

The Textile Industry Environmental Impact: Is It Possible that the Carbon Footprint of the Textile Industry Is Zero?

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Abstract

The textile industry is known to be the second most polluting industrial sector in the world. According to studies, this sector represents 3 to 10% of global carbon emissions. This article presents the current situation and the causes that led to such an ecological disaster. Also, the article explains why it is important to reduce your carbon footprint and what the consequences are for the environment.

Keywords: textile industry, environment, carbon emissions, pollution.

Introduction

In 2022, ecology is at the heart of the concerns of the modern world. Climate change, pollution of the oceans and the countless tons of waste in the world worry humanity. The cause of these disasters is linked to the industrial world and the massive exploitation of planetary resources. Excessive production and the use of chemicals are gradually destroying nature.

Today I would be interested in one of these sectors which contribute to the destruction of the Earth. This is the textile industry, known to be the second most polluting industrial sector in the world. According to studies, this sector represents 3 to 10% of global carbon emissions. And if we look at the report of the Ellen MacArthur Foundation "A new textiles economy: Redesigning fashion's future" have for comparison, it is higher than all the emissions of international maritime and air transport combined. Given the current situation, these figures are impressive, and it is time to act.

I will start this article with a presentation of the current situation and the causes that led to such an ecological disaster. I also explain why it is important to reduce your carbon footprint and what the consequences are for the environment.

I will detail in a second point the methods known to reduce the carbon footprint of this industry. I also explain why certain textile manufacturing steps cannot be depolluted. I will deal with the research and development part that would push the textile industry to have a neutral carbon footprint.

Finally, I will evaluate the pollution share of each step and compare them to each other to prioritize the actions to be taken.

The Textile Industry: What Is the Current Situation?

1. What Is a Carbon Footprint?

According to the dictionary, the carbon footprint is an indicator that aims to measure the impact of an activity on the environment, and more particularly the greenhouse gas emissions linked to this activity. Therefore, the carbon footprint (measured in kilograms of CO₂ equivalent) is the amount of greenhouse gases emitted by the system under study.

Today, we see greenhouse gas emissions as a major source of change in our environment and in the functioning of the planet. They reinforce global warming and the resulting ecological disasters. This situation presents many risks to humans and all other life forms on Earth. We can mention here the melting of the ice, the increase in the level of the oceans and the strong heat waves which multiply each year.

The production of greenhouse gases and therefore a danger for humanity, animals, plants: the entire planet. This gas production has increased considerably in recent years due to the strong industrialization brought by men. We are witnessing, today, the terrible consequences of this industrial revolution. At the time, we used resources and we consumed excessively without worrying about sustainable development and what could happen tomorrow. This awareness was realized at the beginning of the 21st century and continues to grow. In 2022, the environment is increasingly at the heart of the news, and everyone must be aware of it.

Admittedly, manufacturers are on the front line and must deal with more and more ecological constraints created to reduce pollution and make a correct climate prosper.

2. The Role of the Textile Industry in the Environment

When we look at the carbon footprint of a company or an industry, we look at several criteria such as freshwater consumption, the energy used from fossil resources, the imbalance of aquatic environments because of toxic discharges (chemicals), the toxicological impact in humans and many more.

To measure the environmental impact of the textile industry, it is important to divide this industry into several stages and to look at each stage at which polluting activities are involved.

Always relying on the last report of the Ellen Mc Arthur Foundation of 2017. We note that at each stage related to the textile industry, we can realize the ecological scourge of its activities. First in the footsteps of its non-renewable resources, then at the stage of landfilling or incineration of non-recyclable waste, obviously passing through the intensive use of consumer laundry.

It should also be considered that the textile industry works in a very linear way. Recycling is not the most developed, which leads to the following consumption pattern: I produce - I consume - I throw away. There is no concept of a cycle that would make it possible not to constantly produce more.

In the following explanatory diagram, Circular Fiber Initiative Analysis details the share of non-recycled waste. They find that 73% of waste from this industry will be buried or incinerated. Thus, $\frac{3}{4}$ of the waste emitted would not be recycled or reused (figure 1).

Circular Fiber Initiative Analysis brings together key industry players to build a circular economy for textiles, starting with apparel. This group is trying to create a new system for textiles based on the principles of a circular economy while phasing out waste and pollution.

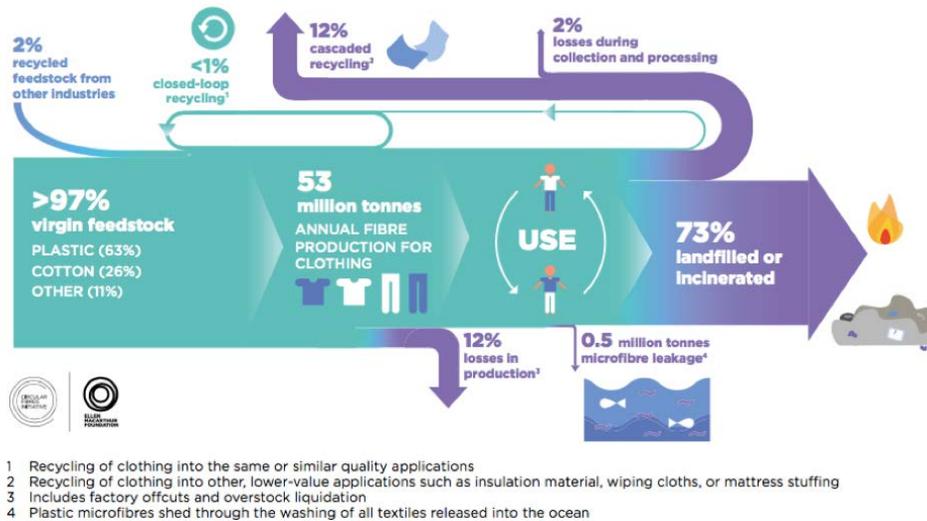
3. Why Does the Textile Industry Always Increase Its Production?

As we saw in the previous point, the textile industry is a linear industry that leaves little room for recycling. This linear pattern results in ever-increasing mass production. Moreover, today in a world where everything is always going very fast because of the media and social networks, fashion is more and more ephemeral. The consumer always seeks to have what is most trendy and

fashionable. This pushes the brands to release more and more collections each year, which multiplies the references.

Figure 1. Global material flows for clothing

(Circular Fibres Initiative analysis – Appendix B)



The consumer seeks to have inexpensive products because he knows that he will only wear them for a short time. The clothes are of less and less good quality because we must produce more and more quickly. According to Greenpeace, we buy on average 60% more clothes than 15 years ago, which feeds the empires of the textile industry.

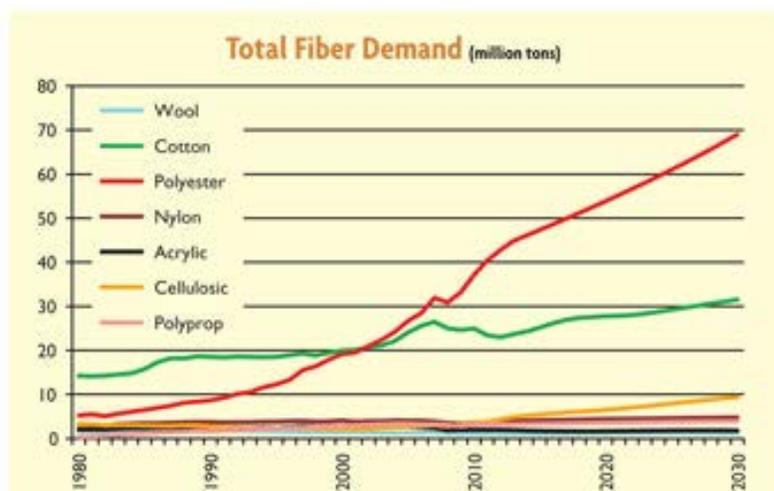
In the Western world, therefore, price and quantity are favored over quality. Companies are looking for cheaper materials to drive down prices like polyester. It is an abbreviated name for a man-made synthetic polymer, more commonly referred to as the polyethylene terephthalate (PET) type. It is made by mixing ethylene glycol and terephthalic acid. It is therefore, more vulgarly, a product like plastic.

This material became a popular choice for clothing in the 1970s because polyester fibers are thermoplastic or heat sensitive. This means that 100% polyester fabrics can have permanent creases as well as decorative shapes and patterns. Plus, they're highly stain-resistant, making them great for cleaning.

However, from an environmental point of view, during its manufacture, polyester is molded and treated with many dangerous chemical elements. The polyester is soaked in a mixture of chemical compounds, including caustic soda (sodium hydroxide) and sodium hydrosulphite, which releases a toxic gas (sulphur dioxide) on contact with water. The dye itself is very irritating. The process is also energy-intensive, as fixing can only be done in ovens above 100°C. The fumes released are toxic and polluting for the human body.

Thus, as the following graph shows, the demand for polyester overtook that of cotton in the early 2000s and needs to increase in the same way as the digitalization of fashion (figure 2).

Figure 2. Total Fiber Demand (million tons)
(England-based PCI Fibers)



The message is clear that polyester is an important part of all other fibers (man-made and natural). Anyone in the fiber industry should be aware that polyester producers will always be looking to see if market share of other fibers can be taken. It is then difficult to face this new fabric giant.

To sum up this first part, we are facing a major problem which is the increase in textile production, the increase in the market for polyester and an industry with an almost 100% linear pattern. We must now see what solutions and methods are in place today to reduce pollution in this sector.

Methods and Solutions Implemented to Reduce the Carbon Footprint of the Textile Industry

In this paragraph, I will deal with the environmental solutions put in place at each stage of the process from the extraction of the raw material to consumption.

1. Management of Raw Materials

As seen in the previous paragraph, raw materials can be synthetic or natural.

On the one hand, about the cultivation of natural fibers, their harvest consumes a large volume of water and involves the use of insecticides. For example, cotton (37% of the world production of textile fibers) consumes 5,000 and 17,000 liters of water per kilogram. According to the Ellen MacArthur Foundation, 4% of the drinking water available in the world is used to produce clothing. The massive consumption of water causes natural disasters such as the disappearance of certain Aral Sea which leads to a disruption of biodiversity (figure 3).

Figure 3. The evolution of the Aral Sea for 44 years

(<https://www.nationalgeographic.fr/environnement/2014/10/disparition-de-la-mer-daral-les-causes-dun-desastre-ecologique>)



Cotton plantations also pose the problem of monoculture. Crops will be planted on large surfaces that will occupy all the surrounding space and thus generate the replacement of the biodiversity initially present. The soils are then depleted from year to year, linked to the lack of nutrients provided by this biodiversity. Thus, to overcome this problem of soil depletion, farmers use

chemical fertilizers that are dangerous for the environment. These are short-term solutions that only delay the problems associated with intensive production that further degrades our planet.

On the other side, when it comes to synthetic fibers. The exploitation of fossil oil resources does not correspond to a sustainable development approach. It is estimated that more than 70 million barrels per year are used for the manufacture of synthetic textiles alone.

The proposed solutions to the above problems consist in turning to more sustainable materials such as linen which consumes little water for example, or recycled plastic. This implies less damage on nature. Although techniques are modernizing, there are few or no solutions that would meet the current massive demand. It is up to the consumer to become aware of the climate cause and to direct their demand towards materials that are less destructive to the environment.

2. Manufacture and Processing

When spinning and designing garments, many power-hungry machines are used. They consume a lot of electricity and run constantly in some countries. However, the worst does not lie in the power consumption but rather in the composition of the fabric treatments.

Spinning, which transforms the material into yarn, requires the use of highly polluting lubricating chemical agents to prepare the fibers. Also, during weaving, the grease used to make the threads more resistant is very polluting because it is produced from petroleum.

Once weaved, the fabrics are first bleached before applying any color, so they then have dyes in the compositions are very chemical. But this does not end here. There is a whole other processing suite for the fabrics to be commercialized. They are treated so that the colors do not fade, to waterproof them, to change their texture, to prevent them from igniting too easily, to fight against stains and to finish for dry cleaning. This chain of treatment involves chemical processes that make the fabric a very polluting product if left in nature.

Once again, water consumption is still high, especially in the sanding stage. This step consists of removing the indigo pigmentation from the denim fabric by propelling a jet of sand under high pressure.

To reduce the carbon footprint of this step, new techniques make it possible to limit water consumption and pollution. First, there is ozone washing, which is an eco-responsible alternative

to sandblasting. By replacing the water in this sandblasting with ozone, the quantity of water needed for washing is reduced by 50%. Similarly, CO₂ dyeing makes it possible to dye polyester without water, additives or drying.

From a legal point of view, Europe has implemented a 2007 REACH regulation which aims to secure the manufacture and use of chemical substances in industry.

According to me, the solution here would simply be not to consume new products but to turn to products that have already been woven, and to reuse them to make new clothes, for example. This would avoid reprocessing the fabric and rethreading bobbins.

3. Distribution and Transportation

According to ADEME (the French Environment and Energy Management Agency), jeans travel an average of 65,000 km before arriving at their destination, which represents 1.5 times around the earth. Its transport would be carried out mainly by plane and boat, a major consumer of oil energy. The relocation of manufacturing plants is the main cause of the increase in journeys. Indeed, the textile industry is in Asian countries mainly where labor is cheaper far from its Western consumers. The solutions for this problem are very simple. We must buy closer to reduce the distance between the manufacturer and the consumer. It seems physically easy to relocate a manufacturing plant unlike a mining field. It is then on the manufacture that it is necessary to act.

4. Use and maintenance

Although oil extraction in the marine environment pollutes the water, washing it in a washing machine also pollutes. Washing our synthetic clothes in the washing machine releases 500,000 tones of plastic microparticles each year into the ocean, which corresponds to 50 billion plastic bottles. Evacuated in wastewater, they largely pass through the mesh of treatment plants and end up in the ocean. They will take thousands of years to degrade.

These microparticles harm marine flora and fauna and disrupt the proper functioning of marine biodiversity. This problem is serious, according to WWF, the plastic microparticles released by the domestic washing of clothes constitute the 3rd source of plastic pollution in the oceans.

To deal with this increasingly worrying problem, many scientists are looking into the subject, such as Richard Thompson, director of the Marine Institute at the University of Plymouth. He advocates the use of filters intended to retain microparticles in washing machines. The researcher took part in a study that assessed the effectiveness of existing models. It shows that the best performer

manages to stop nearly 80% of the microfibers. This technology would be a major effort against pollution.

In addition, the use of organic detergent and washing products is preferable to chemical products marketed in most supermarkets.

5. End of Life

In France, current figures indicate that an inhabitant consumes 29.2 kg per year and only recycles 23.2 kg by selling it, or by giving it to collection centers for example (Source: Rad Canada). The remaining 6kg are often thrown away with household waste and then burned or buried in public dumps. As we had previously, the toxic molecules of the fabric will end up in nature and in the same way as other waste will disturb the surrounding biodiversity.

In my opinion, when you want to get rid of fabric, you must first find out why you no longer want the fabric. If it is because it is damaged, then we can try to repair it or give it another function. If we simply don't like it anymore, then we can try to sell it and give it a second life. Otherwise, there are special textile bins, where companies come to collect their entire bags of fabric to recycle them. This makes it possible not to produce again. It is important to understand that there is already enough tissue on Earth and there is no need to produce more and more. Just look and be interested in what we already have available.

Summary Table of the Global Environmental Impact of Each Phase of the Textile Life Cycle

An analysis of the share of pollution in each stage of the textile life cycle was carried out by Elise Beurrier, founder of the French brand Youkan.

Table 1 makes us aware that the most polluting steps are those related to the use of chemicals. This implies that micro-particles are a real threat to the environment. It is on this main point on which we must act.

Pollution linked to microparticles is difficult to understand because it is an element that cannot be seen with the naked eye. Its size is comparable to 1/30 the diameter of a human hair. Their real impact is still little known. We now just know that these particles are found throughout the

environment, are ingested by animals and by humans. The smallest micro plastics could end up in our cells.

Table 1: Global Environmental Impact of Each Phase of the Textile Life Cycle

(Source: Elise Beurrier, founder of the French brand Youkan)

Phase	Share of pollution	Main impacts
Raw material management	44%	Large spaces and large quantities of water for irrigation, use of GMOs, fertilizers, and pesticides
Manufacturing and processing	14%	Many steps requiring energy, water, and chemicals
Distribution and Transport	4%	Numerous transports over long distances with polluting vehicles, in particular the plane
Use and maintenance	38%	Use of energy, water, and chemicals for washing, drying, and ironing
End of life	0.1%	Transport, incineration, storage

The seas and oceans would be the most affected because of wastewater discharges. These particles break down very slowly and their ratio to other debris will continue to increase. Currently, they form around 80% of marine litter.

However, it is not just the oceans that are affected. Microplastics have reached the deepest abysses but also the summits of our planet: 11 snow samples and 8 water samples taken from the streams downstream of Mount Everest in the spring of 2019 were examined in the laboratory by the University of Plymouth, which identified microparticles of all kinds such as polyester, acrylic, nylon, and polypropylene.

These molecules are almost always textile fibers. The researchers suspect that they come from the wear and tear of the clothes worn by the climbers, the wind blowing through them and of course the evaporation of the oceans which fall as snow or rain to Earth. The water cycle involves massive transport of these microparticles.

Conclusion and my Opinion About the Future

In this article we try above all to show whether the textile industry could have a neutral carbon footprint. Unfortunately, that seems far from the case. My development has assured us that no step in the textile industrialization process has a neutral carbon footprint. However, nothing is lost and there are solutions to reduce the environmental impact of each step.

Although industrial methods are questioned, the real source of the problem comes from consumer demand. The sales made and the quantities produced show enormous figures. It is mass production that has a heavy impact on the planet. If demand were reduced, manufacturers would not need to exceed capacity using polluting methods.

In the 21st century, our way of life, our mores, our habits are geared towards consumerism and convenience. According to the European Environment Agency (EEA), the amount of clothing purchased in the European Union increased by 40% between 1996 and 2012 and each person keeps an item for half as long on average. And indeed, for each stage of the industrial process, we have seen that the consumer can act to reduce the carbon footprint. So, consumers are the key.

As Mrs. Gro Harlem Brundtland, Prime Minister of Norway stated in 1987, development that meets the needs of the present without compromising the ability of future generations to meet theirs is sustainable development". For the textile sector, a common awareness of the environmental situation is necessary.

I then offer you solutions applied to the consumer to reduce the carbon footprint of the textile industry to 0:

- First, it is obvious to limit our consumption. It would be enough to buy better and, in less quantity, to concentrate on the essentials. the manufacturer would reduce their production volume and therefore their pollution impact.
- Secondly, we must use what already exists. The second-hand market is increasingly developing and offers those who have little means or who want to bring textiles back to life to obtain items at low cost. This system combines economy and ecology. This second-hand market, which was at 21.2 billion euros in 2018, represents 45 billion euros in 2021 according to an American study. An approach that gives hope for the planet.

- Third, clothing recycling centers are prioritized when disposing of fabric. In France and in many Western countries, there are collection points for clothing. They are maintained by organizations that salvage the clothing to make new items or donate to people in need. To recycle clothes, it is also possible to seek to repair them or offer them another use.
- Fourth, the consumer can buy ecological. Not to mention greenwashing and the whole green wave on which brands are surfing, there are more and more brands that are really committed. They seek to make their clothing as neutral as possible in terms of carbon footprint. Clothing can be made from recycled materials or natural organic plant fibers. Some brands also offer local manufacturing to reduce transport.

You still must realize that this last solution is generally more expensive, and it is not accessible to everyone.

To conclude, although ecology is not at the heart of everyone's concerns. The pollution emitted by the textile industry is directly caused by the consumer and it is up to him to act for himself and for others. As previously developed, there are simple solutions accessible to all to bring the carbon footprint of the sector towards 0.

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