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A REVIEW OF TEXTILE RECYCLING

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Abstract— **Textile recycling plays a vital role in consumer goods industry. Due to increase in world population and advancement of living standard, global fiber consumption has been increased in the past few years which results into a greater amount of post-industrial and post-consumer fiber waste. The reuse of waste material can contribute to improve the sustainability of materials. The aim of this paper is to review the contributions of the researchers in the field of recycling of textile waste. It is found from the literature about 5.8 million of textile waste is produced every year only 25 percent is recycled. However, recycling of waste is beneficial for both environmental and economic conditions. The major part of recycling involves the conversion of roving waste into usable yarn. With this finding from the literature, the project is undertaken to develop pneumatic roving end opener.**

Keywords-Textile Waste, Recycling, Fibres, Roving Waste

I. INTRODUCTION

Textiles are produced to perform a variety of functions and are made up of different types of fibers mixed in variable proportions. It is being a history that a huge amount of waste is generated from textile industry every year. Financially, textile waste generation is affected by the creation of textile products, the higher the generation, the more noteworthy the measure of waste. Apparel fabricating produces a lot of material waste, which winds up in landfills and can be reused. Reusing of material waste can help as methods for giving answers for some monetary, natural and social issues [1]. A large percentage of the textile waste is from cotton and it blends with synthetic fibers. Discarding such huge volumes of waste is an expanding issue for the textile industry. Covering and landfilling the material waste are real worries for nature. [3]. Even though the considerable technical improvements have been made in blowroom machines, the generated

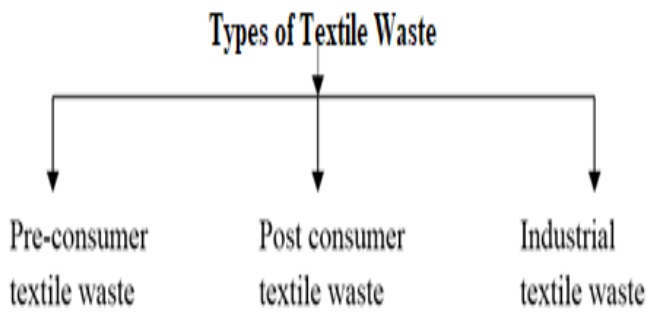

Fig. 1 Types of Textile Waste [2]

waste in cotton spinning comprises a high portion of fibers. Raw material prices, energy and labor costs have been constantly rising for many years. Therefore, manufacturers attempt to improve the utilization of the raw material by recovering fibers from waste and providing high cleaning efficiency in blow-room and cards [9]. The textile waste is mainly categorized in three types which are shown in fig.1.

Recovery from the waste stream contains recycling the waste into a product and reuse of a product in its original form is a common practice for clothes. Recycling technologies are split into primary, secondary, tertiary, and quaternary approaches. Primary method includes recycling industrial scrap; secondary recycling involves mechanical processing of a post-consumer product. Tertiary recycling incorporates procedures, for example, pyrolysis and hydrolysis, which basic chemicals, monomers or fuels are recovered from plastic waste. Quaternary recycling includes recovery of heat by burning the fibrous solid waste [2]. Different types of waste produced in different types of production industries are given in Table 1 [5].

Table 1 Types of Waste Produced in Different Production industries [5]

Production Type	Types of Waste
Spinning waste, yarn waste	Opening Waste, Carding Waste, Sliver Waste, Roving Waste, Combed Noil, Bonda hard waste from ring spinning, Winding and doubling, Bonda soft waste, Pneumafill waste.
Clothing waste	Knitting waste fiber and yarn, Woven waste fiber and yarn, Woven and knit cutting waste.
Nonwovens production waste	Thermally and chemically bonded, lightweight webs, needled webs, coated, uncoated.
Carpet mill waste	Needle felt, tufted carpet, cut waste, coated, uncoated
Used textiles	Old clothing

II. LITERATURE REVIEW

A. Aluigi, C. Vineis, A. Ceria, C. Tonin [1] described protein fiber squanders, for example, side-effects from the fleece material industry, low quality crude fleeces not fit for turning, speak to a significant inexhaustible wellspring of biopolymers. Hairs and feathers are largely made of keratin, that could be recovered and transformed into new materials with inventive properties reasonable for textile or other uses (fibers, compostable packaging, disposables, agricultural films, membranes and coatings). Fleece strands when vexed in their histological sections joining the intercellular bond by ultrasonic-chemical medications, the subsequent cells were implanted in a polymeric film-shaping grid of cellulose acetic

acid derivation, of getting another composite material, reasonable for film generation and fiber turning.

Cellulose acetic acid derivation is primarily utilized in the generation of yarns for materials, channels, plastics; electrical protections, photographic movies, straightforward and pigmented sheets, restorative and clean application since it shows a striking protection from molds and microscopic organisms. By the by, cellulose acetic acid derivation is combustible in nature and hard to color. As a result of special properties of Plastics and material strands, for example, improved, dampness recapture, imperviousness to fire, coloring exhibitions and shading impacts, handle and look may be produced using new composite materials joining properties of manufactured and protein polymers which are normally hydrophilic, non-consuming and colored well by the vast majority of the business color stuffs. Improvement of the warm properties has been obtained concerning the pure cellulose acidic corrosive determination film. Cortical cells from fleece likewise provide for cellulose acetic acid derivation a progressively hydrophilic character and, potentially, other performances typical of wool, such as novel dyeing properties and colour effects, which are very important characteristics for textile applications.

A D Sule and M K Bardhan [2] stated no less than 3-4% of the weft yarn including get closes is an unavoidable waste in each sort of weaving machine. The catch selvedge yarn strip is sold at discard cost. The filaments are isolated by the garnetter who utilizes them for stuffing of cushions and blankets. Some utilization this loss for making extravagant composites for floor covering. By utilizing 100% wool yarn for 100% wool weft or polyester-wool mixed yarn, the wool rich catch selvedge can be prodded to recoup filaments to sustain to the woolen cards to deliver covers which have a market in cooler locales. This is a financially savvy arrangement and accommodates the wool rich crude materials required for delivering covers.

A. Payne [3] mentioned two systems of recycling closed loop recycling and open loop recycling in both the system in the first stage waste is collected and reprocessed. The waste is collected from various sources and decision is taken whether it will contribute to open or closed loop system. In open loop recycling some of the waste which is indefinitely excluded from the system and diverted to landfill. There are two reasons for this exclusion are 1) degradation of the raw material that results in reduced quality and (2) incorporation of the raw material into a product that is not recyclable. An alternate and more sustainable strategy is closed-loop recycling. The recycling of the material is indefinite and without degradation. This change of the utilized item back to crude materials takes into consideration making a similar item over and again. Biodegradable items are likewise a piece of the shut circle reusing framework. This is otherwise called support to-support.

F.A. Esteve-Turrillas, M. de la Guardia [6] referenced the procedure for the generation of superb cotton yarn from reused materials all around grouped by their shading. The key steps involved in the production of Recover cotton fibers is shown in Fig. 2. In this approach, pre-consumer textile waste is collected and arranged according to their color and quality from different textile plants as a raw material, then this waste is cut into small pieces, shredded and opened into fibers without affecting fiber length. The recovered fibers have a length of 10-15 mm and attain a high-quality standard.

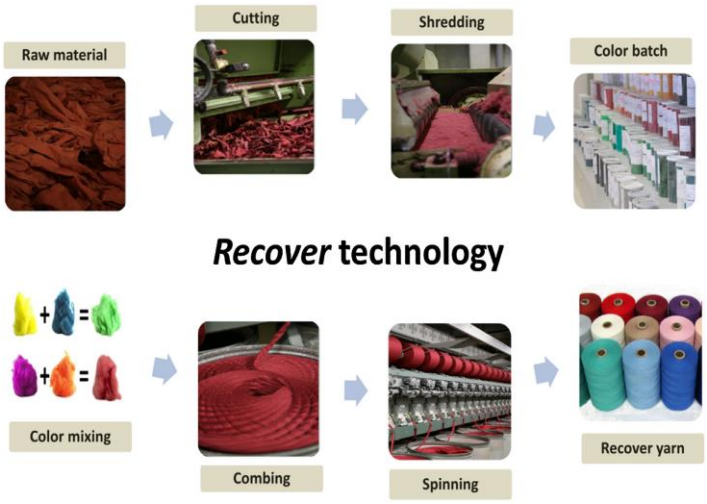

Fig. 2 Main Steps Involved in Production of Recover Cotton

Lightman, Elliott, D. [7] discussed the process of utilizing waste cotton material for the production of textile product. The procedure can incorporate gathering diverse classifications of waste cotton material from an assortment of material arrangement forms. The procedure can likewise incorporate choosing explicit classifications of waste cotton material to be mixed together relying upon the material item to be delivered. Simultaneously, the grouping of cleaning, opening and mixing handling steps can be chosen to be utilized in making a yarn contingent upon the material item to be produced. The chose explicit classes of waste cotton material can be cleaned, opened and mixed into mixed cotton strands. The mixed cotton fibers would then be able to be prepared into the material item to be delivered.

Mohamed Taher Halimi, Mohamed Ben Hassen, Faouzi Sakli [9] describes the textile waste generated during the different process in the textile mill and they can be recycled. The comparison of recovered yarn quality and fiber quality is done. The results show that the insertion of 25% of waste does not alter the tenacity, the irregularity and the yarn elongation.

Rajesh Mishra, Bijoya Behra, Jiri Milltky [10] this paper aims to convert textile waste into appropriate reinforcement structures so that they can be used as composite preforms. Attention has been focused on the development of fiber-reinforced composites with superior mechanical properties. In order to fulfil this basic objective, his work is aimed at manufacturing fibrous structure reinforced composites from waste fabric and explores the possibility of using alternate materials that can be used in composites. The waste fabric was opened into a fibrous form by garneting technique and it was blended with different proportions of virgin polypropylene

(PP) fiber. Compression Molding Technique was used for manufacturing of composite samples from fibrous webs as well as 3D woven fabrics.

Sushma Rani, Zeba Jamal [11] stated textile waste is mainly categorized into three types pre-consumer, post-consumer and industrial textile waste which can be recycled by physical and chemical recycling. Pre and post-consumer waste are reprocessed into products using reclamation process by physical recycling and it is more favorable than chemical recycling. The recycling of textile wastes is carried out in the fiber stage and garment stage. In the fiber stage, fibers are recovered from the textile mill and it is to be produced blended yarns in varying portions. Nonwoven materials are produced using reused filaments. In garment stage breakdown of waste to the fiber through cutting, destroying, checking, and other mechanical procedures. The fiber is then re-built into esteem included items. These items incorporate stuffing, cover underlay's, building materials, for example, protection and material felt, and low-end covers.

Thaís dos Santos Pegoretti, Damien Evrard, A Arruda, Fabrice Mathieux, Daniel Brissaud, José Roberto de Franc [12] presented the design options for the acoustic panel for automobile model called Agile produced by General Motor with the combination of recycled cotton textile and other polymers. Three designs of a panel are illustrated in this paper these are DL-PU panel, ABA-Cotton panel and DL- Cotton panel.

Youjiang Wang [13] depicts a summary of fiber and textile recycling, concentrating working on it of floor coverings, which represent an extensive piece of the material waste. Mechanical methods are employed to isolate the carpet fibres. One or more segregated components then are recycled into products that generally compete with products produced from virgin polymers. Different fibre recycling approaches like melt processing in which extrusion converts thermoplastic polymers into resin pellets and Polymer depolymerization converts polymeric waste into monomers or oligomers that may be repolymerized to produce virgin-quality polymers as a means for closed-loop recycling. Any type of polymer waste can be recycled by chemical recycling process irrespective of its type.

Zhangxin Zhen [14] stated the method for opening waste roving by using airflow. During the spinning process, some portion of the roving left on the roving bobbin which goes into waste and this waste roving is removed by using a hook knife results into damage to the bobbin. This removed roving waste is opened by using spiked drum but, it damages the fibers so to avoid this pneumatically operated roving waste processor is a good choice.

III. LITERATURE FINDINGS

- About 15-20% of recycled fiber can be mixed with fresh cotton which can be used for the production of yarn without affecting the quality of yarn.
- The cost of raw material can be reduced by blending the recycled fibre with raw material.
- The twist multiple plays a vital role in creating strong quality yarn using fibres with a mix of short medium and long staple lengths.
- Recycled fibre can be used to make fibre-reinforced composites with superior mechanical properties.
- By combining the cotton waste with the base material (polyurethane) different products can be made like acoustic panel and insulating material for buildings.
- Roving waste opening by mechanical machine results into damage to the quality of fibre.

IV. CONCLUSION

Recycling technologies involve the shredding of the garments into fibers and reconstitute the fibers into yarns. Other recycling approaches involve the chemical conversion of the wastes into new fibers, other usable items and production of energy and other chemicals. Approximately 4-6 million tons of carpet waste is generated per year worldwide. Around one million tons of textiles are discarded each year in India out of which half of textile waste is recyclable. Waste recycling is of great importance in decreasing production cost and saving of valuable raw material.

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