



Post-Consumer Textile Waste Minimization: A Review*

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Abstract

The rise of fast fashion in the textile industry has led to a high level of waste generation in the sense that over consumption and disposal of garments. Therefore every year million tons of textile waste is being sent to landfills. Despite high volume and high recycling potential of post-consumer textile waste, there is more effort to recycle pre-consumer textile waste as it is easier to sort and process. In recent years, there is a growing sensitivity to post-consumer product waste management because of environmental issues. In this study post-consumer textile waste management strategies, methods and practices are presented. In addition to these, consumer behaviour in disposal of textiles and the influencing - motivating factors are discussed in the direction of literature review.

1. Introduction

In 21st century, textile and fashion consumption in the world has increased dramatically as a result of various factors such as the growth in world population, overall improvement of living standards and the rapid rise of the fast-fashion. The total volume of textile and fashion production at the global level is estimated to be more than 80 million tons annually. The fashion industry has great impact on the environment (Lu & Hamouda., 2014, Eser et. al., 2015, Üner & Başaran., 2016). Every year million tons of textile waste is being sent to landfills. Statistics collected by the Council for Textile Recycling indicate that less than 25% of the total post-consumer textiles waste is recycled annually (World Wear Project., 2018).

According to the Environmental Protection Agency, 15.3 million tons of textile waste is generated in US in a year, account for 9 percent of total Municipal Waste (MSW) generation (Figure 1) and the amount has doubled over the last 20 years. While estimates suggest as much as 95 % of the post-consumer waste is recyclable, only 15.2 % of this waste is recovered, 84.8 % of this waste is sent to landfills (Table 1) (United States Environmental Protection Agency., 2015). In China, the situation is more serious, there are more than 20 million tons of textile wastes, and less than 10% is recycled per year (Lu & Hamouda., 2014). In the UK and overseas,

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there is 2 million tons of textile waste generated annually; 24% were collected for reuse and recycling (Morley et. Al., 2009). In Japan, approximately 1 million tons of used clothing every year are disposed of, with only from 12 to 13 %, being recovered in some way (Guo., 2010).

Figure 1. Total MSW generation (by material)
(United States Environmental Protection Agency., 2015).

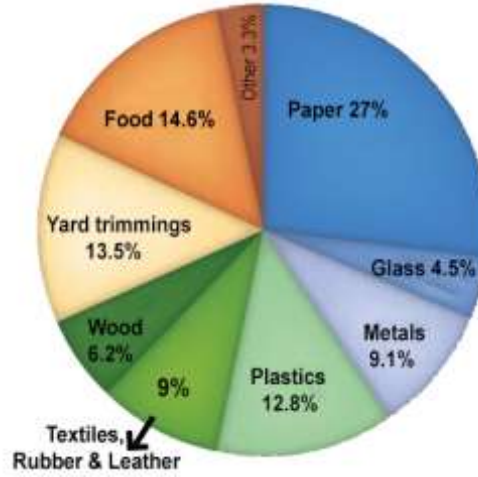


Table 1. Generation, recovery and discards of materials in MSW, 2013
(United States Environmental Protection Agency., 2015)

Material	Weight Generated (million tons)	Weight Recovered (million tons)	Recovery as Percent of Generation	Weight Discarded (million tons)
Paper and paper board	68.60	43.40	63.3 %	25.20
Glass	11.54	3.15	27.3 %	8.39
Metals	23.06	7.87	34.1 %	15.19
Plastics	32.52	3.0	9.2 %	29.52
Rubber and leather	7.72	1.24	16.1 %	6.48
Textiles	15.13	2.30	15.2 %	12.83
Wood	15.77	2.47	15.7 %	13.30
Other materials	4.58	1.31	28.6 %	3.27
Other wastes (Food, yard trimming etc.)	75.19	22.44	29.8 %	52.75
Total municipal solid waste	254.11	87.18	34.3 %	166.93

In Turkey, post consumer textile waste constitutes 1.14% of the total post-consumer waste. With this approach, the amount of textile waste thrown into garbage from houses is approximately 565.000 tons per year (Altun., 2016). Although a certain amount of post-consumer waste recycling rate is not given in official records, according to the report of Turkish Statistical Institute (TÜİK), the amount of recoverable waste collected separately by municipalities is about 15.000 tons in 2016 (Türkiye İstatistik Kurumu., 2016). Furthermore, the recyclable waste amounts that belong to a municipality with a population of 210.000 in Turkey; have been calculated by Kaya et. al (2012). If the results are generalized to Turkey with a population of approximately 80 million, the amount of recyclable textile waste can be said that over 130 million tons per year. In this

case, it is not wrong to say that the recycling rate for post-consumer textile waste is below 10% in Turkey.

In recent years, there have been increasing concerns in the disposal of textile waste around the world (Kaya et. Al., 2012). Textile wastes cause environmental problems, significant resource and energy losses, additional storage, and accumulation costs (Vadicherla & Saravanan., 2014). The long life of textiles in landfills contributes significantly to greenhouse gasses, including Carbon Dioxide and Methane. The Environmental Protection Agency estimates that the recovery of 2.25 million tons of textiles, diverted from landfills, has the carbon reduction equivalent impact of removing 1.2 million cars from roads (Newell., 2015). This information provides evidence that increased recovery of textiles can have a major impact on reducing greenhouse gasses. The United Nations Environment Programme's (UNEP) prediction, in its 2011 annual report that the rate of consumption would become three times higher by the year 2050, indicates that waste problem will continue to increase in the future (UNEP., 2011). The concepts of recycling, together with reduce and reuse are the most important key factors for minimizing the amount of post-consumer textile wastes (Doğan., 2013, Gupta & Khare., 2017).

In this study, post-consumer textile waste is considered in the context of fast fashion and over consumption of textiles. Post-consumer textile waste management strategies, methods and practices are reviewed. In addition, textile and clothing disposal behaviors of consumers, the factors motivating and influencing them, are discussed in the direction of literature review.

2. Fast Fashion and Over Consumption of Textiles

A key current trend in the world clothing demand is the growth in fashionable, low priced, 'disposable' clothing (Allwood et. Al., 2006). This business model, which called 'Fast Fashion' focuses on bringing new products to market as quickly as possible, and rapidly changing consumer preferences, has encouraged increased consumption among consumers. (Thompson., 2017). Due to globalization and technology development, the apparel industry is able to use cheap resources such as materials and labour anywhere in the world. Because such apparel is made of cheap materials, sold and made to be worn fewer than ten times, and are even called disposable fashions (Chau., 2012, Joung., 2014).

The rise of fast fashion in the textile industry has led to a high level of waste generation in the sense that over consumption and disposal of garments (Kaya et. Al., 2012). "Fast fashion" brands such as Zara, Topshop, H&M, Primemark and many others shorten the fashion cycle and attune the costumer for consume more. Consumers react to changes in fashion, both in clothing and household interior designs. Thus consumers are motivated to displace the garments in their wardrobe with the trendy items in a routine manner. Fast fashion model allows people to make numerous choices, even to make mistakes, as their choices do not have a high cost (Koukouvinos., 2012, Gabrielli et. al., 2013, Büyükaslan et. al., 2015, Gupta & Khare., 2017). Fast fashion and over consumption of textiles have two main effects on environmental change;

- 1) the increase in waste generation as a result of consumption,
- 2) the destruction of natural resources (Eser et. al., 2015).

3. Post-Consumer Textile Wastes

According to Council for Textile Recycling, the recycling materials can be classified as pre-consumer and post-consumer wastes (Council for Textile Recycling., 2018). Textile industry produces by-products during manufacturing process and some of these by-products, in other words pre-consumer wastes, are recycled to be used for automotive, aeronautics, furniture, home building, paper, and apparel industries. Post-consumer products are defined as any garment or household product that owner no longer need and decides to discard. There are several reasons for disposal of a garment such as poor fit, low quality, worn out, boredom and the influence of the fast fashion industry on consumers that pushed them to dispose garments more often. There is more effort to recycle pre-consumer textile waste as it is easier to sort and recycle when compared to post-consumer textile waste (Büyükaslan et. al., 2015, Eser et. al., 2015, Üner % Başaran., 2016, Gupta & Khare., 2017). The post-consumer textile waste is a mixture of natural fibers, synthetic fibers, and other substances (zippers, buttons, snap fasteners etc), which make it hard to degrade. Furthermore, landfilling may release toxic substances, and it can generate methane, which contributes to the global warming issue. Therefore, these accumulated wastes lead to an environmental problem (Pensupa et. al., 2017). The volume of post-consumer waste is quite high and it is almost 100% recyclable. According to the Council for Textile Recycling, post-consumer textile waste in the US increased 40%, in ten years' time, however the waste diversion rate has increased only 2% (Council for Textile Recycling., 2018).

3.1. Management Strategies

Due to the depletion of natural resources and the increase in waste disposal costs, textile waste management is becoming increasingly important all over the world. The strategies and policies, to promote viable textile waste management from the perspective of enabling both environmental conservation and economic efficiency, have been formulated in different regions. Many organizations in waste management around the world are working to raise awareness of textile waste (Lu & Hamouda., 2014, Eser et. al., 2015).

OECD's "Sustainable Materials Management Policies" are the most known of waste management strategies. This study report focuses on three fundamental rules for sustainable resource use; 1- Saving resources and energy, 2- Reusing the product and extending the use period, 3- Recycling. In the study involving fourteen OECD countries, the scope of sustainable materials management policies was extended in 2007-2011, product categories and the countries in which the policies apply have been increased. As of 2011, textile wastes are the seventh rank in the materials that have a high waste amount, such as glass, paper, metal and plastic (Doğan., 2013). The 3R (Reduce, Reuse, Recycle) strategy is also integrated in the United Nation's Sustainable Development Goals. For example, the target of Goal 12 is to ensure sustainable consumption and production patterns by aiming to substantially reduce waste generation through 3R by 2030. Numerous countries

and cities around the world also incorporate and encourage these principles as part of their waste management strategies (OECD., 2005, Thompson., 2017).

There are several organizations which encourage consumers to dispose their used clothes in a most environmental way and provide them opportunities for re-use or recycling. Textile Recycling Association (TSA), Secondary Materials and Recycled Textiles (SMART), Waste & Resourcing Action Programming (WRAP), Council for Textile Recycling (CTR) are some governmental organizations which put an effort to reduce textile waste in UK and US. These organizations offer some road maps to consumers, designers, industry and governments to create more sustainable clothing cycles (Büyükaslan et. al., 2015). The UK Department for Environment, Food and Rural Affairs (DEFRA) led Sustainable Clothing Roadmap industry initiative to improve the environmental and ethical impacts of clothing; it has commissioned a series of industry informed evidence projects in key areas one of which is "Maximizing Reuse and Recycling of UK Clothing and Textiles". The aim of this project was to report up-to-date, comprehensive and robust data on the quality and quantity of post-consumer textile waste in the UK, and present strategies for increasing reuse and recycling in order to divert them from landfill (Lu & Hamouda., 2014). Since the 1990s, numerous environmental management system (EMS) have been developed for textile customers to assess the suppliers' operational performance, for example, the Green Dragon Environmental Management Standard in the UK and Global Recycling Standards for textiles and clothing (Pensupa et. al., 2017).

The Turkey Solid Waste Management Project, which was enacted in 1995, aimed to prepare an international waste management strategy and this aim became the focus of other projects. Studies in the field of waste management have shown a very significant development with increasing social and political sensitivity. "National Recycling Strategy and Action Plan" prepared in order to find solutions to recycling problems and reach sustainable recycling system and effective structure, aims at the same rate with European Union criteria in the long-term. One of the waste reduction efforts in the textile industry in Europe is "EU Cost Action 628: Life Cycle Assessment of Textile Products Project". A study was conducted on this subject that a total of sixteen universities attended by Turkey and the European countries (Öztürk., 2014, Gören & Özdemir., 2011, Unites Nations., 2018).

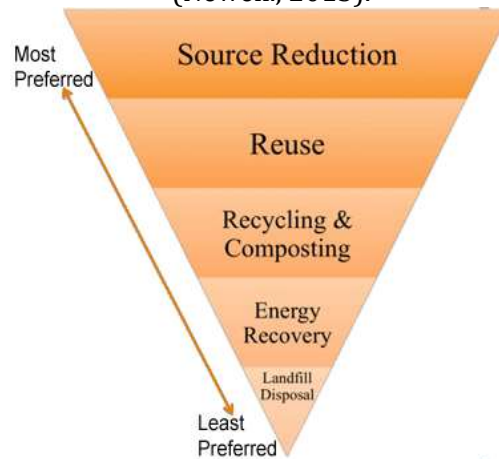
3.2. Methods and Practices

The hierarchy of methods for managing solid waste, developed by the Environmental Protection Agency in 1989, includes reducing, reusing, recycling and composting, waste-to energy combustion and traditional landfill disposal, in that preferred order as shown in Figure 2. This is also used for textile waste management (Newell., 2015).

Textile waste management strategies include 3R (Reduce, Reuse, Recycle). According to some in the literature, "Repair" is proposed as one of the components of this waste hierarchy, while for others "Repair" should be considered in the "Reduce" stage. Furthermore Recovery of energy can also be accepted as a part of

this strategy. The purpose of all these strategies is to provide maximum benefit by prolonging life of the products (Eser et. al., 2015, Thompson., 2017).

Figure 2. Graphic developed on outline from the U.S. Environmental Protection Agency (Newell., 2015).



The first principle in the 3R waste hierarchy is Reduce. It focuses on changing consumption habits to prevent the generation of waste (Thompson., 2017). Low product qualities and environmentally hazardous effects of fast-fashion have encouraged the growth of the “Slow Fashion” movement. Slow fashion refers to using greener fibers, reducing waste or taking into account the movement of the product through the supply chain. Slow fashion items are becoming popular as designers begin to forgo the high frequency fashion industry and adopt flexible, seasonless designs. Eileen Fisher, Abercrombie and Fitch, Burberry, and James Perse all carry clothing pieces that may be considered slow fashion (Pookulangara & Shephard., 2013). However, reducing consumption is a controversial issue as it challenges our current consumption driven culture. Given the widespread adoption of the fast fashion business model by retailers and consumers, the idea of slow fashion to take the place of fast fashion will not be a realistic approach. Ekström and Salomonson (2014) found that Fast Fashion companies are not interested in discussing reduced consumption but instead consider their participation in the promotion of recycling as action on sustainability issues and a way to continue consumption at its current rate (Wicker., 2016). For example, the latest initiative by H & M is getting customers to recycle their old clothes by putting them in bins in H&M’s stores worldwide (Wicker., 2016, H&M., 2017).

The second principle in the 3R is Reuse. Reuse focuses on using an item again, prolonging its life. In practice, the most common example of Reuse is the second-hand market. There are also other options for reusing textile item except using it in its original state by a new owner (Chamorro., 2014, Thompson., 2017). When clothing is not suitable for reuse for its original purpose, it can be downcycled into some other products with different functions: for example, some goods are used for wipers. This represents an economic and environmental saving of valuable way (Hawley., 2006, Dissanayake & Sinha., 2012). Redesigning is another alternative option to reuse post-consumer wastes, which gives textiles a long-term value. The wasted item may be recontextualised, without changing its form, or it may be up-cycled into a new object. The deconstruction of old clothes into new fashion is also

a magic of designer. There are examples include Nawato, using mending and patchwork strategies to embellish and deconstruct denim jeans, or Studio Mücke, deconstructing men's shirts to create womenswear (Payne & Binotto., 2017). Independent designer Rachael Cassar is another example of sustainable redesigning, who creates couture pieces from the fabric of secondhand garments (Cassar., 2018). Designers and fashion lines such as Miguel Adrover, Ggrippo for trash-a-porter, Koi, ynnub, and VICC, are being praised for their innovative reconfigurations of Burberry coats, mattresses, t-shirts, jeans, and suits (Young et. al., 2004).

The final R in the 3R Waste Hierarchy is Recycle. This process conserves wastes to virgin materials (Thompson., 2017). After synthetic fibers came onto the market in the 20th century, post-consumer textile waste recycling became more complex due to increased fiber strength (made it difficult to "open" the fibers), and fiber blends (made it difficult the sorting process) (Hawley., 2008, Büyükaslan et. al., 2015). The textile recycling industry is undertaking efforts to the recovery of post-consumer textile waste dumped into landfills by two methods; mechanical and chemical recycling. (Chen & Burns., 2006).

In the mechanical recycling process, textiles are broken down through cutting, shredding, and carding processes. Creation of new products, Shoddy (from knitted textiles) and Mungo (from woven textiles), by mechanical recycling is term used for the category of recycling that "opens" textile waste and used clothing and returns them to fibrous form. The fibers produced through this process are weaker and shorter than virgin fibers. To increase quality these fibers are blended with virgin fibers. Mechanically recycled fibers are used in various applications, including upholstery, automotive components, building materials such as insulation and roofing felt, disposable diapers, wiping, and fillings (Gadkari & Burji., 2015, Thompson., 2017). Chamorro (2014), proposed a new sustainable business model that offers the creation of an up-cycling process using mechanically recycled fabrics, and working with skilled women in handicraft living in developing countries (Figure 3). His business model called as MOOD, is able to create sustainable as well as fashionable and high quality products using discarded fabrics by incorporating sustainable design principles and up-cycling processes (Hawley., 2006). Also Turkish people recycle their worn cloths to make rugs, mattresses and furniture (Büyükaslan et. al., 2015). In Anatolia, traditional shoddy weaving, called as "çaput weaving" uses clothing wastes as raw material and it is obtained by plain weaving technique (Figure 4). These fabrics are preferably used as rugs, mats, automobile seat covers, pillowcases, bags and accessories (Üner & Başaran., 2016). Chapputz, a brand founded by a young Turkish designer, transforms worn clothes to stylish handmade kilim products while using "çaput" weaving culture of Turkish Nomads as a mechanical recycling method. This brand employs villager women in its production process and brings outmoded weaving culture and modernization mindset together, produces Ipad cases, clutches, backpacks etc. and sells them in designer stores (Chapputz., 2018).

Figure 3. Up-cycling process to obtain mood products (Chamorro., 2014).

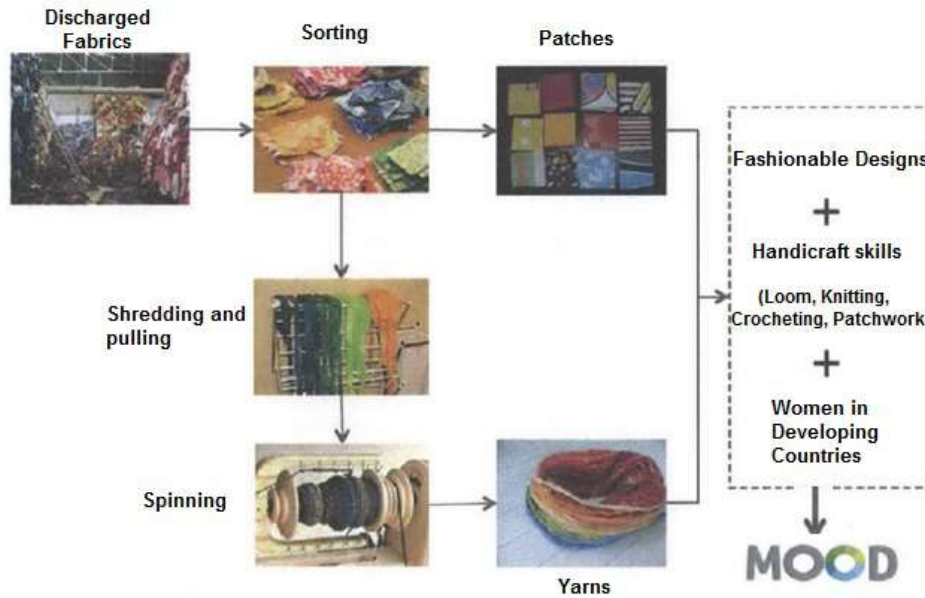


Figure 4. Shoddy weaving “çaput” from Anatolia (Üner & Başaran., 2016, Chapputz., 2018)



The principle of chemical recycling is to convert high molecular weight polymers into low molecular weight substances via chemical reactions. The obtained substances can be used as the reactants for other chemicals and polymers by re-polymerizing and then can be re-spun into new fibers. Unlike mechanical recycling, there is no loss of quality since the resulting fibers are the same length and quality as virgin fibers. This process is most commonly used for synthetic textiles, particularly polyester. Teijin, a Japanese company, has a production process for manufacturing raw polyester materials by breaking down discarded polyester fabric into monomers without using of petroleum. Their production results in an energy saving of 76% and a 71% CO₂ emissions reduction compared with polyester produced from virgin materials. Chemical recycling techniques exist for natural fibers as well, however these technologies are not yet widespread (Hawley., 2006, Gadkari & Burji., 2015, Thompson., 2017). For example Evrnu, an American company, is chemically recycling cotton scraps into a new manufactured

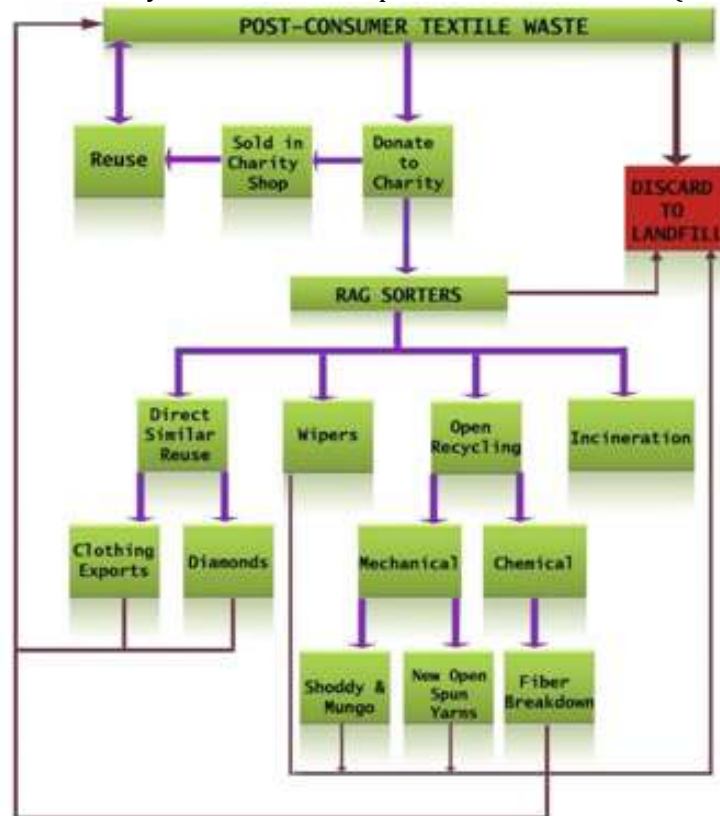
cellulosic yarn and Re: newcell (Sweden) and Saxion (Netherlands) are also working on emerging technologies.

A schematic for the sorting process of post-consumer textiles is illustrated in Figure 5. Most of the post-consumer textile waste is collected by municipalities together with other household waste and usually buried in municipal landfills. There are alternative ways as described above (Büyükaslan et. al., 2015). Consumers often give their old clothes to charity agencies. These agencies sort the clothes, choose items for the sales floor, and then the leftovers are sold to rag sorters. Largest volume of goods (48%) is sorted for secondhand clothing markets, primarily for export markets in developing countries or disaster relief and what is referred to as diamonds. The Diamond category accounts for approximately 1% of the total volume of goods that enter the textile recycling stream, yet this category also accounts for the largest profit center for most textile recycling companies. Categories of diamonds include couture clothing and accessories, Americana items such as Harley Davidson and Levi's, certain branded items, trendy vintage clothes, luxury fibers for new yarn production, and antique items. Many of the customers for diamonds are well-known designers or wealthy individuals. Ralph Lauren and Donna Karan both now have vintage collections. Other sorting categories are converting to wipers, new products from open recycling, incineration for energy or landfill dumping (Hawley., 2006). Incinerating textile wastes for energy production is a topic of recent researches. It is preferable to landfill, as it allows energy recovery and reduces final waste volumes. Incineration of used textiles as an alternative fuel source is more common in Europe than in the United States. This is primarily due to the higher costs of fuel in Europe (Alwood et. al., 2006, Hawley., 2006). For some reclaimed fiber, no viable value-added market exists, so the used goods must be sent to the landfill. When textile fibers, are buried in a landfill, they produce the potent greenhouse gas methane as they degrade, even if they are natural. Natural fibers go through a lot of unnatural processes (bleaching, dyeing, and printing, scouring in chemical baths) on their way to become clothing. Those chemicals can leach from the textiles and into groundwater. Burning the items in incinerators can release those toxins into the air (Hawley., 2006, Wicker., 2016).

3.3. Consumer Behaviours

According to literature there are several reasons for consumers to dispose of textiles such as poor fit, outdated style, boredom or wear-out and also several options to get rid of them such as discarding, donating, reusing, trading or selling (Shim., 1995, Koch & Domina., 1999). The most commonly used consumer behaviors are donating to charities, passing on to family and friends (Büyükaslan et. al., 2015). In recent years, researchers pay more attention to consumers' environmental attitudes, concerns, and awareness and examine their effects on textile disposal behaviors. Shim (1995) identified eight clothing disposal motivations and behaviors: (1) economically motivated resale; (2) environmentally motivated resale; (3) charity-motivated donation; (4) environmentally motivated donation; (5) economically oriented reuse; (6) environmentally motivated reuse; (7) convenience-oriented discarding; and (8) unawareness-based discarding. It has been noted that there may be multiple motivations that drive certain disposal behavior.

Figure 5. General life-cycle schematic for post-consumer textiles (Hawley., 2006).



Most of the people in US donate their used garments to professional organizations such as Goodwill and Salvation Army and to other nonprofit organizations (Gupta & Khare., 2017). Büyükaşlan et. al. (2015), revealed that Turkish people traditionally keep and store their used cloths for years and they give less worn and in good condition clothes to family members, friends or people who need them. In urban areas historical perspective of recycling of cloths are still prevalent. People reuse their worn cloths to make rugs, mattresses and furniture. Morgan and Birtwistle's study (2009) confirms that UK citizens have similar clothing disposal behavior to US citizens. According to this study the majority of the clothing (36 %) was given to charity shops and 7.4 % was put in textile recycling bins. They examined the purchase behavior and disposal habits of young female consumers in UK. The findings of this study have highlighted that, although there is concern about the environment, there is no direct correlation between environmental awareness and textile disposal behavior. Meanwhile, several other studies indicate that consumers, who have positive attitudes towards the environment, have more tendencies on recycling their clothes (Bianchi & Birtwistle., 2012, Joung & Park-Poaps., 2013, Weber et. al., 2017). Bianchi and Birtwistle's study (2012) which used data from females located in Australia and Chile shows that consumer recycling behavior is a strong and direct driver of donating to charity. Their results find that consumer awareness of the environment and consumer age affects donating behavior.

Shim (1995) has studied to examine the influence of consumers' general environmental attitude and waste recycling behavior on their clothing disposal

patterns. Results indicated that one's environmental attitude was a more influential factor for environmentally oriented clothing disposition than was one's self-reported actual recycling behavior of waste. Also the results showed that resale behavior is more driven by monetary or economic reasons rather than by environmental reasons. Furthermore gender and age were significant factors in predicting donation and discarding behaviors. For instance, females were more likely to choose environmentally friendly disposal patterns and were less likely to discard old garments than were males. And the older people tend to keep rather than throw things away and to be more socially responsible (Shim., 1995).

It is a well-known fact that the fast-fashion creates a wasteful culture. However Weber et. al. (2017), indicated that less purchasing and less disposing by non-fashion consumers, does not mean that they manage their unwanted garments in a more sustainable way. The results of their study highlighted that, those with a higher fashion index show a stronger interest in what to do with unwanted clothes (Weber et. al., 2017).

Ha-Brookshire and Hodges (2009) interpreted their analyses in the way that the primary motivation of consumers' used clothing donation behavior is the need to create space in the closet for something new. The fact that the threat of guilt feelings played a significant role throughout the process prior to donation, specifically in the decision whether to discard or donate a clothing item, showed that consumers had both utilitarian and hedonic values regarding their donation behavior (Ha-Brookshire & Hodges., 2009)

Joung and Park-Poaps (2013) examined factors that motivate and influence college students' clothing disposal behaviors. Their results showed that although peer influence has been a significant predictor of purchase behaviors, such influence was not related to disposal behaviors. According to the conclusion of their study; consumers dispose of unwanted clothing in different ways based on different motivational factors. That is, those who want to save money resell or reuse. Consumers who donate used clothing are motivated by environmental and charity concerns. Those motivated by convenience tend to discard unwanted textiles (Joung & Park-Poaps., 2013).

Convenience is an important determinant of recycling behavior (Laitala., 2014). A survey by Goodwill Industries, found that half of the people making donations prefer door-to-door pickup, and more than half would not go more than 10 minutes out of their way to make a drop off (Gupta & Khare., 2017). In a similar way, national survey on recycling coordinators reported that communities with a curbside collection programme for recyclable solid waste had a 24% higher participation rate than communities with a drop-off site (Joung & Park-Poaps., 2013). Domina and Koch (2002), in their study about convenience and frequency of recycling, noted that the respondents did not participate in recycling because they did not have local recycling programmes and did not know other options. A Value Village survey of North American consumers found that 62% of respondents threw away items because they did not think a donation centre would accept them. However, even if items cannot be resold through charity thrift shops, they can be sold to for-profit recyclers (Value Village., 2017).

3. Conclusion

Over consumption of textiles lead to their over disposal so every year million tons of textile waste is being sent to landfills. Estimates indicate that waste problem will continue to increase in the future. Post-consumer waste has strong reuse and recycling potential. There is a growing sensitivity to environmental issues has stimulated increased consumer recycling of post-consumer product waste. For developing a more sustainable future, minimizing post-consumer textile waste is a crucial issue throughout the world. This could be achieved by the cooperation of academia, business and government as well as consumers.

Rational planning and policy guidance from governments by adopting a comprehensive textile waste strategy, that incorporates the 3R principles, is important. At this point, awareness should be created on people about alternatives of throwing their clothes to the garbage bin by education and campaigns. There should be more educational efforts and community recycling programmes based on consumer motivations to dispose of textiles appropriately. Making these campaigns integrated with social media is an opportune way to reach the millennial generation, primarily targeted by fast fashion retailers. Consumers should be encouraged to; Buy second-hand clothing and textiles, Buy more durable products, Lease clothes that would otherwise not be worn to the end of their natural life, Extend the life of clothing and textile products through repair, Dispose of used clothing and textiles through recycling businesses.

On the other hand, textile products should be designed in a way which they can actually be recycled. Designers and manufacturers must account for the entire life cycle of the product during production. For example restricting the number of materials and blends used in products would facilitate recycling. Or increased emphasis on durability as a component of fashion would support a move towards reduced material flow. The sector could halve its material flow without economic loss if consumers pay a higher price for a product that lasts twice as long. In this context, education, both for designers and manufacturers, is another efficient factor in minimizing post-consumer textile waste. Training designers in areas such as zero-waste pattern design and recycling processes will have a positive impact on the environment and profit margins. So it would be a great benefit to include the relevant lessons in the curriculum of fashion and textile design education programmes. Besides, new business models, where consumers pay for services such as repair, novel coatings, remanufacturing or 'fashion upgrades' could help prolonging the use life of products. The entrepreneurs, interested in this kind of business models, could be supported by governments through incentive programs.

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