

DEVELOPMENT OF ECO-FRIENDLY ENVIRONMENT USING RECYCLED TEXTILES

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ABSTRACT: The shortened life cycle of apparels due to rapid fashion growth create a great amount of post-consumer textile waste. A tremendous number of clothing which are in fact in good condition being disposed of every year to impose a great problem to the environment. These post-consumer textile wastes can be reused or recycled which will align with the larger movements of global industries toward a circular economy and work to achieve a closed-loop production cycle.

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

1. INTRODUCTION:

The global textile and fashion industries represent one of the most polluting and waste-generating sectors in the world. A new survey found that the average American will toss out 81 pounds of clothing this year. That amounts to 26 billion pounds of textiles and clothes ending up in landfills [1]. According to the 2011 FAO/ICAC survey issued by the United Nations (FAO/ICAC, 2011), the world fibre consumption, and therefore the consumption of final product made of fibres, e.g. clothing, home textiles or industrial textiles, has grown nearly 30 times since the 1950s.[2]. In 2013, the global consumption of fibres and yarns increased to 90.1 million tons from a record of 82 million tons in 2011[3]. The exaggerated consumption and incorrect waste disposal have generated an increasing and alarming environmental, social and economic problems. Data from the United States Environmental Protection Agency (2015) report that approximately 13 million tons of textile waste were generated in 2013, making up 9% of total municipal solid waste in the United States. From 1999 to 2009, the amount of SHC reportedly increased by 40%, while the rate of landfill diversion for Second hand clothing (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

Management system follows the trilogy of reducing, reusing and recycling. Since the life cycle of fashion clothes are reducing day by day due to the availability of resource and less price generate significant amounts of post-consumer textile waste (PCTW) in the form of used or second-hand clothing (SHC). It is also predicted that the textile recycling industry recycled approximately 3.8 billion pounds of post-consumer textile waste that accounts for approximately 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.

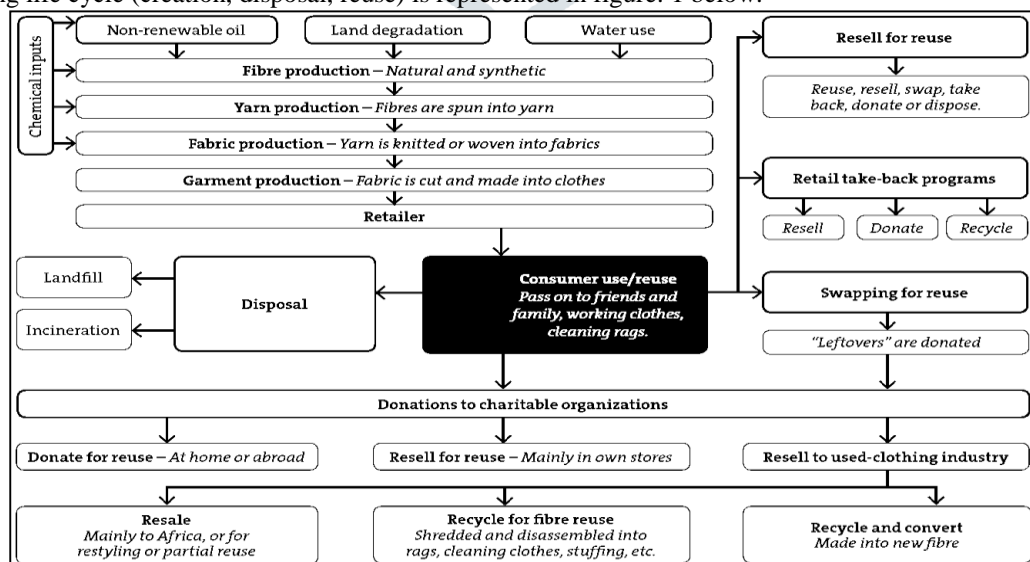


Figure: 1 clothing life cycle: creation, Disposal and Reuse.

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.

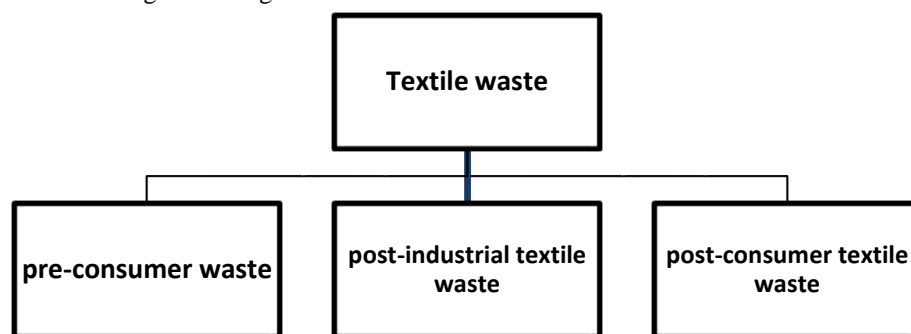


Figure: 2 Classification of Textile Waste.

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.

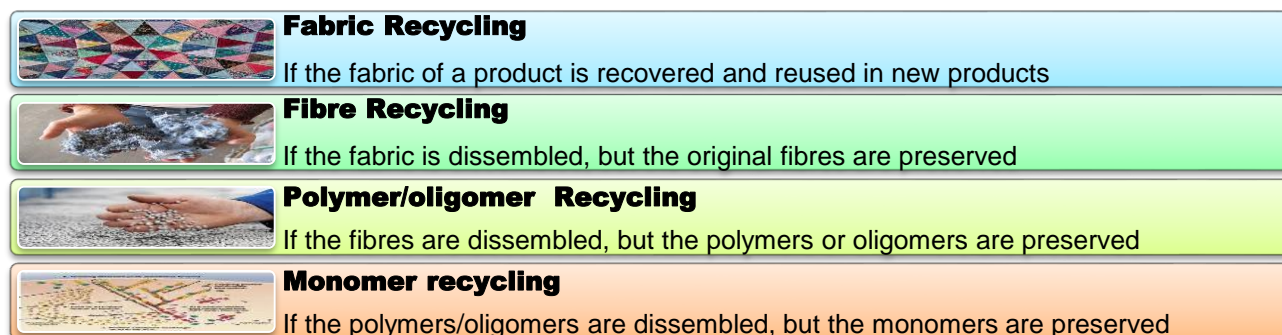


Figure: 3 Recycling of Textiles¹

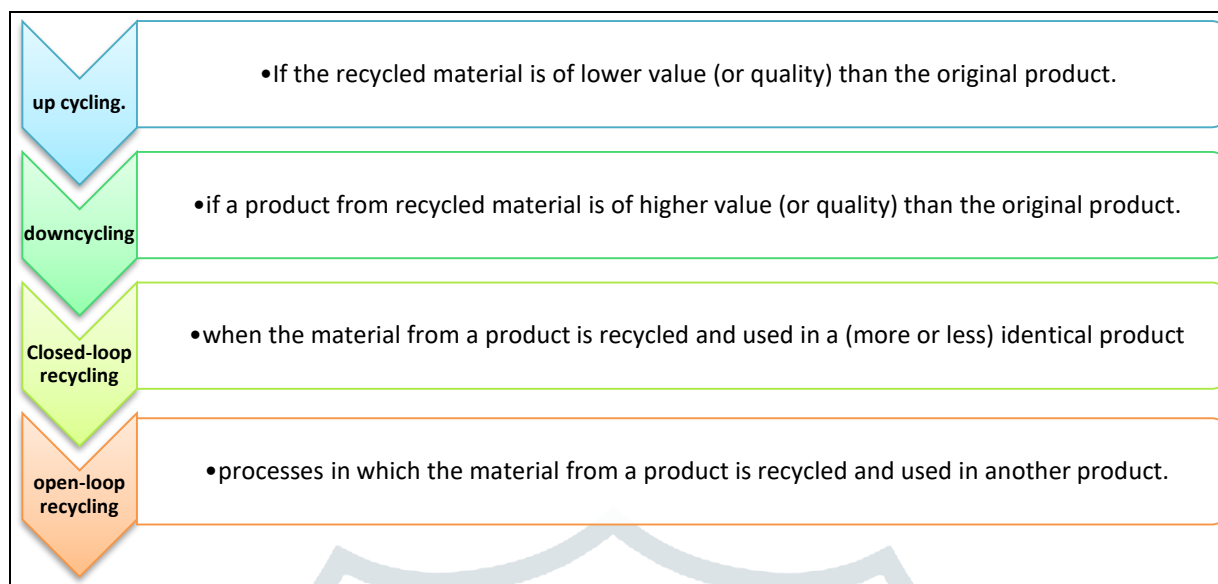


Figure: 4 Recycling of Textile Products².

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://webecoist.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].

Evrnu 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:

The Advantages of using existing Second hand Clothing (SHC) materials are many. First, it eliminates the need to create new materials (fibres and textiles) that consume finite water and fossil fuel resources. Second, the upcycling process of redesigning garments also eliminates the need to use harmful chemicals in dyeing and finishing processes that can impact human health and damage surrounding ecosystems. Third, clothing sourced for this process is diverted from entering a landfill or being incinerated. The future of recycling relies heavily on the development of new advanced technologies and approaches for material processing (without quality loss), collection, sorting, processing, and utilization in a new product that is also recyclable. Several institutions and NGOs are already working with the reuse of textile wastes in order to valorize and train the involved workers, generating income and increasing the environmental awareness.

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