



## **“ZERO WASTE TEXTILE” RECYCLING AND RECREATING COTTON FABRIC**

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### **Abstract:**

As we move forward to the 21st century the textile product industries are facing with a monumental challenge and an opportunity, what to do with textile waste? Recycling of non-hazardous solid textile waste may be viable alternative for industries. Recycling must be an integrated effort a partnership with consumer retailer, manufacturer, recyclers, and government. The market acceptance of recycler textile includes the willingness of manufacture to participate in research development and production of recycled into new products, as well as increasing retailer and consumer awareness and demand for this product category.

### **INTRODUCTION TO TEXTILE RECYCLING:**

The textile recycling industry is one of the oldest and most established recycling industries in the world; yet few people understand the industry, its myriad players, or reclaimed textile products in general throughout the world, used textile and apparel products are salvaged as reclaimed textiles and put to new uses. In general, applications of fibers belong to the following three broad categories: apparel, home furnishing, and industrial. Most of the fibre products are for short term (e.g., disposables) to medium term (e.g., apparel, carpet, automotive interior) use, lasting up to a few years in their service life.



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Textile industry has a long history of being thrifty with its resources; a large proportion of unnecessary waste is still produced each year. Commercially, textile waste generation is influenced by the production of textile goods, higher the production, the greater the amount of waste. This is in turn a function of consumer demand, which is influenced by the state of the economy.

Nowadays, the consumption of synthetic polymers has increased rapidly. This is because these materials have many advantageous properties over other materials including glass, metals, ceramics, and woods. For example, they are lightweight, resistant to chemicals and environmental atmosphere. Furthermore, they can be easily processed into desired products by many methods.

### **ADVANTAGES OF RECYCLING**

1. Recycling minimizes pollution.
2. Protects the environment.
3. Recycling minimizes global warming.
4. Recycling minimizes global warming.
5. Recycling cuts down the amount of waste in landfill sites.
6. Recycling ensures sustainable use of resources.
7. Recycling contributes to the creation of jobs.

### **DISADVANTAGES OF RECYCLING**

1. High upfront capital costs.
2. Recycling sites are always unhygienic, unsafe, and unsightly.
3. Products from recycled waste may not be durable.
4. Recycling might not be inexpensive.

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5. Recycling is not widespread on large scale.
6. More energy consumption and pollution.
7. Increased processing cost and low-quality jobs.

## **INTRODUCTION TO COTTON RECYCLING:**

Cotton recycling prevents unneeded wastage and can be a more sustainable alternative to disposal. Recycled cotton can come from secondhand clothing or from textile waste or leftovers which are then spun into new yarns and fabrics. There are some notable limitations of recycled cotton, including separation of materials that are cotton/polyester mix. There may also be limits to durability in using recycled cotton.

Sustainability continues to be at the forefront of product decisions, brand initiatives, and strategic planning in the textile industry. The use of recycled materials, including recycled cotton, is a growing topic of interest within the sustainability umbrella.

Recycled cotton is not a new concept to the textile and apparel market, but as manufacturers, brands, and retailers continue to evaluate their supply chain footprint, the interest in recycled cotton has grown

## **OBJECTIVES**

- clothesThe aim of this process is recovering fiber ,yarn or fabric and reprocessing the textile materials into useful products.
- The study mechanical recycling process.
- **Customizing own and old:**
  - a. Old clothes can be reused for making cushions,handbags etc.
  - b. Damaged clothing can be used as rags and dusters.
  - c. Bright colored fabrics can be used for borders in a lampshade.



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Old garments can be transformed into works of art; like sewing patches ,buttons and beads into old garments

**MATERIALS AND METHODOLOGY:**

Textile wastes can classified in to

1. Pre consumer textile wastes
2. Post-consumer textile wastes

**1 Pre consumer textile wastes / Garments wastes:**

•Pre-consumer textile waste is a waste material before it reaches to consumer (such as fabric and garment

samples, overstock, fabric from the end of rolls) or is a material that was discarded before it was ready

for consumer use (such as defective printing, dyeing & finishing of fabrics) or is produced while items are

being manufactured (such as the pieces of fabric leftover after cutting out a pattern).

•Pre-consumer waste is the reintroduction of manufacturing scrap back into the manufacturing process.

Pre-consumer waste is commonly used in manufacturing industries and is often not considered recycling

in the traditional sense. This waste is generally clean waste.

•The global apparel industry is expected to produce more than 400 billion square meters of fabric per year

Garments wastes.

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FIG 1: GARMENTS WASTES.



FIG 2: SPINNING WASTES.



FIG 3: WEAVING WASTES.



## **2 Post consumer wastes / used clothes recycled:**

•The post-consumer textile waste, which includes products such as clothing, footwear, fashion accessories, towels, bedding, and drapery that have already been purchased. 95% of all textiles have the potential to be reused or recycled.



FIG 4: USED CLOTHES.

## **METHODOLOGY:**

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FIG 5: MANUFACTURING PROCESS FLOWCHART.

## COTTON FIBRE PREPARATION:

### i.Sorting and Grading

- All clothing has a useful second life. The collected garments are sorted and graded as natural, synthetic, and blended fabrics. Good quality clothing is sent to charity institutions and is used as second-hand clothing. Unwearable textiles are considered as damaged textiles and are processed in the factory as rags. Rags are collected and sent to the wiping and flocking industry. Other materials will be sent for fibre reclamation and stuffing. Fibres from the old fabrics are reclaimed and are used for making new garments.

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Both natural and synthetic fibres can be recycled this way. Incoming textiles are graded into type and Colour.

- Sorting and grading are done according to type of fibre, colours, blend, count etc

**ii Fabric cutter:**

Fabric cutter is used to cut the recycled and sorted fabric into small pieces which will be easy for next process shredding



**FIG 6: FABRIC CUTTER MACHINE.**

**iii Shredding:**

- Shredding is a process where the small fabrics pieces are filled and when machine starts the fabric wastes are passed into the teeth of shredder with the help of conveyor belt. Here the fabrics are grinded, and it forms like a fiber's web. As shown in the figure
- Cloth shredder machine shreds old clothes and rejected clothes. This Fabric Shredding Machine shreds all types of fabrics.



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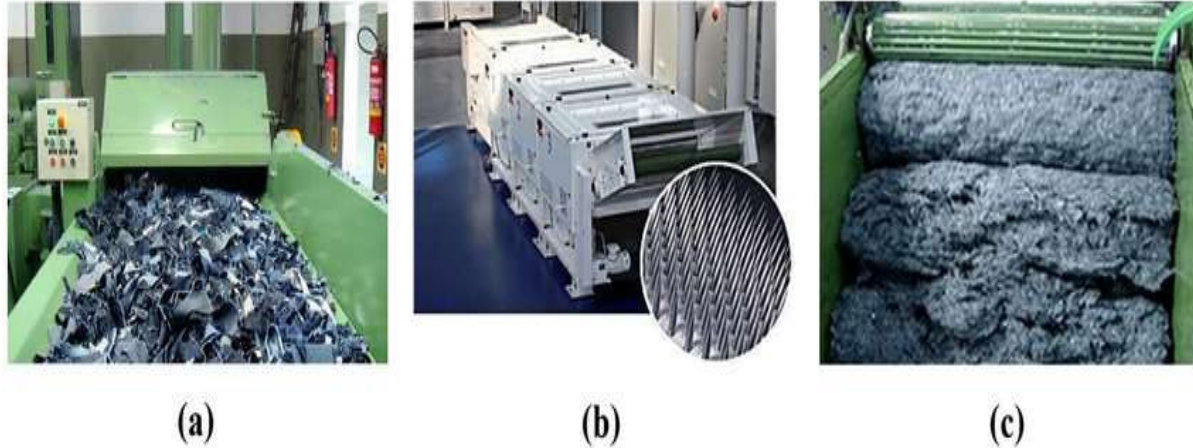


FIG 7: SHREDDING MACHINE.

#### iv Chopper and Crusher:

- This is the machine used to crush and chop the web formed by the shredder machine, to remove the dust, waste, foreign materials present in the goods.
- This process can be skipped as shredder machine also play a similar role.



FIG 8 : CHOPPER AND CRUSHER MACHINE.

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**v Staple fibers:**

- Here the recycled material is crushed and chopped to produce staple fibers
- The staple fibers are graded according to the quality. And separated according to its grades, colors, size etc.
- In recycled cotton the fibers size is comparatively short.
- Short staple fibers have maximum length of 60 mm. Cotton recycled staple fibers having about length of 25-45 mm.



**FIG 9: STAPLE FIBERS FROM COTTON FABRICS.**

**Vi Bale punching:**

- A Cotton bale is a standard-sized and weighted pack of compressed cotton lint after ginning. The dimensions and weight may vary with different cotton-producing countries.
- Bale size: - 1060 mm x 530 mm x 780 mm, 1400 mm x 530 mm x 700 mm, 1240 mm x 480 mm x 480 mm
- bale weight: - 160-170 kg
- grades: -- various grades according to buyer need of parameters.



FIG 10: PACKED BALES.

## PREPARATION OF COTTON FIBRES FOR BLENDING:

### Opening, Cleaning, Blending, Mixing:

- Opening: Bale opener is group of blenders which is suitable for processing various kind of cotton where a fiber condenser feeds the cotton plucked by automatic bale pluckier in this machine to get more blending, opening, and cleaning and then cotton is transported to next machine for additional process.
- Cleaning: In this process the dust, wastes, mud etc.\_are removed and passed to the further process.
- Blending and mixing

Raw materials used in the spinning mill are recycled fibers which are always inhomogeneous in their characteristics, owing to different cultivation conditions of natural fibers and the different conditions for virgin cotton or synthetic fiber materials. Blending is performed mainly to:

The blending takes place according to the buyers need. EX: 70%recycled cotton 30% virgin cotton.

- Give the required characteristics to the product (i.e., cotton/synthetic).
- Compensate for variations in the characteristics of the raw material.
- Optimize the material for the spinning process.





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- Achieve effects by varying colours, fibre lengths, fibre deniers, etc.

## **PREPARATION OF LAP:**

### **CARDING:**

- **Carding:** Carding is a mechanical process that disentangles, cleans, and intermixes fibers to produce a continuous web or sliver suitable for subsequent processing. This is achieved by passing the fibers between differentially moving surfaces covered with card clothing.
- When very fine yarns are desired, carding is followed by combing, a process that removes short fibers, leaving a sliver composed entirely of long fibers, all laid parallel and smoother and more lustrous than uncombed types. Carded and combed sliver is then spun.

### **DRAW FRAME:**

Draw Frame is the machine where the slivers are doubled or combined, blended & mixed, levelled and attenuated transiently through a series of pairs of rollers. In the drafting arrangement

## **COTTON YARN DEVELOPMENT:**

### **ROVING:**

- The input is the finisher draw frame sliver cans and the output of the roving frame is called roving
- Roving process is the last second stage of spinning process conducted after blow room, carding, combining, drawing and prior to conewinding. Overall, the roving operation in textile manufacturing process focuses in decreasing the density of silver from draw frame by draft.
- To attain the good quality of yarn it is difficult to apply draft on silver in a single step. There comes the requirement of better strand wound on smaller packages which can be attained by roving operation as a result silver cans occupy larger spaces as compared to ring spinning frame. Silver is broad and strand which is untwisted which would result into more hair when converting into yarn by drafting. Contrarily, roving is appropriate having twist so that it does not produce any hair during the operation. Roving frames are generally named as speed frames, flyer frames and simplex machines.

## PREPARATION OF COTTON FABRIC:

### Yarn winding:

- The winding is the process of creating large yarn packages called “cone” from several small yarn packages (ring cops) to make use of yarn in subsequent machinery. The Winding process not only make bigger yarn packages, but it also corrects spinning faults like naps, hairiness, and waxes. The process also improves quality of yarn by cleaning.
- Ring cops are the final package from the ring spinning machine which contains a small amount of yarn of a definite count. The cop contains 50-80 grams (1.5-3 ounces) yarns.



FIG 11: YARN WINDING MACHINE.

### Weaving / Fabric production:

- **Weaving:** Weaving is the process of fabric manufacturing by interlacing two sets of yarn called warp and weft. In the weaving, many developed machines are using in the textile industries. For example, Air jet loom, Shuttle less loom, Jacquard loom, etc.
- Generally, three types of fabric are produced for garments and textile production. These three types of the fabric manufacturing process are weaving, knitting and non-woven. The woven fabric is produced by the weaving process. The knitted fabric is produced by



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inter-looping by the knitting machine and non-woven fabric is produced by applied pressure.

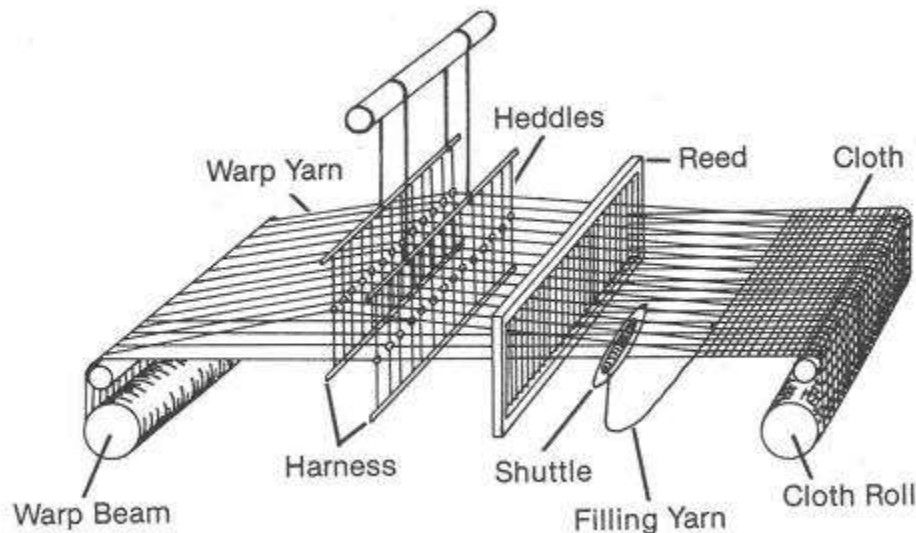


FIG 12: WEAVING MACHINE LINE STRUCTURE.

## Conclusion:

The fibers obtained by recycling are generally evaluated in the production of lower-value products (downcycling) compared to the original product. However, nowadays, recycling fibers have started to increase their evaluation in high value-added products (downcycling). On the other hand, the perspective that focuses only on the cost aspect of the production of recycled garments is not correct. Considering water consumption as well as pesticides and artificial fertilizers used, the textile industry is known to be one of the most polluting and waste-generating sectors. From this point of view, recycling of textiles and garments is of great importance in terms of reducing the use of natural resources (e.g., water used to grow seeds or oil used in the production of synthetic fibers) and CO<sub>2</sub> emissions. Recycling will also save energy and chemicals to produce new textiles, as well as prevent pollution from the production process. In this context, it is important for the future of our world to review all production and consumption processes and supply chains in the focus of circular economy and sustainability. Therefore, the recycling of textile industry waste is very important.

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The future of textile recycling mostly depends on its implementation in the industry and gaining more experience and grounds for more innovative methods. Clothing retailers are key actors on this front, as they are uniquely positioned to be able to influence and improve consumers' approach in favor of sustainability. Not only do clothing retailers have the potential to influence consumer decisions, but also, they are able to alter consumption patterns. People can learn the importance of recycling as well as reuse and resales by the help of companies, and this is not limited to developing countries. Through such actions, consumer awareness about sustainable consumption would increase, leading to less environmental damage in the future.

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