Pre-consumer textile waste- A study and design development

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Abstract. By 2030, India is set to become one of the biggest apparel markets for sustainable fashion. Recycling is one of the effective techniques which is a key concept of waste management. There is an increasing availability of recycled textiles today, which are made by repurposing pre-consumer and post-consumer textile waste. The pre-consumer textile waste is generally recycled into new raw material by producing fiber or yarn, which are used by home furnishing, automotive, paper, and other industries. Therefore, the objective of this study is to identify the nature and volume of pre-consumer textile waste from apparel manufacturers and tailoring units and to develop fashion products using pre-consumer textile waste. The nature and volume of pre-consumer textile waste will be collected from apparel manufacturers using a survey. The marketability of the product will be studied using a consumer willingness survey. The study concludes with an understanding of the nature, volume of pre-consumer textile waste.

Keywords: Sustainable, Recycling, Pre-consumer textile waste

1 Introduction

The textile industry is accused of being one of the most polluting industries. Other than production, the consumption of textiles also produces waste. To overcome the problem, the textile industry has taken many measures for reducing the negative contributions to the environment. Sustainable development has become a constituent part of economic and environmental policy in developed as well as many developing countries. The main purpose of this is to meet the supply and demand of textile materials. The issues in apparel sustainability can be classified based on its contribution to water, energy efficiency, etc. According to the author who conducted a study to assess the water footprint in France for production and consumption perspective, among various products growing cotton contributes to blue water scarcity. It leads to negative environmental and ecological impacts [1]. Based on the study conducted, textile waste can be divided into pre-consumer and post-consumer textile waste [2]. Textile waste can be classified as pre-consumer and post-consumer textile waste and industrial textile waste [3].

Pre-consumer waste is generally clean waste which consists of fiber and yarn waste; waste

from trials and process tuning from the textile mills (particularly dying); cutting waste from garment manufacturing; unsold stock from brands, wholesalers, and retailers; clothing samples or part-finished clothing; damaged textiles or unused textiles; factory surplus textiles; textile swatches or leftover textile sample swatches. Waste can be categorized as production waste, pre-consumer, and post-consumer textile waste. Among this cutting, waste is generated daily in huge quantities. Marker efficiency also plays a major role in cutting waste [4]. An efficient marker will reduce waste. A study was conducted to investigate the fabric wastage in various sections in garment manufacture in T-shirt manufacturing units in Bangladesh. It was seen that cutting waste contributed 50% of the total waste[5].

In the landfill, the disposal times are remarkably high, approximately up to a year to decompose natural fibers, and around 30–40 years to break synthetic fibers, with a hundred years to their full decomposition [5]. In terms of reducing the impact reuse or recycling must be considered. Textile recycling can be done in two categories mechanical recycling and chemical recycling [6].Mechanical recycling leads to degraded quality in fiber. Chemical recycling is possible at a molecular level and is turned into a fiber, yarn, or textiles. Also in a study, to analyze the quality parameters of the recycled blended yarn, the waste cotton fabric is collected, then shredded, and blended in 5 different ratios. The yarn is manufactured from OE spun yarn. Using the yarn, a single jersey fabric was produced. The results prove that the fiber strength of recycled cotton is reduced by 4.0% compared to virgin cotton and a 36% reduction was noticed in fiber elongation. Similarly, for recycled polyester, the strength reduction is 10.06% compared to virgin polyester and the reduction in elongation for recycled polyester is 18% [7].

In a study, an evaluation of the spinnability of recycled blends obtained from garment manufacturing units was done. Recycled fiber is blended with virgin cotton of various proportions. Results show that as waste percent increases, yarn tenacity and breaking elongation decrease. The authors also suggest the application of this yarn that it could use as a gauge bandage fabric [8]. There are few barriers to recycling, as reported by [3], like lack of equipment, lack of consumer awareness, cost of the end product, and lack of marketing. Thus this study aims to understand the types of textile waste and understand in detail the nature of cutting waste.

2 Materials and methods

A. Study design: An explorative and qualitative study design is used as the methodology. It is based on telephonic interviews with people related to apparel industries to determine their views on pre-consumer textile waste. This design helps find out the attitudes and experiences of the respondents.

B. Questionnaire variable identification: The questionnaire was prepared based on several influential variables such as cutting department employees, machines used, type of fabrics handled, lay height, lay length, marker efficiency, etc.

C. Questionnaire preparation: A set of questions based on pre-consumer apparel waste in industries are framed. The questions were based on the general information of the apparel industry and especially about the cutting department and cutting waste.

D. Preparing contact list: A convenience sampling was followed. People who own apparel

industries and people who work in apparel industries were selected as respondents as they come across pre-consumer textile waste in their daily life.

E. Fix appointment: An appointment was fixed before the survey

F. Telephonic survey: Telephone interview was chosen as the mode as the face-to-face interview was difficult during the pandemic situation. A fifteen-minute telephone survey was done with each of the respondents and the call was recorded.

G. Transcription: The responses were later transcribed. The recording was played and each response was transcribed.

H. Analysis: A qualitative analysis was carried out. The results are analyzed and a consolidated discussion was provided. Based on the survey results, ideas were generated and products were designed out of pre-consumer textile waste.

3 Results and Discussion

By consolidating the responses, the results were furnished. The results of each respondent were given below. According to Respondent 1, who owns a factory at Tirupur, which was started in 2006 handling 2 lakh pieces per month in two units with 250 employees, handling kids wear and menswear, pre-consumer textile waste recycling is been there for a decade which is been mostly used for home textiles.   In their cutting department, there are nearly 30 employees with 6 straight knife machines and 4 band knife machines. The lay length is 6 to 6.5-meter length and 2.5-meter width. Usually, 16- 17 layers of lay are kept for single jersey fabrics. The lay plan efficiency is 75-80% minimum. Then the textile waste is collected, segregated based on color, and stored in the storehouse. Once in a week or two, the textile waste is collected by the textile waste collector. Approximate prices of white color textile waste-Rs.60/kg; Color textile waste- Rs.30/kg - Rs.35/kg and all-over printed textile waste it is Rs.20/kg. Fabric end bits can be used as rags which are priced at Rs.70/kg. The textile waste is collected and made into OE (open-end) yarn. This OE yarn can be blended with polyester or any filament yarn to increase its quality. The polyester used for blending can also be made from recycled PET bottles thus making a recycled yarn. Depending on yarn quality made out of textile waste several products were made. According to respondent 1, prices are comparatively lower for products made of pre-consumer textile waste.

According to respondent 2, who is working in an export industry which is been in operation for 36 years handling knitted outerwear and inner wear. Some of their notable buyers are US Polo, Aero, Louis Philippe, splash, etc. Their industry has 3 units with 500 machines and 650-700 employees. In the cutting department, there are around 60 employees with 6hand cutting machines and 5 band knife cutting machines. Nearly 10,000 pieces of fabrics were cut daily which contributes to 300 kg of textile waste. 80-90% of marker efficiency is observed. This textile waste is stored and once in a week or two, the textile waste collector collects the textile waste after segregating. They segregate textile waste based on color and size. Though they sell the cutting waste to the waste collector, he suggested that the small bits of fabric can be used to make masks or gloves, etc.

According to respondent 3, who owns a factory in Tiruppur, started in 2011. Nearly 30 M/C are there handling knits and 30-40 employees work here. Some of their notable buyers are NYL, Fashion UK, and the Royal Enfield apparel division. Only cutting and sewing operations are done by them as the fabric is outsourced. 100% cotton fabrics are handled

mostly. They cut nearly 2000 pieces daily. 3 employees take part in the cutting process, and they dispose of 50 kg of textile waste daily. If the cutting waste is bigger in measurements, they try to use it to make kids' garments, vests are briefs. The textile waste is collected by the textile waste collector every 15 days. Nearly 80- 90% of marker efficiency is observed. The cash and carry method is practiced in disposing of textile waste. Prices of textile waste white in color are Rs.55/kg; colored textile waste is Rs.25-30/kg.

According to respondent 4, who owns a factory at Tiruppur since 2008 handling innerwear in knits with 350 employees. 12 employees work in the cutting section with 3 band knife machines and 3 straight knife machines. They handle nearly 1000kg of fabrics a day for cutting. The number of lays depends upon the design and garment. They segregate the textile waste and store it in different color boxes for easy identification. Once in two weeks, the textile waste is sold which contributes 1% of their sales value. The textile waste is recycled and used for home furnishings and some even use the textile waste for cleaning without recycling.

According to respondent 5, who is the cutting in charge of a well-known denim factory in Coimbatore, which is in operation for more than 50 years with 5000 employees, the cutting waste is been collected once a month. The lay length is 53 meters and the lay width is 5-20 meters. 4 cutting masters with 6 Straight knife machines and one band knife machine are present in the cutting department. A picture of cutting department is shown in Fig.1. Nearly 85% efficiency is achieved in lay plan. As they handle denim fabric, there is no segregation in textile waste; they collect daily and store it in the storeroom. Fig.2. Depicts a store room with bundles of pre consumer textile waste.

Fig. 1. Cutting department of an apparel industry

Fig.2. Bundles of Pre-consumer textile waste

According to respondent 6, who is a manager of a sampling unit handling swim shorts, hoodies, pants, and mostly menswear in Bangalore, dispose the textile cutting waste to the municipality where the textile waste is not recycled; they end up in landfills. 2-3 kg of textile waste per day is disposed of. According to the respondent, it is difficult to recycle as they use 100% polyester mostly.

According to respondent 7, who owns industry in Tiruppur since 1990, handles knitwear of all categories and uses different fibers such as cotton, poly-cotton, elastane, modal,etc. They store their textile waste in the allotted godown. Segregation is based on fabric types. The textile waste is collected once a month. The cutting waste collected is used for making recycled yarn. Nearly 15000 pieces were handled per day. The OE yarn made out of cutting waste can be used to produce any type of garments but the quality may be inferior. As seen above, pre-consumer waste is collected and mostly sold to the waste collector. Depending upon the textile waste fabric type, color, size, one can decide its application. Since sustainability is the need of the hour, apparel industries should consider developing new products which are useful for people out of pre-consumer textile waste. Value-added products can also be made. This will also generate employment. By giving some value addition like embroidery etc, these products can be sold at a higher price.

A.Design development: Based on the observation, few products were designed that can be made out of pre-consumer textile waste. Products like mobile pouches, wallets, table mats can be made out of comparatively large-sized textile waste as shown in Fig.3,4,6; whereas hair accessories like clips, bands, key chains, thoran, etc. can be made out of small-sized textile waste as shown in Fig.5,7,8,9. To add aesthetic, beads are added with varied color combinations. Few brands that produce value-added products websites were visited. From them, inspiration was taken. Then based on the inspiration and the fabric size the designs were made using Adobe Illustrator.

Pre-consumer textile waste fabric as small as 4 * 4 inches can be used to make a wallet as shown in Fig.3. A flap with one button is placed for closure. Polyester and Cotton knit fabric waste can be used to make wallet as these fabrics are produced more in the industries.
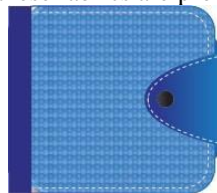

Fig. 3. Wallet

Pre-consumer textile waste fabric of measurements around 7 * 6.5 inches is sufficient to make a phone case as sown in Fig.4. A thick canvas can be sewn with the fabric for stability. Polyester fleece knitted fabric waste can be laminated for waterproof performance. Three pockets of size 3.5 *2.2 inches can be made to keep cards on the left side.

Fig. 4. Phone case

Small bits of fabric from pre-consumer textile waste can be wrapped over elastic bands to make hair accessories as shown in Fig.5. Beads can be added to enhance the look. Synthetic fabrics are preferred to cotton to enhance durability and to avoid pilling. Spandex blended with polyester can be used for elasticity.

Fig. 5. Hair accessories

Knitted cotton fabric from pre-consumer waste can be used for a floor mat as cotton has better water absorption. Different colored fabrics of size 4*4 inches can be patched together to make the floor mat as shown in Fig. 6.

Fig. 6. Floor mat

Synthetic fabric bits of small size from pre-consumer textile waste can be wrapped over a plain bangle. The fabric is made into a round shape and can be combined with metallic beads to add aesthetic to the bracelet as shown in Fig.7.

Fig. 7. Beaded bracelet

Small bits of fabric from pre consumer textile waste can be used to make accessories like key chains as shown in Fig.8. First, the fabric can be cut into necessary shapes and then attached as per the design. To improve the aesthetics small balls made of fabric or cotton pom poms or beads can be attached at the corners. A Ring is inserted to hold the key chain.

Fig. 8. Key chain

Fabric of various colors, shapes, and textures can be used to make a thoran as shown in Fig.9. To avoid fraying of fabric, the edges can be sewn firmly. As cotton and polyester knit waste were seen more, these fabrics can be used to make wall hangings like thoran. Several metallic beads can be added in between for aesthetics. It can be held using hooks and rings.
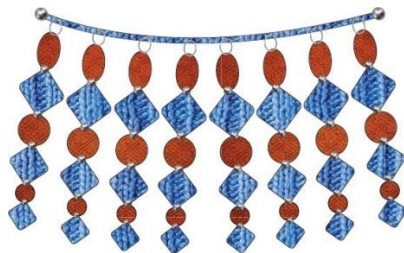

Fig. 9. Thoran

4 Conclusion

This study aimed at understanding the types of textile waste. A detailed study was conducted to understand the nature of cutting waste. A qualitative survey was conducted; the primary data was collected using telephonic conversation. The responses were noted down, analyzed, and consolidated. It shows that there is a large amount of cutting waste is generated daily and only the smallest waste is sold to the waste collector. Most of these wastes are shredded, blended, and recycled, and made into OE yarn. It is understood that recycling involves additional energy and time; therefore, few value-added products were designed. These products can limit the additional usage of energy and create employment. There are limitations to this study in terms of the number of responses gathered. Customer awareness and acceptance of recycled products out of precut textile waste can be understood in the future.

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