

Environmentally friendly environment development using recycled textiles

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ABSTRACT: Post-consumer textile waste has greatly increased as a result of the shortened life cycles of clothing brought on by the rapid expansion of fashion. Every year, an enormous amount of clothing that is actually in fine shape is discarded, posing a serious environmental issue. These post-consumer textile wastes can be recycled or repurposed, which will support broader efforts by international companies to move towards a circular economy and create a closed-loop manufacturing cycle.

KEYWORDS: Textile reuse and recycling, clothing, waste management.

1. INTRODUCTION:

One of the most polluting and waste-producing businesses in the world is the worldwide textile and fashion industry. According to a recent poll, Americans will discard 81 pounds of clothing on average this year. 26 billion pounds of textiles and clothing are thus disposed of in landfills [1]. The world's use of fibres, and consequently the consumption of finished products made of fibres, such as clothes, home textiles, or industrial textiles, has increased about 30 times since the 1950s, according to the 2011 FAO/ICAC survey published by the United Nations (FAO/ICAC, 2011). [2]. The consumption of fibres and yarns worldwide climbed to a record 90.1 million tonnes in 2013 from 82 million tonnes in 2011[3]. Extreme consumerism and improper waste management have led to grave and growing environmental, societal, and economic issues. According to data from the United States Environmental Protection Agency (2015), 13 million tonnes of textile trash were produced in the United States in 2013, accounting for 9% of all municipal solid waste. According to reports, the number of secondhand clothing (SHC) increased by 40% between 1999 and 2009, however the rate of landfill diversion for SHC only increased by 2%. (www.wearonaterecycle.org).[7]In the United States, the average Americans recycled or donated only 15% of their used clothing. The remainder— about 10.5 million tons a year—went to landfills[4]. Waste is considered to be a problem for many reasons, of which the harm to the environment and human health, limited space for landfills are important. As textiles present a nonhazardous solid waste, their recycling is often sidelined. In 2012, in the USA alone, the incineration of synthetic fibres resulted in 1.1 MMT (million metric tons) of CO₂ (carbon dioxide equivalents) emissions, while textiles in landfills contributed a net 8.5 MMT CO₂ that year (Patagonia 2016a) [3]. The textile and apparel industries include a no. of processes from the production of fibre to the finishing of apparels. The textile industry is the second-largest industry in the world (after the food industry), Consuming nearly ten per cent of the world's energy. By its origin, textile waste can be divided into two broad categories: post-consumer waste and post-industrial waste generated during the manufacturing process. Contemporary waste

The management system adheres to the recycling, reusing, and reducing trinity. Significant amounts of post-consumer textile waste (PCTW) in the form of worn or second-hand clothing are produced due to the fact that the life cycle of fashion clothing is shrinking day by day as a result of the availability of resources and lower price (SHC). Also, it is anticipated that the textile recycling sector will recycle about 3.8 billion pounds of post-consumer textile waste, or 15% of the total (National Cotton Council of America 2016). [3]A number of fashion industries are now launching various programs to collect used clothing from the customers to sell them or to donate them as second-hand clothing or to recycle them into fibers or fuels, thus extending their product lives and reducing waste. The clothing life cycle (creation, disposal, reuse) is represented in figure: 1 below.

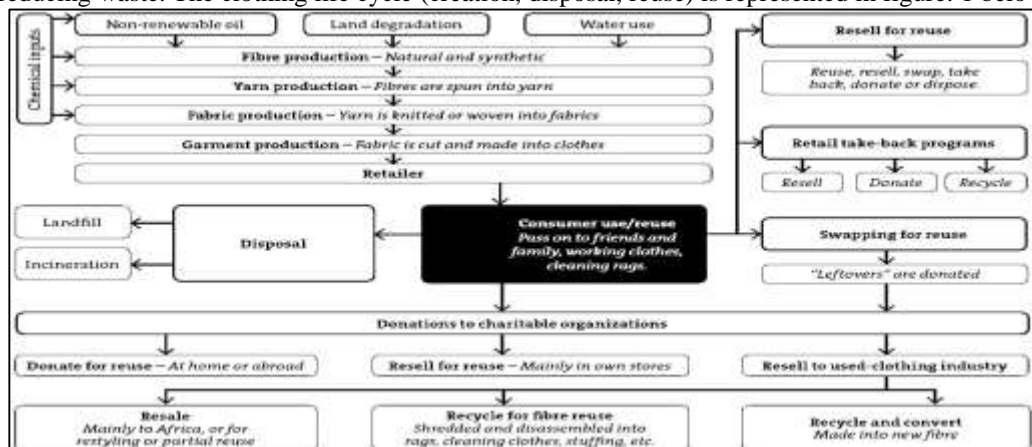


Figure: 1 clothing life cycle: creation, Disposal and Reuse.

Source:http://www.forgerecycling.co.uk/blog/wp-content/uploads/2016/01/Clothing-Life-Cycle_-Creation-Disposal-Reuse.png

2. SOURCES OF GARMENT WASTE:

Textile wastes can be classified into three categories. (1) Pre-consumer waste, (2) post-industrial textile waste and (3) post-consumer textile waste as given in Figure: 2.

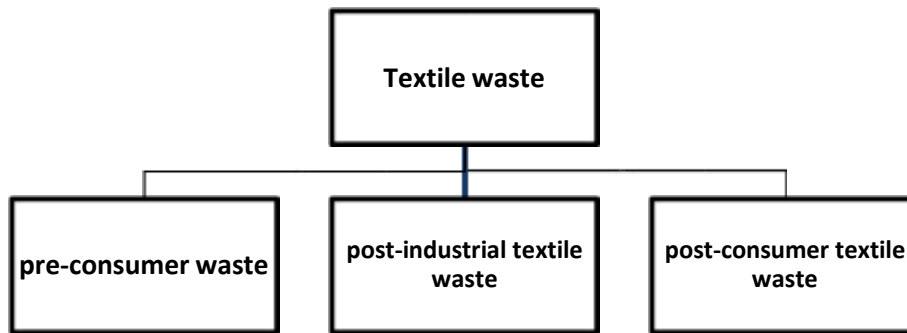


Figure: 2 Classification of Textile Waste.

Wastes generated by the original manufacturer that never reaches the consumers are best classified as pre-consumer waste. Various hazardous chemicals are used and emitted while manufacturing and processing clothes. Sixty-three per cent of textile fibres is derived from petrochemicals (Lenzing, 2017) whose production and fate give rise to considerable carbon dioxide (CO2) emissions (Shen et al., 2010a). The remaining 37% is dominated by cotton (24%)[5]. Post-industrial textile wastes are generated during the manufacturing process. Wet treatment processes (dyeing, finishing, printing, etc.) are major sources of toxic emissions (Roos et al., 2015b), and spinning of yarns and weaving/knitting of fabrics most often rely on fossil energy use, causing emissions such as CO2 and particulates (Roos et al., 2015a)[5]. Sandin et al. (2015) estimate that, for several environmental impact categories, the impact per garment use in a western country (in this case, Sweden) must be reduced by 30-100% by 2050 if the industry is to be considered sustainable with regard to the planetary boundaries outlined by Steffen et al. (2015)[5]. On average, about 15 % of fabric used in garment production is cut, discarded, and wasted in the process, which contributes to post-industrial waste.

Post-consumer waste is received from the public, which includes items that have no more use for the owner. This commonly includes donated and discarded apparel and some plastic items such as plastic bottles made from polyethylene terephthalate. Nylon can also be recycled and a large source of post-consumer nylon waste is fishing nets left in the ocean. The US EPA estimates that textile waste occupies nearly 5 % of all landfill space and the average US citizen throws away 70 lb of clothing annually.[3]

Roos et al. (2016) show that such a grand transition requires a combination of different measures for impact reduction, most likely including more reuse and recycling [5].

3. CONCEPT OF REDUCE, REUSE & RECYCLE:

The notion of 3R is popular and fundamental in waste management. Its earliest documented origin may be traced back from the United States in the 1970s when it was mentioned in De Bell (1970) and appeared as a slogan for various environmental campaigns during the time.[4] Essentially, the 3R concept encourages people to reduce the use of resources and waste, to reuse items for different purposes, to recycle items to reusable forms or as raw materials for new products.

Reuse of textile means prolonging the service life of textile products by transferring them to new owners with or without any modifications i.e renting, trading, swapping, borrowing and inheriting facilitated by second-hand shops, flea markets, garage sales, online marketplaces, charities and clothing libraries.

Recycling of textiles means, the reprocessing of pre- or post-consumer textile waste for use in new textile or non-textile products. Textile recycling can be done by either mechanical, chemical or, less frequently, a thermal process or a mix of all three processes. Chemical recycling most often refers to depolymerisation of polymers or dissolution of polymers. Thermal recycling often refers to the conversion of PET flakes, pellets or chips into fibres by melt extrusion whereas the flakes, pellets and chips have been produced from PET waste by mechanical means, which is sometimes referred to as mechanical recycling.

4. CLASSIFICATION OF RECYCLING PROCESS:

Two types of classification of the recycling process are given in Figure:3 and 4 Below.

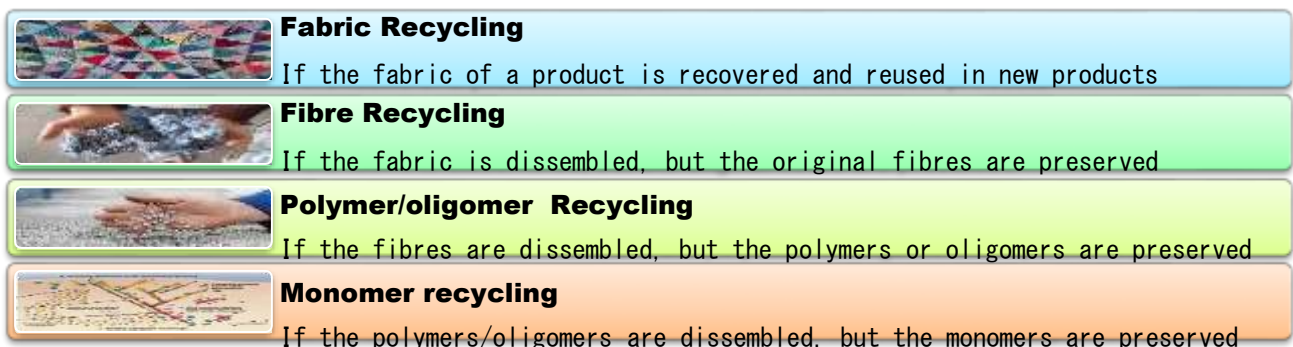


Figure: 3 Recycling of Textiles¹

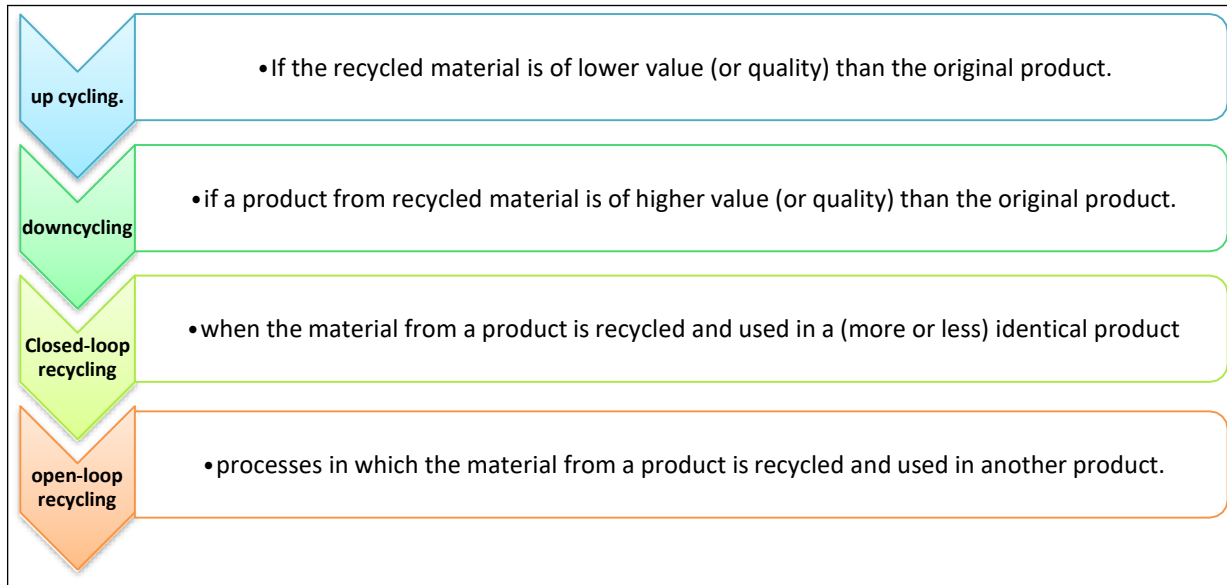


Figure: 4 Recycling of Textile Products².

5. RECYCLING AND REUSING OF CLOTH:

There are two stages in the recycling of cloth, collection and processing. Recycled materials used in textile and apparel products can be obtained throughout the textile and apparel supply chain and post-consumer collection methods. With the introduction of manmade and synthetic fibres in the late nineteenth and twentieth century, the practice of reusing the pre and post-consumer products was reduced due to the availability of increased raw materials. Secondly, as natural and man-made blended fibres became more popular, it was difficult to separate the fibres by generic class. Large percentages of cotton and polyester used in textiles and apparel products contribute to the interest in the development of successful recycling programs. Benefits of polyester recycling methods include reducing the high ecological and social cost of oil reducing petrochemical pollution and reduction production emissions, including environmentally damaging chemical such as cobalt, manganese salts, sodium bromide, antimony oxide, and titanium dioxide (Hayes 2011)[3].

Reuse of Apparel Historically, it was common that when apparel was no longer useful, i.e no longer in style, it was remade to fit someone else or redesigned to create a more stylish garment. Today it is quite common for apparel items to be donated to charities for resale or discarded in the trash bin after they have fulfilled their initial use. Goods that were not recycled or reused translate into about an \$88 billion loss. That’s due to a loss in value and resources that went into making them. On the other hand, contributing to the secondhand industry helps to infuse money into the economy. The industry employs nearly 100,000 workers and creates \$1 billion in wages in the U.S. alone [1]. some photos of recycling of textile waste (Trash to fashion) is given in figure: 5.



Figure: 5 Trash to fashion

Source:<http://webcoist.momtastic.com/assets/uploads/2011/11/upcycled-fashion-karishma-shahani.jpg>

Second-hand clothing markets were noted as the usual manner of reusing clothing. In the USA, the largest volume of apparel goods (48%) was sorted for second-hand clothing markets, primarily for export markets in developing countries or disaster relief (Hawley, 2006)[7].

In2012, the United Nations calculated the global trade in used or second-hand clothing (SHC) to be approximately \$5 billion (UN Comrade, 2014)[3]. Similarly, Sweden reuses around 17% of annually purchased clothing by donations to Africa and Eastern Europe (Palm, 2011)[14].

The use of Parachute Netting into Camouflage Garments is shown in figure: 6



Figure:6 Parachute Netting into Camouflage Garments.

Source:<https://inhabitat.com/wp-content/blogs.dir/26/files/2011/07/ao-textiles-debbie-little-2-120x120.jpg>

Reuse of Military Materials to Warm Winter Fashion is shown in figure:7.



Figure: 7 Military Materials to Warm Winter

FashionSource:<http://webecoist.momtastic.com/assets/uploads/2011/11/upcycled-fashion-christopher-raeburn.jpg>

6. MARKET TRENDS:

In 2013, Americans recycled 2.3 million tons of textiles which reduced greenhouse gases equivalent to taking 1.2 million cars off the road for a whole year (Freeman 2016)[10]. Patagonia is perhaps the first company to operate a global recycling program for apparel (Green 2008). Nike states 'We envision a transition from linear to circular business models and a world that demands closed-loop products – designed with better materials, made with fewer resources and assembled to allow easy reuse in new products' (Nike 2016c)[3].

Evnu one of the leading brands in cotton recycling uses post-consumer cotton garment waste to create a high-quality, bio-based fiber (Enrvu 2015a). EcoAlf is an apparel brand who has recycled fishing nets, plastic bottles, tires, and other wastes into jackets, shoes, and bags. Beginning in the early 1990s, the Reuse-A-Shoe program was introduced by Nike. Econyl® is a synthetic textile made using a variety of wastes including the post-industrial scraps and post-consumer waste such as abandoned fishing nets and old carpets. In Levi's (2012) introduced a new collection of denim identified as Waste Less™. Each product contains a minimum of 20 % post-consumer waste.[9] In Finland, a secondhand charity shop received more than eight million kilograms of old clothing in 2010, an increase of 3.5% over the previous year [8] [9]. In Brazil, the reuse and recycling of textiles have no due importance, unlike some European countries and the United States [10-13], where laws on the disposal of solid wastes and studies about industrial and domestic scraps of textiles have relevance. H&M one of the leading textile brand has committed that by 2030 all of the clothing in their stores will come from sustainable sources.[15]

7. CONCLUSION:

Using Second Hand Clothes (SHC) materials has a number of benefits. First of all, it does away with the need to produce new materials (fibres and textiles) that use limited supplies of water and fossil fuels. Second, by redesigning clothing through the upcycling process, dangerous chemicals that can affect the environment and human health are not used in the dyeing and finishing steps. Thirdly, the clothes used in this procedure is saved from a landfill or being burned. The development of new cutting-edge technologies and methods for material processing (without quality loss), collecting, sorting, processing, and usage in a new product that is also recyclable is crucial to the future of recycling. In order to train and value the people engaged, generate revenue, and raise environmental consciousness, a number of organisations and Charities are already working with the reuse of textile

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