlook International - including biotechnology, plasma technology, super hydrophobic and self-cleaning technology, and softening technology. Advances in biotechnology have led to the development of environmentally-friendly treatments which significantly reduce the amount of water, chemicals and energy used in textile processing. Examples include the Gentle Power Bleach system by Huntsman Textile Effects, which is considered to be a more sustainable pretreatment system than conventional methods such as peroxide bleaching. DyStar's Sera Zyme C-PE enables producers to use considerably less caustic soda and acid-based rinsing agents compared with the large amounts used in traditional alkaline scouring. The new pretreatment significantly lowers the level of pollution in waste water and has been tested on an industrial scale by two large textile producers in Italy.

9. Conclusion: - "Eco friendly textiles" are gaining importance in the consumer market. Consumers who initially considered only the aesthetic value are now looking at the harmful effects created by various chemicals. "It is better for the society to prevent pollution than to cure it after its creations". Environmental protection and eco-friendliness play an increasing part in consumer awareness today. Therefore the textile industry become aware of it and efforts are being initiated in the production and export of "Eco-friendly textiles".

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