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Enviromental Pollution Impacts of Textile Production and Processing

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Abstract

Environmental impact of textiles examines that effects all phases of textile production and use have on the environment from growing or making fibers to discarding a product after its useful life has ended. If the waste products, e.g, chemical effluents are discharged straight into the atmosphere, they may be contributing to global warming. To improve conditions for workers and stem pollution, textile producers, manufacturers and distributors are launching the first initiatives built around sustainable development and who knows, ecology may be the next new trend. The main environmental problems associated with textile industry are typically those associated with water body pollution caused by the discharge of untreated effluents. The development of genetically modified cotton adds to environmental problems at another level. The textile industry is one of the most chemically intensive industries on the earth, and the number one polluter of clean water. The effluent is of critical environmental concern since drastically decreases oxygen concentration due to the presence of hydrosulphides and blocks the passage of light through water body which is detrimental to the water ecosystem. It is important to be vigilant when buying eco-friendly clothing. Environmental pollution risk analysis and risk management in textile industry is vital in order to prevent chemical disaster which may lead to terrible results.

Keywords: *Textile industry, Enviromental Pollution, Volatile Organic Compounds (VOC's)*

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INTRODUCTION

The textile industry has been condemned as being one of the world's worst offenders in terms of pollution because it requires a great amount of two components. Chemicals as many as 2000, different types are used in the textile industry, from dyes to transfer agents and water a finite resource that is quickly becoming scarce, and is used at every step. The water becomes full of chemical additives and is then expelled as waste water, which in turn pollutes the environment [01]. Traditionally produced fabrics contain residuals of chemicals that evaporate into the air we breathe or are absorbed through our skin. Some of the chemicals are carcinogenic or may cause harm to children even before birth. OEcotextiles, the producer of high quality organic fabrics aims to change the way the fabrics are made, by providing that it's possible to produce luxurious and sensuous fabrics in ways that are non-toxic, ethical and sustainable. It is well known that every customer product has an impact on the environment. However, an ordinary customer does not know which product has less or more impact than the other one. To improve conditions for workers and stern pollution, textile producers, manufacturers and distributors are launching the first initiative built around sustainable development who knows, ecology may be the next new trend [02]. Environmental impact of textiles examines that effects all phases of textile production and use have on the environment, from growing or making fibers to discarding a product after its useful life has ended [03]. The main environmental problems associated with textile industry are typically those associated with water body pollution caused by the discharge of untreated effluents and other environmental issues of equal importance are emission, notably Volatile Organic Compounds (VOC's) and excessive noise or odor as well as work place safety [04]. The textile industry is one of the world's largest industries. The production of textiles over the years has contributed to significant environmental problems as reported [05].

The pesticides that farmers use to protect textiles as they grow can harm wild life, contaminate other products and get into the food we eat. The chemicals that are used to bleach and color textiles can damage the environment and peoples' health. Over-usage of natural resources like plants, water, etc depletes or disturbs ecological balance. Most of the textile machineries cause noise, sound and air pollution [06]. Use of

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synthetic dyes has an adverse effect on all forms of life. Presence of sulphur, naphthol, vat dyes, nitrates, acetic acid, soaps, enzymes chromium compounds and heavy metals like copper, arsenic, lead, cad-mercury, nickel and cobalt and certain auxiliary chemicals all collectively make the textile effluents highly toxic [07]. Textile effluent is a cause of significant amount of environmental degradation and human illness [08]. The process of converting fiber to cloth, bleaching, dyeing and finishing, uses yet more energy and water and causes yet more pollution [09]. Environmental Impacts of Textile Processing together with the chemicals used in textile manufacturing is one of the largest polluting sectors in China [10].

Environmental pollution risk analysis and risk management in textile industry is vital in order to prevent chemical disaster which may lead to terrible result [11].One of the most resource-intensive industries in the world, the global textile and apparel industry is built on complex linear supply chains. Lack of visibility over what's happening further down that chain has often resulted in toxic pollution, unethical, labor practices and escalating waste, with the rise of 'fast fashion' sending materials hurtling towards end-of-life quicker than ever [12]. Many harmful chemicals present in the water may be formaldehyde base dye fixing agents, chlorinated stain removers, hydrocarbons base softeners and non-bio degradable dyeing chemicals. These organic materials react with many disinfectants especially chlorine and form by products that are often carcinogenic and therefore undesirable [13]. The colloidal matter present along with colors and oily scum increases the turbidity, gives the water a bad appearance and foul smell and prevents the penetration of sunlight necessary for the process of photosynthesis. Color is the main attraction of any fabric. No matter how excellent its constitution, if unsuitability colored it is bound to be a failure as a commercial fabric. But the toxic nature of the colors has become a cause of grave concern to environmentalists [14]. The effluents, if allowed to flow in the fields clog the pores of the soil resulting in loss of its productivity and therefore, it is important to remove these pollutants from the waste water before their final disposal [15].

Textile industry not only comprises large quantity of water for the processes but also need various chemicals and dyeing agents for the processes. Each time the

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manufacturing process varies according to the requirement of the customer, so the waste generated varies each time depending on the type of chemicals and raw materials used. Pollution is considered to be the unwanted material into the environment [16]. In order to prevent the hazards due to emission from the industry the workers can be advised to use Material Safety Data sheets to handle all the substances individually. This material data sheet can include physical properties, toxic rate, ill effects and first-aid for effective handling of the resources [17]. The water consumption for the textile industry includes various processes such as sizing, dyeing and other end product processes. The major problem arises when these chemicals are directly discharged into water bodies, thus causing water pollution [18]. The production of cotton is very hazardous with the use of poisonous pesticides used frequently. The use of these pesticides poisons the cotton labors, even killing some of them. Organic cotton is grown without pesticides, so is better for the environment and the workers [19]. The manufacture of clothing has varying impacts on the environment, depending on factors like fabric type or dyeing and finishing options [20].

Fabrics made from natural sources are biodegradable, so waste disposal is not a problem and this causes little damage [21]. A number of environmental problems have been caused by the textile and apparel industry [22]. Consumers' attitude towards hygiene and active life style has created a rapidly increasing market for anti-microbial textiles, which in turn has stimulated intensive research and development [23]. Research was conducted in order to quantify the energy used by a reuse/recycling operation and whether this resulted in a net energy benefit [24]. A study was conducted to use a life-cycle perspective to model the quantities of engineered nano-particles released into the environment [25].

2. ENVIRONMENTAL ISSUES IN TEXTILES

Processes used to produce a design can affect the environment but it is possible to assess how environmentally friendly a product is by carrying out a 'cradle to crave' analysis. Fabrics made from natural sources are biodegradable, so waste disposal is not a problem and this causes little damage to the environment. Synthetic fibers are non-renewable and the extraction causes significant environmental damage [21]. These are not biodegradable. The methods

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of transport for various materials using fuels in the mill and the exhaust fumes emitted add to global pollution. Energy is required to produce various items in a textile mill using toxic chemicals and the waste products are discharged straight into the atmosphere, which may be contributing to global warming.

A large amount of waste water and polluted air is generated during production. A number of other problems arise that are not simply related to the output waste product. Waste water and emissions generally received the most attention from politicians and consumers due to their hazardous nature [22]. A large amount of fabric waste and other scraps are left over at the end of production. Packaging materials are not always able to be reused or recycled. Worries are also there about pollution of rivers and beaches from textile processes.

3. IMPACT OF TEXTILES AND CLOTHING INDUSTRY ON ENVIRONMENT

The textile and clothing industry is a diverse one, as much in the raw materials it uses as the techniques it employs. Most of the clothes in our wardrobes contain polyester, elastone or lycra. Their manufacturing creates pollution and they are hard to recycle. At each of the six stages typically required to make a garment, the negative impacts on the environment are as numerous as they are varied [02].

Spinning, weaving and industrial manufacture undermine air quality. Dyeing and printing consume vast amount of water and chemical, and release numerous volatile agents into atmosphere that are particularly harmful to our health. Environmental impact of textiles examines what effects all phases of textiles production and use have on the on the environment, from growing or making fibers to discarding a product after its useful life has ended. It looks at the physical environment affected by these processes, including resource depletion, pollution and energy [03].

The textile manufacturing process is characterized by the high consumption of resources like, water, fuel and a variety of chemicals in a long process sequence that generate a significant amount of waste. The common practices of low process efficiency result in substantial wastage of resources and a severe damage to the environment. The main environmental problems associated with textile industry are typically

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those with water body pollution caused by the discharge of untreated effluents. Other environmental issues of equal importance are air emission, and excessive noise and odor as well as workspace safety [04]. To get fiber, cotton must be grown, this entails vast amount of chemical fertilizers and pesticides that pollute and deplete the soil. Despite mechanical harvesting, the cotton is still largely dependent on cheap labor. The raw cotton is then dyed, meaning chemicals and heavy, metals with harmful effects on the environment. From waste water emission to air pollution and energy consumption, the textile industry weighs heavily on the environment [06].

Different fabrics have different impacts, depending on what they are made of Nylon or Polyester, made from petrochemicals, are synthetics and non-biodegradable as well, so they also are inherently unsustainable on two counts. Both processes are also very energy hungry. Rayon is another artificial fiber and to make rayon, the wood pulp is treated with hazardous chemicals such as caustic soda and sulphuric acid. In case of wool, both agricultural and crafts workers suffer from exposure to organophosphate sheep dip. Getting from fiber to cloth, bleaching, dyeing and finishing, uses yet more energy and toxic waste water is what makes the textile industry so environmentally damaging. Instead of recycling the waste water many dye houses build pipes which dump the potentially toxic bi-products directly into rivers and lakes. It is saying in China that if you want to know what colors are currently in fashion all you have to do is look at the rivers [10]. In USA, natural capital is the environmental resources from which we make goods and services. It includes minerals, land and forests, as well as services such as stable climate and clean air that sustain their eco-system [12]. These natural goods and services often freely provide business and society by a healthy planet and the result is that their natural capital is being used at an unsustainable rate and being damaged. Climate change is the leading example. Man-made carbon emissions are damaging the planet's ability to maintain a stable climate, resulting in global warming, rising sea levels and extreme weather.

4. ENVIRONMENTAL HAZARDS

Traditionally produced fabrics contain residues of chemicals used during their manufacture, and chemicals that evaporate into the air we breathe or are absorbed through our skin. Some of the chemicals are

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carcinogenic or may cause harm to children even before birth, while others may trigger allergic reactions in some people. OEcotextiles hopes to make environmentally appearing technologies appealing and available to the main streams, and to be among the fore front of companies raising peoples' consciousness about the far-reaching implications of their textile choices [01]. OEcotextiles is thrilled to have a relationship with a mill based in Southern Italy, which uses no water for the weaving process. All of the mills OEcotextiles have waste water treatment in place, OEcotextiles uses only fibers that have grown without any toxic pesticides, herbicides, or chemical fertilizers. The company supports maintenance of healthy soils, which in turn helps minimize global warming. OEcotextiles routinely reevaluates its environmental best practices and life cycle assessment in light of new developments.

Color is the main attraction of any fabric. Manufacturing and use of synthetic dyes for fabric dyeing has become a massive industry today. The toxic nature of synthetic dyes has become a cause of grave concern to environmentalists. Other harmful chemicals present in the water may be formaldehyde based dye fixing agents, chlorinated stain removers, hydro carbon based softeners, non-biodegradable dyeing chemicals. These organic materials react with many disinfectants especially chlorine and form bi- products that are often carcinogenic and therefore undesirable [07]. The colloidal matters present along with colors and oily scum increases the turbidity, gives the water a bad appearance and foul smell and prevents the penetration of sunlight necessary for the process of photosynthesis.

The textile production industry is one of the oldest technologically complex of all industries. With escalating demand for textile products, textile mills and their waste water have been increasing proportionately causing a major problem of pollution in the world. Many chemicals used in the textile industry cause environmental and health problems [18]. Among these, the chemicals in textile waste water, dyes, are considered important pollutants. The effluents of critical environmental concern drastically decrease oxygen concentration due to the presence of hydrosulphides and block the passage of light through water bodies which is detrimental to the water ecosystem. Textile effluents are a cause of significant amount of environmental degradation and

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human illness. Chemicals evaporate into the air, we breathe or are absorbent through our skin, they show up as allergic reactions and may cause harm to children even before birth. Untreated or incompletely treated textile effluent can be harmful to both aquatic and terrestrial life by adversely affecting the natural ecosystem and causing long term health effects.

5. LIFE CYCLE ASSESSMENT FOR REUSED CLOTHING

Textiles can be reused or undergo a processing stage and enter a recycling stream. Research was conducted in order to quantify the energy used by a reuse/recycling operation and whether this resulted in a net energy benefit. Taking into account extraction of resources, manufacture of materials, electricity generation, clothing collection, processing and distribution and final disposal of wastes it was demonstrated that for every kilogram of virgin cotton displaced by second hand clothing approximately 65 kWh is saved, and for every kilogram of polyester around 90 kWh is saved. Therefore, the reuse and recycling of the donated clothing results in a reduction in the environmental burden compared to purchasing new clothing made from virgin materials [24]. The clothing industry impacts on people in many ways from the labors involved in collections of raw materials, for factory workers, to those affected by disposal and end-of-life garments. This study on 'uniform reuse' [20], focuses on the recovery of clothing. The manufacturer of clothing has varying impacts on the environment, depending on factors like fabric type, or dyeing and finishing options. For example, if garments are made with natural fabrics, then growing period of fibers and use of fertilizers, insecticides and herbicides may affect the soil, water and air. The major environmental issues associated with clothing are resource consumption, greenhouse gas emission, land use, toxic production process and landfill.

The key resources are fossil fuels and water and the consumption, includes use in growing or obtaining the raw materials, in producing the clothing, and in transporting the raw materials and final product. The release of CO2 depends on the fabric type and processing system involved. Polyester/cotton blend is believed to have the highest GHG influence in the steaming process, with all most all the emissions being CO2. Wool has a greater GHG impact earlier in the production, due to methane released by sheep before manufacture has

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even began. Land degradation can come from chemical pollution of soil and of ground water through use of herbicides and fertilizers, and loss of biodiversity. Some manufacturing practices in the textile industry use hazardous or acidic chemicals, which can sometimes be released in affluent. Most textiles end up in landfill. Textiles are pretty bulky compared with other house hold wastes, and quickly use up the limited space available, but also the biodegradable fraction then breads down, releasing GHG.

6. THE FUTURE OF TEXTILES

The production of textiles over the years has contributed significant environmental problems, especially due to the water pollution it leads to. Much depends on cotton, which is used in about half of all textile manufacturing, and is extremely water-intensive. To produce one kilogram of cotton can require up to 29,000 liters of water not to mention the chemicals used for forming, cleaning and dyeing of fabrics. To produce a plain T-shirt in cotton means 2700 liters of water and 150 grams of chemicals have been used. Another important environmental aspect of textile production used is the emissions of GHGs. Cotton production is obviously important in this context, but considering that over half of all textiles produced are oil based-synthetic fibers like acrylic, polyester and nylon, it is a clean link to the use of fossil fuels and emissions of carbon dioxide [05[.

In recent years, extensive research has been conducted to develop new environmentally friendly materials in textiles that, that are not based on cellulose fibers from cotton, or produced synthetically from oil. Moreover, research is going on to reduce water use and climate impact of textile industry and has made jeans of cellulose fibers from eucalypts trees. Jeans have been developed that feel as soft as regular jeans and do not shrink or stick. In addition, digital printing methods have been developed to produce jeans wear that look working instead of the dyeing and stone washing of conventional manufacturing. This requires only one fifth of the water, chemicals and energy is needed for production.

Research and innovations are going on to develop clothes ranging from new fibers into smart interactive fabrics where technology and textiles work together. Such fibers are like bamboo and hemp. These are natural cellulosic fibers. Corn has been used to make fibers suitable for textile

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manufacturing, but fabrics made out of this fiber are not soft enough to be used in clothing. It is believed that potato flour, ground mussel shells or the Swedish forests may be important for production of textiles, which need to be produced in large quantities. Among the smart textiles that are developed, are electrically conductive textiles produced without the use of metals. In this fabric fibers are subjected to an evaporation of electrically conductive polymers. The vapor forms an area of the textile fibers that thus retains its softness and flexibility while having conductive and mechanical properties. It is expected that these fabrics will be used in, among other things, solar panels, bio-fuel cells, and, membranes for anti-static air filters. Researchers in developing countries have shown great interest in the method that they hope can be implemented as a new technology in the future of textile manufacturing.

Ethical and far trading in reference to environmental issues [19] suggested a number of areas which can be dealt with to avoid damage of environment by the textile industry. European Eco Label can be used on products that contain no harmful substances and cause minimum damage to the environment. All textile products can be recycled by taking them to a charity shop or collection bin in recycling centers. Textile companies are trying to reduce the use of packaging in order to make the textiles industry more environmentally friendly. It is suggested that waste from production processes should be reduced to prevent it going to landfill. Washing textiles products has a huge impact on the environment.

7. ADVANCES IN TREATMENT OF TEXTILES

The growth of microbes on textiles during use and storage negatively affects the wearer as well as the textile itself. The detrimental effects can be controlled by durable anti-microbial finishing of the textiles using broad spectrum biocides or by incorporating the biocides into synthetic fibers during extrusion. Consumer's attitude towards hygiene and active life style has credited a rapidly increasing market for anti-microbial textiles, which in turn has stipulated intensive research and development. The study conducted by the authors [13], reviewed the requirements for anti-microbial finishing, qualitative and quantitative evaluations of the anti-microbial efficacy, the application methods of anti-microbial agents and some of the most recent developments in anti-microbial

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treatments of textiles using varies active agents such as silver, quartermary salts, polyhexamethylene biguanide, triclosan, chitosan, dyes and regenerable N-halamine compounds and peroxiacids.

The aim of the study on "Exposure modeling of engineered nano particles in environment" was to use a life-cycle perspective to model the quantities of engineered nano particles released into the environment. Three types of nanoparticles were studied, nanosilver (nano-Ag), nanoTiO2 (TiO2), and carbon nanotubes (CNT). The quantification was based on a substance flow analysis from products to air, soil and water in Switzerland. The parameters used as model inputs are estimated worldwide production volume, allocation of the production to product categories, particle release from products and flow coefficients within the environmental components [25]. The predicted environmental concentration (PEC) were then compared to the predicted no effect concentration (PNEC) delivered from the literature to estimate a possible risk. The expected concentrations of the nanoparticles in the different environmental compartments vary widely, caused by the different life-cycles of the nano particles containing products. The results of this study make it possible for the first time to carry out a quantitative risk assessment of nanoparticles in the environment and suggest further detailed studies of nanoTiO2.

8. ANALYSIS AND MANAGEMENT OF ENVIRONMENTAL POLLUTION RISK MECHANISM

The study by the authors [11], aimed to identify and analyze the pollution due to water and air in a textile industry and steps to reduce the risk which arises due to pollution. Many industries like oil refineries, textiles and chemical industries in India create water pollution above the permissible limit. Water pollution is considered to be the biggest environmental threats all over the world. In India, government is investing more to control water pollution but the results are below the satisfactory level. The textile industry accounts for 2.07% of water consumption. The consumption for the textile industry includes various processes such as sizing, dyeing, and other end product processes. The major problem arises when these chemicals are directly discharged into the water bodies thus causing water pollution. Dyed textile yarns while undergoing

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different processes various pollutants are discharged as chemical waste and if water is discharged without any proper treatment, it will lead to hazardous effects to living organisms. Therefore, before discharging they should be properly treated either biological or physical or chemical means. In a textile processing unit, usually sulphur dioxide, sulphates, emanate from the poly-condensation, spinning the fibers and the fur generated during the weaving and spinning processes. In the textile industry coal and water are used which will generate steam comprising of carbon, carbon dioxide, carbon monoxide and sulphur polluting the air together.

Risk is defined as uncertainty and ignoring the risk will certainly affect the employees' health issues, lower the reputation of the company and at last the environment also. The effect of risk depends on vulnerability of the factors involving risk and it may be either in terms of financial or non-financial terms. In order to protect the environment every organization should regularly check and file the documents related to regulations concerning work place safety. The management must ensure that the organization has protocol to implement all the rules regarding the environment and workers safety. The workers of the textile industry should ensure the production area is distinct from the place where they take food in order to avoid the consumption of chemicals through air.

CONCLUSION

Energy is required to produce various items in a textile mill using toxic chemicals and the waste products are discharged straight into the atmosphere, which may be contributing to global warming.

From waste water emissions to air pollution and energy consumption, the textile industry weighs heavily on the environment. The nature of synthetic dyes has become a cause of grave concern to environmentalists. Textiles are pretty bulky compared to other household wastes, and quickly use up the limited space available, but also the biodegradable fraction then breaks down, releasing GHG. Consumer's attitude towards hygiene and active life style has created a rapid increase in market for anti-microbial textiles, which in turn has stimulated intensive research and development. Dyed textile yarns while undergoing different processes various pollutants are discharged as chemical waste and if water is discharge without any proper

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treatment, it will lead to hazardous effects to living organisms.

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