

Harmful Chemical Clothing Affecting Humans Skin And Body Disease

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Abstract

Garment is one of essential elements to survive from external and internal conditions for humans, but this important factor has caused serious disease in humans health as most garments are made with chemicals in general. During washing and manufacturing fabrics, chemicals are used in many diverse ways. Even cotton, the most familiar fabric with human is synthesized with chemicals when it is manufactured. Then, how are chemicals used in manufacturing fabrics and garments and what kind of chemicals are hazardous for human skin and body disease?

There are some dangerous chemicals-Alkylphenols, Perfluorinated chemicals, and so on. Out of them, the most commonly used chemical is called as Alkylphenols, involving nonylphenols (NPs), ethoxylates, and nonylphenol ethoxylates. NPs are widely used in the textile industry for cleaning and dyeing process, they can disrupt sexual development in some organisms through controlling hormones. Like Alkylphenols, other hazardous chemicals used through cleaning and finishing fabrics have also caused hormone systems, cancer, and so on (GreenPeace). Symptoms of all these diseases appear in humans' bodies when contacting with bacterium through garments, many people suffer these diseases every month and year. If so, aren't there any alternatives instead of using chemicals and why do manufacturers, and brands prefer to use chemicals?

Many brands and manufacturers have used chemicals as it costs less and an easy producing way. However, since many customers today seek to purchase more eco-friendly garments for their health and environment, brands and experts are looking for other alternatives and attempting them to use in process now. In this paper, this topic will be covered deeper.

Keywords: Chemical, Human skin, Alternatives, Manufacturing, Environment

Introduction

For a human being, food, shelter and garments are the most important elements to survive from external and internal conditions. However, these essential elements cause troubles in humans' lives from time to time; rotten or contaminated food with bacterium cause extreme abdominal pain, disease or even gastric cancer after consuming them. Not only food, but a place where one resides in also causes troubles in his or her life; when constructing buildings, subsidiary materials, such as painting, woods, invisible dust and bugs in the carpets are available to cause skin diseases, asthma, and skin cancer. As with food and constructing, garments cause serious diseases in both of humans' skin and bodies through skin absorption, breathing, and directly contacting too.

In general, most people take care of food and houses for their health very well when they purchase and eat or stay them; they even check if food is organic or not and if architects and engineers use eco-friendly subsidiary materials or not. However, except for patients or parents who have children suffering skin or body disease from wearing garments made with chemicals, most people in general take care of apparel less than the others. These people are aware that chemicals have been a big issue for environment pollution and may cause troubles to humans too, but they believe they and their families, particularly their children will be exempt from the problems. Because of these some people's foolishness, garments with synthetic fibers are being sold very well in the market, manufacturers and brands still produce them. Since the time that synthetic fibers were made, human skin and body disease had been issues, but recently the issues caused from synthetic fabrics have been increased more.

Every year patients suffering skin or body disease are increasing and these patients have looked for organic cotton, natural fibers, or fabrics mostly made with natural fibers. However,

these are also dealt with and produced under chemicals like pesticides, chemical liquid or powders when they are grown or cleaned. Not only cotton and natural fibers, but most fabrics especially manufactured in China and some countries in East Europe have also produced under harmful chemicals. About these issues, New Zealand's government has strengthened its law under the international laws for imported materials particularly from China and East Europe and tested its safety for adults and children since 2007.

From their testing, they found one particular compound named formaldehyde which is a colorless pungent gas in solution made by oxidizing methanol. This compound can cause throat irritation, cough, chest pain, shortness of breath, and wheezing when it is absorbed into human's body more than standard levels – between 75 parts per million and 202 ppm of free formaldehyde - through washing and drying over time. If manufacturers keep this international law for standard levels, although it can still cause children, particularly babies because they absorb chemicals faster than adults, it causes less for adults. However, China has ignored the international law of using chemicals with standard level when producing fabrics (Clements, 2012). So, it seems like finding solutions are not easy, but there are alternatives to stay humans' condition away from garments made with chemicals and brands are trying to figure out solutions too, but the brands trying to solve problems and producing clothing with less or no chemicals are selling garments in high price.

In brands' perspectives, because many customers are more interested in apparel and fashion items with eco-friendly, brands are trying to make eco-friendly garments to attract more customers with high price. However, the problem is that brands need to take care of environment, as well as human skin and body condition from brands' items, not only their profits and their customers' interest. Except for few richest, the majority of population is middle or low

income which means population and patients with middle or low income cannot purchase high priced eco-friendly garments whether or not brands try to produce eco-friendly garments with high price. Not only brands, but there are more problems by public who needs to pay attention to their neighborhood and patients suffering skin and body problems surrounding them and by other external and internal factors. However, before I'll look for solutions and alternatives, to have information, I need to know what kinds of chemicals are used to produce clothing and what kinds of chemicals are the most hazardous, common, and what kinds of diseases they cause first.

Methodology

Chemical Compounds

According to the international organization GreenPeace, there are well-known nine harmful chemical compounds – Alkylphenols, Brominated and chlorinated flame retardants, Azo dyes, Organotin compounds, Perfluorinated chemicals, Chlorobenzenes, Chlorinated solvents, Chlorophenols, Heavy metals: cadmium, lead, mercury and chromium (VI) - causing problems in human's health. Out of them, the most commonly used chemical compound is Alkylphenols which is from phenol having one or more alkyl groups that one or more alkyl groups with a metal are compound.

This compound involves nonylphenols (NPs), octylphenols and their ethoxylates, particularly nonylphenol ethoxylates, NPs are an organic chemistry that is a family of closely related to organic compounds. This compound is mostly used in the textile industry when cleaning and dyeing fabrics and garments, but using NPs to produce garments has been heavily regulated in Europe and European Union – wide has banned using the chemical since 2005 because the toxic causes sexual development problems in human's body. The chemical compound can mimic human's natural hormones, it can disrupt sexual development in human, as well as some organisms like fish. For the marine life, the compound stays in the environment for a long time, can amass in body tissue and increase concentration through the food chain and then disrupts sexual development of some marine organisms. Though, not only Alkylphenols, but Brominated and chlorinated flame retardants cause sexual development troubles too.

Brominated and chlorinated flame retardants are a chemical compound made by human to be used for industries, as well as to be added to many diverse products like plastics, electronic devices. This compound in general stays in the environment and contain Polybrominated

diphenyl ethers which are flame-retardant chemicals. The toxic – PBDEs - is used as materials for fireproof in the textile industry. For sure, the chemical compound has helped firemen from dangerous situations, but it has also caused serious hormone problems into human's body; the compound is able to interrupt hormone systems causing growth and sexual development issues. For these reasons, European Union strongly restricts to use PBDEs when produce fabrics and garments. Like Brominated and chlorinated flame retardants and Alkylphenols, Perfluorinated chemicals also affect hormone issues into human's body.

Perfluorinated chemicals are basically man-made chemicals, a family of fluorine containing chemicals with unique characteristics to support materials with garments to be resistant against water. So, in particular, it is widely used for leather products in the textile industry. This compound, even though the chemicals are capable of water-repellence, has affected the liver and hormone issues, causing growth levels and reproductive hormones; this toxic persists in the environment for very long time. While staying for a long time, it accumulates body tissue and increases concentration through the food chain. By the food chain in the environment, this toxic is absorbed into humans, as well as some organisms in eco-system. For this issue, the Stockholm Convention has restricted to use the toxic and using this compound has been banned within Europe and Canada. As Perfluorinated chemicals mainly affect the liver and reproductive hormones, some other chemicals like Organotin compounds and Chlorobenzenes cause similar troubles too.

In the case of Organotin compounds, this chemical contains both of tin – a metal with silver and white color - and carbon, this is widely used to prevent bad odors caused by sweating when produce socks, shoes, and sportwear in the textile industry since it can get rid of fungi. Despite its pros, it has cons too; this compound contains named tributyltin (TBT) which is an

organic compound associated with molecule, this toxic can cause immune and reproductive systems into humans and some organisms in marine life. So, using this toxic is largely banned now under European Union regulations. If Organotin compounds have mainly caused reproductive systems, Chlorobenzenes affect the liver.

Chlorobenzenes functions as solvent and are mainly used for dyes in the textile industry. Its main problem is that it can cause the liver, thyroid, and central nervous system depending on the type of chlorobenzenes and how long and how much one is exposed to this toxic. So, the European Union classifies this compound as priority hazardous substances under its regulations and it is listed as persistent organic pollutants under global restriction. Though, not only Chlorobenzenes affect into humans and the environment as solvent, but Chlorinated solvents also affects nervous system issues.

Chlorinated solvents involve trichloroethane (TCE) - which is a substance persisting in the environment for a long time and reducing an ozone extremely - and are used to dissolve other substances when manufacture and clean fabrics. However, this trichloroethane cause serious problems like the central nervous system, liver, and kidneys to humans. So, the European Union has strongly prohibited to use TCE in both of manufacturing products and cleaning fabrics since 2008. As Chlorobenzenes and Chlorinated solvents have caused serious illness and issues to humans and some organisms in eco-system, other chemicals like Azo dyes and Heavy metals: cadmium, lead, mercury and chromium (VI) have caused serious problems too.

Azo dyes are basically synthetic dyes that molecules have two similar nitrogen atoms between carbon atoms. These dyes are one of the most mainly used dyes in the textile industry, but the chemicals cause cancer through a period of using and releasing chemicals known as aromatic amines. So, the European Union has prohibited to use the Azo dyes because its main

illness - cancer - can be caused when human skin is contacted to this toxic through any textiles. As with Azo dyes, Heavy metals like cadmium, lead, mercury, and chromium can cause cancer too.

Heavy metals like cadmium, lead, mercury, and chromium have functioned as dyes and pigments for textiles in the textile industry. Through garments, the hazardous metals are accumulated into human's body over time and then cause toxic. When the toxic is accumulated, the toxic of lead, mercury, and cadmium affects the nervous system, kidneys, and cancer in human's body, whereas chromium mostly affects organisms in marine life and functions for leather tanning in the textile processes. So, the European Union has classified the heavy metals as priority hazardous substances under its regulations and has strongly restricted to use the metals in the textile processes in Europe. As with heavy metals like cadmium, lead, mercury, chromium, and other chemical compounds, Chlorophenols affect human body condition too.

Chlorophenols are a chemical group that is used in a wide range of pesticides to wood protection and textiles as biocides. This compound involves Pentachlorophenol (PCP) which is a colorless, synthetic compound used as weed killers, wood protection, pesticides, and anti-bacterium, it is used in the textile industry. However, the European Union has strongly restricted to use and sell all goods containing this compound since 1991 because the chemical is very harmful as it can affect many organs in humans' bodies. Not only chemicals what I've found from the international organization GreenPeace, but there are some more harmful chemicals that can cause serious illness in human body too.

According to the book *Killer Clothes*, synthetic, particularly blue dyes cause serious disease to human body. For blue dyes, there are two typical dyes; Blue No. 1 called as "brilliant blue" and Blue No. 2 called as "indigotine". In the case of brilliant blue, it is typical modern dyes

originated from coal tar, whereas indigotine is a synthetic version of the plant-based indigo that has been used in textile for a long time (Borrell, 2009). These widely used synthetic dyes in textile industry have caused allergic dermatitis which can cause infection to the skin when the dyes contact to the skin's surface directly (American Academy of Allergy Asthma and Immunology).

To know how blue dyes affect human body disease and how many people suffer skin illness from the dyes, Dr. Aneta Lazarov, who was worked with the Sackler School of Medicine at Tel Aviv University tested six hundred forty-four people (four hundred forty-one women and two hundred three men) in 2004. For the study, the selected six hundred forty-four people wore clothes made with the dyes – blue 124, blue 106, and blue 85 - to be contacted to dermatitis. The result was around thirty-one percent out of the total tested people had a reaction of Blue 124, twenty-seven out of the total had a reaction of Blue 106, and about ten percent out of the total showed a reaction of Blue 85. Not only these tested people, but many other non-tested patients were also suffering allergies from multiple types of Blue dyes, some patients were suffering serious disease developed on their bodies. Based on these results, Dr. Lazarov observed dyes in clothing would not be disappear with laundering (Clements, 2012). As with dyes, chemicals used in cotton has even caused problems to human body too.

In normal, when people think of garments made with cotton, most people believe the garments will be safe because it is made with cotton. When they also think cotton, words of organic and natural come in their mind first. So, without a doubt, they purchase the clothes for them and for their children. Though, all cottons are not created in same level. Some organic cottons are made with one hundred percent without any chemicals, but most are manufactured using chemicals.

In the case of non-organic cotton, from the growing process, pesticides, chemical fertilizers, and herbicides are used, cotton is the plant that the most pesticides are used out of plants harvested for fabrics. Not only in the growing process, but at each stage of its production, toxic chemicals, such as harsh petroleum scours, softeners, brightener, formaldehyde, synthetic chemical dyes, and flame retardant - a substance applied to fabric, wood, or other materials to protect against fire - are used, these chemicals do not disappear well after laundering. So, those are very harmful to human health, particularly infants and children health since babies and children have more fragile skin than adults (Clements, 2012). Then, how the chemicals affect human health?

Illness caused by harmful chemicals

As many chemicals are used when cotton is grown up and processed, it causes a range of health problems, such as allergies, insomnia, immune disorders, cancer, and neurological disorders by absorbing into skin through the garments (Clements, 2012). When the chemicals are absorbed into human body, in the case of adults, because adults have immune system that they can recover or protect their health against bacterium or chemicals, they are less affected. However, the problem is babies and children.

In the case of infants and children, their skin is more porous, thinner, more fragile, absorbent, and less oily than adults' skin (Clements, 2012). In other words, their immune system is very weak. So, once they absorb harmful chemicals through their skin and breathing, their skin will be irritated, will have atopic dermatitis, other skin disease, or neurological disorders. Especially flame retardant which is a compound of chemicals that cotton fabric contain is very hazardous because it can cause cancer, neurological disorders, and damage the DNA. This

compound was used for protecting human's body against fire before. However, since 1970s, this compound has been used to manufacture for pajamas including sleepwear of babies and children (Clements, 2012). This is a big problem because the toxic is absorbed through skin and mouth, infants or children have habits biting their clothing or sleepwear when they go to sleep or in general. To prove it, Oregon State University research team recruited ninety-two Oregon children between ages three to five for their study.

The research team excused the children to wear a silicone wristband for seven days to measure the children's exposure to flame retardants. The result was that all of the children who participated in the study had some or high exposure to the chemicals. Interestingly, the children who had exposed higher to the chemicals showed less responsible behavior, more aggression, no pay attention, and bullying behaviors (Lewis, 2017). It was not the case for only children, but adults who wore clothing made with flame retardant suffered health problems too.

At the Ergon Energy plant in Queensland, Australia, three thousand four hundred workers suffered severe allergic reactions in August 2008. The workers wore new uniforms made by China while working. After wearing the uniforms for a couple of weeks, they started to throw up, have blisters on their bodies, nausea, headaches, and other more symptoms. Because of these issues, chemists in a lab tested the uniforms and they found the garments contained high levels of the toxic chemical (Clements, 2012). As you see from the case in Australia and the study's result for children, synthetic cotton fabric and flame retardant can make big troubles to human body particularly babies and children, as well as their behaviors that can make troubles in a society. However, not only the chemical and cotton, but there are more other chemicals, such as blue dyes causing children's health problems, as well as adults' ones.

As its risks were shown through the study in Israel in 2004 before, blue dyes are very dangerous because at least one Disperse Blue Dye can cause health problems that are much more serious ones – potential cancer – than contact dermatitis. According to the report on *Carcinogens* published by the National Institutes of Health, the dye Blue 1 is a fabric dye for nylon, cellulose acetate, triacetate which is a form of cellulose acetate involving three acetate groups and used as a basic form for man-made fibers, polyester, and acrylate fibers, the dye Blue 1 can format malignant tumor in an unusual degree (Clements, 2012). Although the dye occurs serious problems, using and selling the dye and garments made with the dye continues without any significant restrictions or warning. Especially the dye is widely used sixty-five separate clothing brands in China and the garments from China is exported to many countries including the United States (Clements, 2012). As blue dyes are very hazardous, other synthetic fibers made with chemicals are very deadly too.

Synthetic fibers with chemicals cause three main problems: muscle, sexual issues, and hormone in general. For muscle, it particularly happens to athletes. The garments (uniforms) athletes wear contain many chemicals because it should absorb or repel water and sweat, should be flexible so that sportsmen and women can feel comfortable while practicing their fields. However, the synthetic garments cause muscle disruptions because the synthetic fabric creates emission of an electrostatic field over the surface of the muscle and it results in athletes feel very tired and exhausted (Clements, 2012).

Second one is sexual issues among males. Since World War II, males' sperm amounts have been declined every decade. There will be many factors like environment effects causing this issue, synthetic chemicals cannot be exempt from the factors. To prove the chemical was one of causes that had decreased men's sperm counts, a study was published in the medical journal

Urological Research in 1993. According to the research, the researchers put loose – fitting polyester underpants to the twelve dogs for two years, the result showed the dogs' sperm amounts were significantly decreased and the dogs wanted sexual behavior less than normal (Clements, 2012).

The last one is hormone disruption. Garments, such as stain-resistant clothing made with chemicals like perfluorooctanoic acid - also known as C8, is a synthetic man-made chemical that is stable perfluorinated carboxylic acid and fluorosurfactant – cause thyroid disease that has high blood concentration than normal in thyroid gland by duplicating the thyroid hormone system. This is a big problem because the thyroid hormone system plays a significant role in maintaining human body's heart rate and controlling metabolism, body temperature, and digestion (Clements, 2012). As many studies, cases, and researches show, using the chemicals is very hazardous to human, as well as to the environment. Despite its danger, the chemicals are still used in manufacturing. Then, how is it used and is not there any solution?

How Harmful Chemicals Are Used in Manufacturing Clothing

Synthetic and natural textiles are made in four stages when they are processed from fibers to fabrics. In the first step, the fibers are cleaned and processed of spinning and weaving. Natural and plants based fibers like silk and cotton require to be cleaned and dried so that dirty particles in the fibers can be removed. However, protein based fibers like raw wool requires chemicals to clean it because it contains many impurities like pesticides, lanolin (wool grease), and dirt and perspiration residues. To remove all these impurities, it requires the most common solvent named trichloroethylene, this chemical compound causes cancer because it induces lung and liver tumors in human's bodies, as well as animal's bodies.

In the second step, fibers are singed and scoured to remove more impurities and then do a process called a bleaching, including optical brightening. During the bleaching, a chemical named EDTA (Ethylenediaminetetraacetic acid) which is a molecule called a chelating agent that is a claw-like substance that can grab and stick to other molecules is used. Because this chemical can disrupt hormone as it can mimic natural hormones' effects produced by the body's endocrine system, the compound is regarded as dangerous one for human's body.

In the third step, fabrics are dyed or printed. If the fabrics are dyed in natural ways, there is almost no concern for human's health and environment. However, once chemical dyes are used during the process, the effects of using chemical dyes will be definitely different. In the chemical process, three harmful dyes to humans' bodies are used; Vat dyes, Sulphur dyes, and Chrome dyes.

The Vat dyes include indigo or anthraquinone colors and the dyes release heavy metals during the production process. In the case of Sulphur dyes, to make the dyes, Sulphide and sodium hydrosulphide are used, these compounds can cause environmental issues when these are released into ecosystems. As with Vat dyes and Sulphur dyes, Chrome dyes are used to wash fabrics faster; the bonded chrome ions are attached to the fibers to have an excellent and fast washing process. The dyes work well, but it induces allergic skin reactions and damages the human kidneys and liver. Not only dyes, but pigments for printing also cause problems. The most typical chemical pigment is DEHP - the most common member of phthalates that are used as plasticizers – causes reproductive systems and damages sperm cells.

After the process of dyeing and printing, the last step is finish. In this step, depending on the fabrics and the claims, requests by manufacturers for customers, a wide range of finishes are applied. By customers' requests, fabrics are handled in many different ways, such as easy care

fabrics against wrinkles and shrinkage from laundering, water repellent finishes, and antibacterial and fungicidal finishes.

About the easy care, garments with no wrinkle and shrinkage release formaldehyde, which is dangerous for both human and animal health. In the case of water repellent finishes, to work against oil and water from surfaces of fabrics, fluoropolymers which are a polymer with multiple carbon-fluorine bonds and work as solvents, acids, and bases are used, but the chemical impacts unknown effects in ecosystems. In the process of bacterial and fungicidal finishes, triclosan which is an ingredient added to many customer products to reduce and prevent bacterial contamination is used as the most common application in this category of finishes. In general, one hundred ninety-five parts per million of triclosan levels are used, it is hazardous for human health (Clements, 2012). Even though manufacturers and brands know using chemicals is very dangerous for both of human and environment, they've kept using the chemicals since it's the easiest and cheapest way. To find alternatives instead of using the chemicals, brands, scientists, and technicians have tested and put many efforts so far.

Solution-Alternatives

As many customers concern about their health, as well as environment now, manufacturers and apparel companies attempt to find solutions, such as selling organic plants based garments. There are some companies selling organic garments; Rawganique, Thought, Synergy clothing, Beaumont Organic, and Bibico. Basically, all of the five apparel companies manufacture their garments using mostly certified organic cotton, hemp, bamboo, and natural materials.

The company Rawganique has founded in Canada since 1997. The company deals with all organic cotton, linen, and hemp, it also grows, weaves, knits, and sews its products itself to pay attention to human health, as well as environment. However, because the company handles with all natural materials, its most products are high priced; the average cost of its products is above \$60 (Rawganique).

The companies Thought, Beaumont Organic, and Bibico are based in the United Kingdom. Unlike Rawganique, the three companies seek organic garments, but they combine most of organic materials with a little or some synthetic materials. However, compare the three companies to other apparel companies in the fashion industry, the three companies definitely use very few or less synthetic materials for human health and environment. Also, because they seek organic garments, most of their products are expensive; the average cost of the three companies' products is above £80 in the U.K currency (Thought, Beaumont Organic, Bibico).

The company Synergy Clothing is based in Santa Cruz, California, the U.S, it sells actual organic garments. As with the three organic apparel companies in the U.K, the company Synergy Clothing also combines most of organic and natural materials with very few or some synthetic materials. However, for human health and environment, the company tries to use very low impact dyes and recycled polyesters when they use synthetic materials. Because the company deals with organic products, most of its items are high priced like the other companies; the average cost of its products is above \$60. But, unlike other organic apparel companies, Synergy Clothing offers discounted prices or coupons for discounts to its customers (Synergy Clothing). As you read so far, there are some people and companies, considering human health and environment are coming up. However, because making garments through whole the process that

uses only organic and natural materials is expensive and difficult, it seems like producing garments using only organic materials will take more times for the more apparel companies.

Result

Based on methodology, a lot of harmful chemicals are used in manufacturing garments. Because most of them are based on chemical formulas, names of the chemicals, such as Brominated and chlorinated flame retardants, Azo dyes, Organotin compounds, Perfluorinated chemicals, Chlorobenzenes, Chlorinated solvents, Chlorophenols, Heavy metals, and EDTA (Ethylenediaminetetraacetic acid) are unfamiliar with customers and public in general. However, the fact is that most of them are solvents, Sulphur, metals, dyes, polyester, and acid groups that function well, but very dangerous for environment and human.

All the chemical compounds that are used as synthetic fibers have their own functions, such as water resistant, wrinkle repellent, shrinkage protection, protecting body against fire, getting rid of impurities, maintaining body temperature against external conditions like cold and hot weather, and putting colors into fabrics. However, despite the synthetic fibers' advantages, the compounds have affected so much things to environment and human. For instance, the chemicals have affected organism of marine life and animals through disrupting hormone systems and imitating their tissues. For human, the compounds have caused cancer, disrupted hormone systems, the endocrinology systems, immune systems, asthma, and more. These harmful chemicals are mostly used in a process of manufacturing clothes.

The chemicals are used in four steps; washing the fibers to remove all impurities like dust, singeing and scouring to remove more impurities and doing bleaching, dyeing and printing, and then finishing. Out of the steps, particularly in the step of dyeing and printing, very dangerous chemical dyes like Azo dyes and blue dyes which have caused so many skin diseases, health problems to humans and have affected environment have been used. To protect ecosystems and humans' health, some people have contributed to solving these issues.

Some apparel companies in some countries have noticed garments made with chemicals can be a big problem for the planet and human. So, to resolve these problems, some garments companies have sold organic fashion products that have made themselves using only natural materials or combined natural materials with very few synthetic fibers. Though, since the fashion products are mostly made with organic cotton, hemp, and bamboo, the products are sold in a very high price. So, even though companies, scientists, and experts have looked for alternatives, it seems like finding a complete solution will take long time.

Conclusion

When I decided this topic first time, I just wanted to find solutions for my cousins and boyfriend who are suffering skin problems caused by synthetic fabrics. However, while researching data for the project, I realized so many chemicals are used in a wide range of products and the chemicals are even very hazardous for human, as well as environment. In general, for me, chemicals were mostly used during the manufacturing garments, especially washing the fibers or the powders and liquid that are used to wash my clothing in the laundry can be dangerous because they are chemicals as well. However, I never doubt that dyes to dye and print fabrics are actually one of the most dangerous chemicals.

To put colors into our garments, so many dyes are used today, the dyes are used not only in adults' garments, but it is also used in garments of babies and children. Based on the researches, in the case of adults, you and I have immune and recovery systems in our bodies so that you can protect your body against bacterium or hormone disruptors caused by chemicals. However, in the case of children and infants, they are very weak at bacterium and hormone disruptors because their skin and every organism in their bodies are very soft and weak. In this situation, if the brands and manufacturers keep using chemicals into garments without concerns about their families and children also wear the synthetic garments, then they will regret one day because their kids will have very serious illness caused by the synthetic clothes. Not only they will regret because of their kids' illness, but they will also regret because of public's claim for damaging ecosystems (environment).

By using many chemicals to produce garments, the organism that is in the most dangerous situation is animals, marine organism, and environment than human. Because of human's greed, irresponsibility, and foolishness, ecosystems and environment are suffering a

pain instead of humans now. The problem is that everything, such as food and water human takes is from nature (ecosystems and environment). So, if apparel companies and factories keep disembodying impurities caused by producing garments to the environment like lake, river, and ocean, humans will suffer severe illness and pain by its faults. The issues have been already happened in some countries. Many people in poor countries where mostly produce garments using chemicals are suffering skin diseases, as well as many unknown or known diseases. To solve these issues, some apparel companies have attempted to make only organic fabrics.

However, manufacturing only organic garments is not easy. Or, although companies like I mentioned in the solution part try to make organic clothes, the clothing is very high priced because it is mostly made with organic cotton, hemp, and bamboo. For rich customers, the price does not matter. Though, the major customers in most time are middle and low incomes. Also, the most patients who are suffering skin diseases and health problems in the world are middle, low incomes or a poor group. For them, although there are some organic garments that can be helpful for their skin, body diseases, if its price is too high like the five organic apparel companies Rawganique, Thought, Synergy clothing, Beaumont Organic, and Bibico, then the poor patients cannot purchase the organic garments and they will keep suffering their pain. So, the fashion industry, as well as scientists and technicians need to invent and develop a better one which is non-chemical, but less expensive for customers.

Limitation

While gathering data for my project, I planned two more areas. The first one was that I looked for statistics of how many patients are suffering skin and body disease and how many patients who are suffering the illness come up every day, week, month, and year. For this part, I wanted to connect to professionals like doctors, but connecting them was not easy because I had to make appointments to ask them. Although I wanted to contact them through phones (asked them through phones), receptionists rejected my excuses in general. So, to solve this problem myself, I tried to find information from online. But, finding professional and certified information for the statistics part in online was very difficult. I wanted to find more cases that patients had suffered illness caused by the chemical compounds too, but the data what I wanted was very restricted.

The second challenge was that I wanted to have interviews with professionals in the manufacturing factories in order to have more professional and exact information from the experts. However, because of my private and school schedules, controlling schedules to visit the manufacturing factories was very difficult. So, to find professional information, I had to google it or look up the books and the data from school library database or other colleges' libraries. Those two were the most difficult parts for my project.

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Appendices



Figure 1

<https://www.greenpeace.org/usa/toxics/>



Figure 2

https://en.wikipedia.org/wiki/Effects_of_global_warming_on_human_health



Figure 3

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Figure 4

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Figure 5

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Figure 6

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Figure 7

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