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Recycling of textiles waste for environmental protection

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Abstract

Textile industry is among the most essential consumer goods industry. However, textile industry is accused of being one of the most polluting industries. Not only production but consumption of textiles also produces waste. To counter the problem, textile industry has taken many measures for reducing its negative contribution towards environment. One of such measures is textile recycling- the reuse as well as reproduction of fibers from textile waste. Recycling can be done through thermal, material, chemical and mechanical processes. Textile recycling is beneficial for environmental and economic conditions, reducing demand for textile chemicals, requirement of landfill space is reduced, consumption of less energy and reducing of water wastage. Market research, and efforts are needed to increase consumer awareness and to encourage manufacturers to increase the use of recycled textile waste into new products.

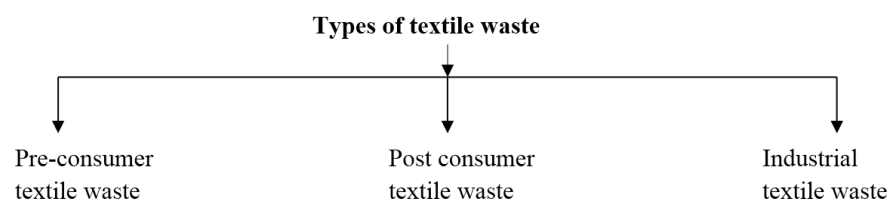
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Introduction

Textiles are manufactured to perform a wide range of functions and are made up of different types of fibers mixed in varying proportions. The textile recycling industry is one of the oldest and most established recycling industries in the world. While the 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. The textile industry has a very negative impact on our environment. Clothing manufacturing generates large amounts of textile waste, which ends up in landfills. Only a minute amount is re-utilized. Out of various activities in textile industry, chemical processing contributes to about 70% of pollution.

What is “textile waste”?

Like all wastes, textile waste originates from the community via number of streams including the fibers, textile or clothing manufacturing industries, consumers, commercial and service industries. Majority of textile waste comes from household sources. Average lifetime of any clothing is deemed to be for about 3 years, after which, they are thrown away as old clothes. Sometimes even 'not so worn garments' are also discarded as they become unfashionable, or undesirable. These are post-consumer waste that goes to jumble sales and charitable organizations.



Pre-consumer textile waste

Pre-consumer textile waste is the manufacturing waste that is generated by processing fibers and the production of finished yarns and textiles, technical textiles, nonwovens, garments including off-cuts, selvages, rejected material, etc. This waste is generally clean waste.

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Post-consumer textile waste

Post-consumer textile waste consists of any type of garments or household textiles that the consumer no longer needs because they are worn out, damaged, or have gone out of fashion. This category has been of reasonable to good quality garment that can be recovered and subsequently recycled by another user as second-hand clothing, much of which is sold to third-world nations like Togo, Ethiopia, Comoros, Haiti etc.



Industrial textile waste

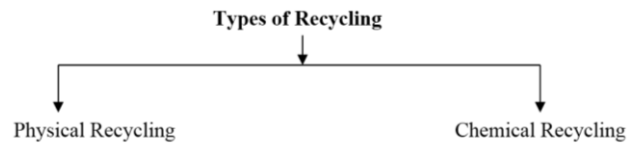
Industrial textile waste is generated from commercial and industrial textile applications including commercial waste such as carpets and curtains. This waste is generally “dirty waste”. A substantial proportion of these end-of-life goods are incinerated or dumped to landfills.



To counter the problem, textile industry has taken many measures for reducing its negative contribution towards environment

- One of such measures is textile recycling - is the method of reusing or reprocessing used clothing, fibrous material and clothing scraps from the manufacturing process.

- Recycling is a key concept of modern waste management. Recycling is the reprocessing of waste materials into new or reusable products. Ninety-nine percent of used textiles are recyclable.



Physical Recycling

In Physical Recycling Manufacturing waste and post consumer products are reprocessed into new products using reclamations process or commingled plastics waste processing. Due to its simpler, cheaper and more environmental friendly process, physical recycling is more favourable than Chemical Recycling.

Chemical Recycling

Chemical recycling is to convert high molecular weight polymers into low molecular weight substances. The obtained substances can be used as the reactants for preparations of other chemicals and polymers.

Recycling of textile waste can serve as a means of providing solutions to many economic, environmental and social issues. Though textile recycling has old history, in recent years it has assumed prime importance due to Fast Fashion culture in western world which has resulted in over consumption of textiles and corresponding waste generation. The least expensive and adverse effect on the environment is when a component can be recycled into its original product, i.e. called ‘closed loop’ recycling. The second best is when it can be used in another article which usually requires less demanding properties, for example face car seat fabric being recycled into backing material.

Types of Recycling Technologies

- Thermal Recycling Technology
- Material Recycling Technology
- Chemical Recycling Technology

Thermal Recycling Technology: Thermal recycling is intended to recover heat energy generated from the incineration of fibre wastes as thermal or electrical energy.

Material Recycling Technology: Material recycling recovers polymers from fibres and at present, the idea of transforming polyethylene terephthalate (PET) into fibres is most economical and widely used for practical purposes.

Chemical Recycling Technology: Chemical recycling recovers monomers from waste fibres by polymer decomposition. Impurities can be easily removed from recovered monomers, so their quality will be made exactly equal to virgin monomers.

Benefits of Textile Recycling

Textile and clothing recycling can give old clothes, linens, and other textiles a second life. The recovery of textiles and clothing for recycling provide both environmental and economic benefits. It avoids many polluting and energy intensive processes that are used to make textiles from fresh materials.

- **Clothing and textile recycling reduces the need for landfill space:** Synthetic fiber products will not decompose in the landfill. Woolen garments do decompose but they also produce methane which contributes to global warming.
- **Clothing and textile recycling reduces pressure on virgin resources:** Recycled clothing does not require the use of new textile resources such as cotton or wool.
- **Clothing and textile recycling encourages the development of additional markets:** Raw materials created from recycled content generally cost less, making their use attractive and desirable to manufacturers. This in turn leads to the development of more markets for reclaimed fibers.
- **Clothing and textile recycling saves Energy and Reduces Pollution:** Recycling saves on energy consumption when processing. Unlike raw wool, reclaimed fibers do not have to be thoroughly washed using large volumes of water.
- **Clothing and textile recycling reduces the demand for dyes and fixing agents:** This in turn reduces the problems caused by their use and manufacture.

The recycling of textile wastes is carried out at two stages:

1. Fiber Stage
2. Garment Stage

Fibre Recycling Technologies

A vast number of products are made from reprocessed fiber because much of this fiber is re-spun into new yarns or manufactured into woven, knitted, non-woven fabrications, upholstery material or composite biomaterial etc. The approaches include:

- Chemical processes to depolymerize nylon and other polymers,
- Recovery of plastic resins from carpet fibres
- Direct extrusion of mixed carpet waste

The recycling of textile wastes on Fiber stage:

- a) **Yarns from Recycled Fibres:** The waste produced in a textile mill is an important factor in determining the operating cost and therefore in influencing mill profits. The recovered fibers from waste can be used to produce blended yarns in different portions. These can be reused for the open end spinning and friction spinning.
- b) **Upholstery Material from Recycled Fibres:** At least 3-4% of the weft yarn including catch ends is unavoidable waste in every type of weaving machine. The catch selvage yarn strip is sold at throw away price. The fibers are separated by the garnetter who uses them for stuffing of pillows and quilts. Use this waste for making fancy composites for floor covering.
- c) **Composite Biomaterials from Recycled Fibres:** Hair and feathers are largely made of keratin, that could be recovered and transformed into new materials with innovative properties suitable for textile or non-textile uses. Protein fiber wastes such as by-products from the wool textile industry, poor quality raw wools not fit for spinning, represent an important renewable source of biopolymers.
- d) **Nonwovens made from Recycled Fibres:** Depending on product functions, reclaimed fibers can be looked upon as conventional in technical textiles, particularly in nonwoven. In all these cases, reclaimed fibres are used because of low prices. This concerns fibers, which would

not be available at a competitive price if made from primary material, such as:

- The high- grade woolen hair found in laminated nonwoven used to make motor vehicle seats.
- Micro- fibre materials used for insulation or cleaning.

The Recycling of textile wastes on Garment stage

a) **Used clothing market:** Recovery from the waste stream includes re-use of a product in its original form, the largest volume of goods is sorted for second hand clothing markets.

b) Conversion to New Products

- **Breakdown of fabric to fibre:** To breakdown of fabric to fibre through cutting, shredding, carding, and other mechanical processes. The fibre is then re-engineered into value-added products. These products include stuffing, carpet underlay's, building materials such as insulation and roofing felt, and low-end blankets.
- **Re-design of used clothing:** Current fashion trends are reflected by a team of young designers who use and customize second-hand clothes for a chain of specialty vintage clothing.

Post-consumer textiles wastes are also up-cycled in small Indian clusters. Traditionally, old cotton *sarees* are made into layers and stitched together using run stitches, to give a unique design effect as "*Kantha*". This is used for infants and children as blankets and wraps as it is soft and suitable for the Indian climatic conditions.

c) Wiping and polishing clothes

- Clothing that has seen the end of its useful life as such may be turned into wiping or polishing cloths for industrial use.
- T-shirts are a primary source for wiping and polishing clothes because the cotton fibres makes an absorbent rag and polishing cloth.
- Old textiles, mostly cotton are often converted to wipes, kitchen towels, dusting cloth. If the garments are in a good condition they are generally passed down to the under privileged people. Garments are collected by different NGOs to distribute to the people after a natural calamity like floods.

Barriers in recycling

Lack of Equipments: It has a greater problem for medium-sized firms than for small or large firms. Recycling often yields fibers that are too short to be spun into yarns. There are problems in recycling blend such as polyester and cotton, or cotton and lycra are not easy to recycled.

Lack of consumer awareness: Due to Lack of awareness, attitude of peoples towards waste issues are complex. But Recovery of post-consumer textile waste is dependent on donations from the public. The increased use of recycled materials in products and the increased recovery of material for recycling can be achieved with an educated public.

Cost of the end product: Costs involved in processing the textile waste into a usable form in many cases is labor intensive. Extensive sorting of materials on the front end of the processing by the recycler must occur to ensure quality output through the recycler's operation. It is difficult for recycled fibers to compete in many markets where the price of virgin fiber is so low.

Lack of marketing: Lack of a market was ranked the highest with choosing it as the most significant barrier to entering the market place. Explanation can be that companies can produce a finite number of wiping clothes, mop heads or trunk liners before the market is saturated.

Strategies of Textile Waste Management

Source Reduction: To have little or even zero waste source reduction is considered in an integrated waste management system e.g. avoiding waste generation, internal reuse of waste, reuse in other products etc.

Incineration: It is a process of burning the solid textile waste like to short, shredded, loose fibres etc. recover the heat energy.

Reusing: Using the article again with the same functionally.

Recycling: 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 these product category.

Market strategies

The study revealed that the most respondents have the perception that products made from recycled fibers are of lower quality than items made from new fibers. So that many companies support marketing strategy that creates a strong trade or channel demand for use with products made with recycled fibers. These are the strategies that are required for successful marketing of products made from textile waste:

- Cooperative advertising
- Increase convenience
- Increase awareness

Some innovative ideas

Sarees are pieces of inheritance. A lot of them are a part of wedding silks and many are passed on by grandmother. To make them more wearable there are many ways to recycle a traditional saree.



Suits: The brocade saris, chiffon ones and even silk etc. can be transformed into a salwar-suit, using contrasting salwar or churidaar with a brocade kameez.

Dupatta: Heavy dupattas with plain suits look great. Get the sari cut into a dupatta in a way that the border is used around the sides.

Skirt: If it is a cotton sari, or a sari with border or patch work, make a skirt out of it. A wrap-around skirt or an A-line one will look great.

Kurti: If it is chiffon, georgette or cotton sari then get a *kurti* or *kurta* made of it. It can be wore with contrast trousers or palazzo pants.

Blouses: Silk sarees can be use as blouses.

Pants: Silk saree can be turned into pants. Cigarette pants look great and can be worn with many *kurtas*.

Scarves: After reinventing sari into an anarkali suit or *kurta*, there may still be some fabric left. Don't waste it. Make a scarf or stole out of it.

Jackets or waistcoats: For Indo-western looks, a brocade or Banarasi sari can transform into a waistcoat or jacket. This jacket can be worn over a simple white anarkali suit or over a grey top and denims.

Children's clothes: The sari can be turned into an anarkali suit for children.

The little bits left over from your sarees after converting them into any of the above items can be used for other purposes around the house. Use them to make book covers, a pair of cushion covers, headbands or phone cases, curtain borders, bedcover borders, table mats or just about anything your creative mind comes up with.

Educating Public about Recycling - Currently, only 15% of used clothing and textiles are being recycled. The other 85% goes straight to our landfills and the majority of people don't know they can recycle those unused textiles and help reduce the negative environmental impact. Secondary Materials and Recycled Textiles Association (SMART) is committed to help federal, state and local government agencies to reduce the amount of textiles going into landfills.

- School programs would help to get students thinking early about textile recycling.
- Textile recycling information should be included in all current public relations and promotions efforts now supporting recycling programmes.
- All clean and dry clothing can be donated and recycled.
- All used clothing, even pieces with stains or missing buttons, can be re-used and repurposed.
- Besides the usual shirts, pants and suits donations, don't forget hats, gloves, socks, undergarments, belts, ties, purses, handbags, of any style, age or condition.
- 95% of consumer textiles can be recycled to be re-worn or re-used. Wearable items are either sold or distributed by charities.
- Un-wearable items are cut into wiping cloths and rags or ground up into fiber to manufacture stuffing, insulation and carpet underlayment.
- Household textiles like curtains, drapes, comforters, sheets, pillow cases, towels, tablecloths and linens are all recyclable.

Government's Role

- Encourage technology advancements for waste recycling.
- Help to create logistic chains and market for recyclable products.
- Promote the use of re-usable or eco-friendly packaging material.
- Direct the industries to reduce the packaging material and its composition, unfriendly packaging to encourage compliance.

Conclusions

- A large amount of textile waste is disposed of in landfills each year. That not only poses economic and environmental problems to the society but also represents a severe waste of resources.
- Market research and efforts are needed to increase consumer awareness and to encourage manufacturers to increase their use of recycled textile waste into new products.
- People those are impetuous for waste disposal would think rationally about the rejuvenation of waste fibers for raise the profit for their firm and also it reflects noble cause for society by reducing the contamination in environment.
- Textiles in India are recycled both for the domestic and the global market. In the domestic market recycled textile products are generally found in the form of floor mats, wipes and rugs. The fibres extracted during recycling of clothing are converted into recycled yarns and it is used in different textile products and also as fillers.
- Textile recycling also teaches everyone to reuse, reduce and recycle these products instead of throwing them away.
- So, it is the time to think and make up our mind to use recycled products to reduce the environmental pollution.

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