# TEXTILE WASTE RECYCLING—A NOVEL APPROACH

***Alpana Shah, Namrita Kola***

S.M.Patel College of Home Science, Sardar Patel University, Gujarat, India

P.G.Department of Home Science, Sardar Patel University, Gujarat, India

***Abstract***

*Accumulation of textile waste on landfill site is gradually becoming a major issue for concern as it creates air, soil and water pollution directly or indirectly. Recycling of industrial textile waste is today's need. Thus, a research was carried out to study the mechanical properties of yarns obtained as waste from textile and fiber reinforced plastic unit of Ahmedabad city. Post-producer textile yarn waste which consisted of cotton, polyester, lycra were collected , chopped, mixed with glass fiber in their original form using epoxy resin in presence of a catalyst. Afterwards a sheet was produced. Later on the tensile, elongation, flexural and impact test were studied. It was observed that mixing of textile yarns with glass waste yarns reduces brittleness and hardness of glass yarns.*

***Key Words****: textile industry, yarn waste, post producer, cotton, glass, tensile strength.*

## Introduction:

Textile industry is one of the largest industrial sector employing millions of people both males & females directly or indirectly. It is the second largest revenue generating economic sector. In India, Gujarat is one of the major state producing textiles & apparels and increase in textile units has led to more solid waste generation. Textile waste is the material that is unusable for any purpose by the owner. The waste generated by textile units is not only in gaseous emissions or liquid effluents but lots of it is in solid form. Many laws and reforms have been imposed to overcome these ecological issues. The waste is produced almost by majority of the departments comprising of fiber, yarn, fabric and garment manufacturing sectors. The waste generated by these units can be classified as post-producer and post- consumer. The post-producer waste is the byproducts of the fabric or garment factories. It is found as yarns, selvedges and fabric pieces in dyed and undyed form as well in woven & knitted constructions. The post-consumer waste is produced during the use or disposal by the consumer. It is important to think of the ways to reduce or overcome the ecological threats caused.

## Significance of research:

With technological advancement, opportunities in technical textiles have immensely increased. On the contrary this leads to more solid waste generation and shortage of landfill sites. To overcome this, textile reuse and recycling becomes immensely important. Ways should be developed to make waste easily available and accessible. With an aim to utilize these waste this research was carried out .In the study waste was used in its original /natural form i.e. without giving any further treatment .This industrial yarn waste was blended with industrial glass yarn waste and compared with original counterparts.

## Methods and materials:

Post-producer yarn waste was collected from the textile industries producing denim and muslin fabrics in Ahmedabad, Gujarat, India. The waste was segregated, cleaned , separated as cotton, polyester & lycra and dried. This waste was mixed with glass yarn using isothalic epoxy resin in presence of methyl ethyl kiton peroxide. The fiber to resin ratio was 1:2(optimum quantities were used). For sample making mild steel die with 200x200mm was made in a fabrication unit. The sample size was 180-200mm with thickness of 5mm. Following samples were prepared:

1. cotton+ glass+ epoxy
2. polyester+ glass+ epoxy
3. lycra+ glass+ epoxy
4. cotton+ epoxy
5. polyester+ epoxy
6. lycra+ epoxy
7. glass+ epoxy

The samples were allowed to cure for about one and half hour at ambient temperature. Later on, prepared samples were tested for strength, impact, flexural and elongation as per standards of testing in 'ALEKH' plastics testing centre, Ahmedabad.

**Fig.1 Mild Steel Dye to Prepare Sample**

**Size: 200mm X 200mm**

**Fig.2 Textile Waste + Glass Fibre + Resin Samples**

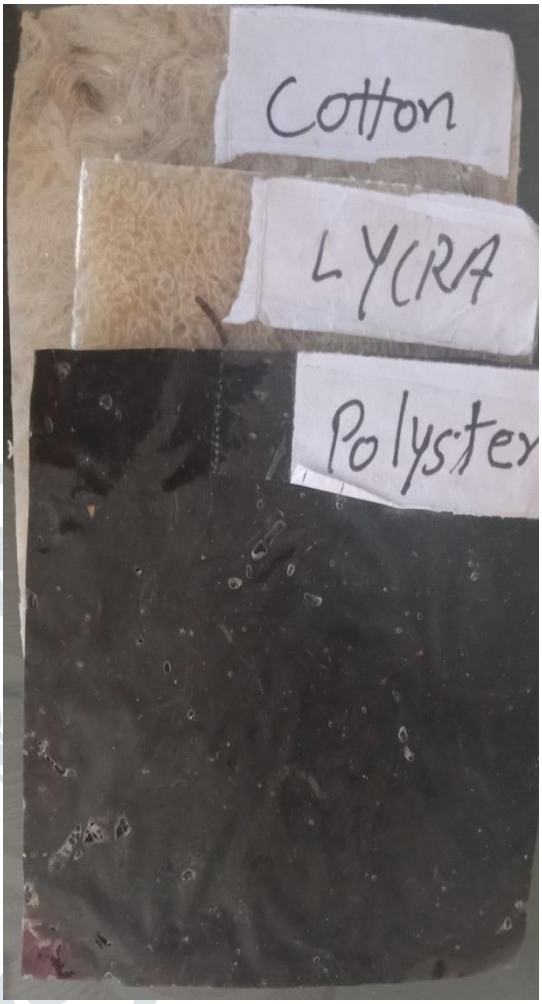



**Fig.3 Only Textile Waste + Resin Samples**

## Results and Discussion:

The cotton yarn waste had lowest tensile strength followed by lycra and polyester. On mixing these yarn waste with same amount of waste glass yarns, the strength increased almost three times(2.7 times) in cotton and two times (2.0) in polyester. It was also observed that there was no noticeable change in tensile strength of lycra when mixed with glass yarns.

The flexural strength of polyester waste yarn was 294kg/cm$^2$ i.e. lowest where as glass yarns showed the highest. Combining of glass fiber with cotton or polyester resulted in almost 1.5 times increase in flexural strength. When lycra yarns were mixed with glass a considerable fall in flexural strength was seen. The flexural strength was the least in lycra -glass followed by polyester, cotton, lycra, polyester- glass, cotton- glass and glass yarn.

In cotton yarn impact strength reduced to almost half when mixed with glass. Mixing cotton and lycra waste yarns with glass yarns showed decrease in izod impact strength i.e. cotton+ glass and lycra+ glass became more tough but this toughness reduced in polyester + glass compared to only polyester waste yarns

The elongation at break for all specimen are from 7 to 10% on average showing no considerable change.

Table I DATA OF MECHANICAL PROPERTIES OF TESTED FIBER SHEETS

| | TENSILE STRENGTH ($kg/cm^2$) | FLEXURAL STRENGTH ($kg/cm^2$) | IMPACT TEST (J/m) |
|---|---|---|---|
| **TEST METHOD** | **ASTM D 638** | **ASTM D 790** | **ASTM D 256** |
| **COTTON** | **39** | **334** | **15** |
| **COTTON + GLASS** | **110** | **587** | **7.7** |
| **LYCRA** | **52** | **349** | **9** |
| **LYCRA + GLASS** | **50** | **232** | **6.2** |
| **POLYESTER** | **57** | **294** | **6.6** |
| **POLYESTER + GLASS** | **118** | **510** | **7.3** |
| **GLASS** | **1000** | **2002** | **No Break** |

Chart I Comparison of Tensile strength of fibers and their blended glass counterparts

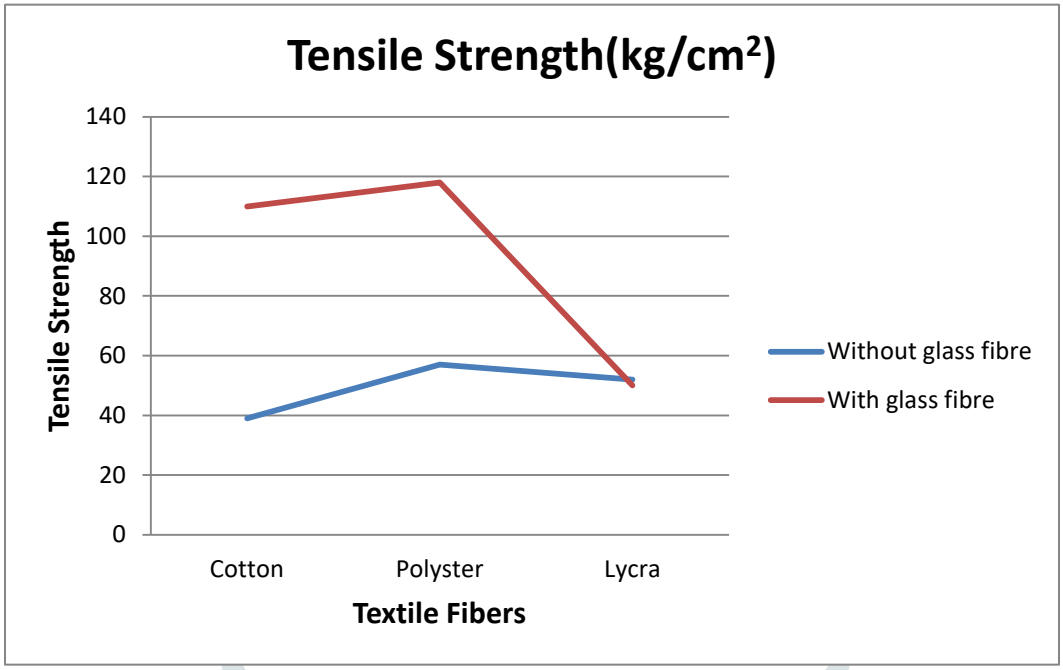



Chart II Comparison of flexural strength of fibers with its glass blended counterparts

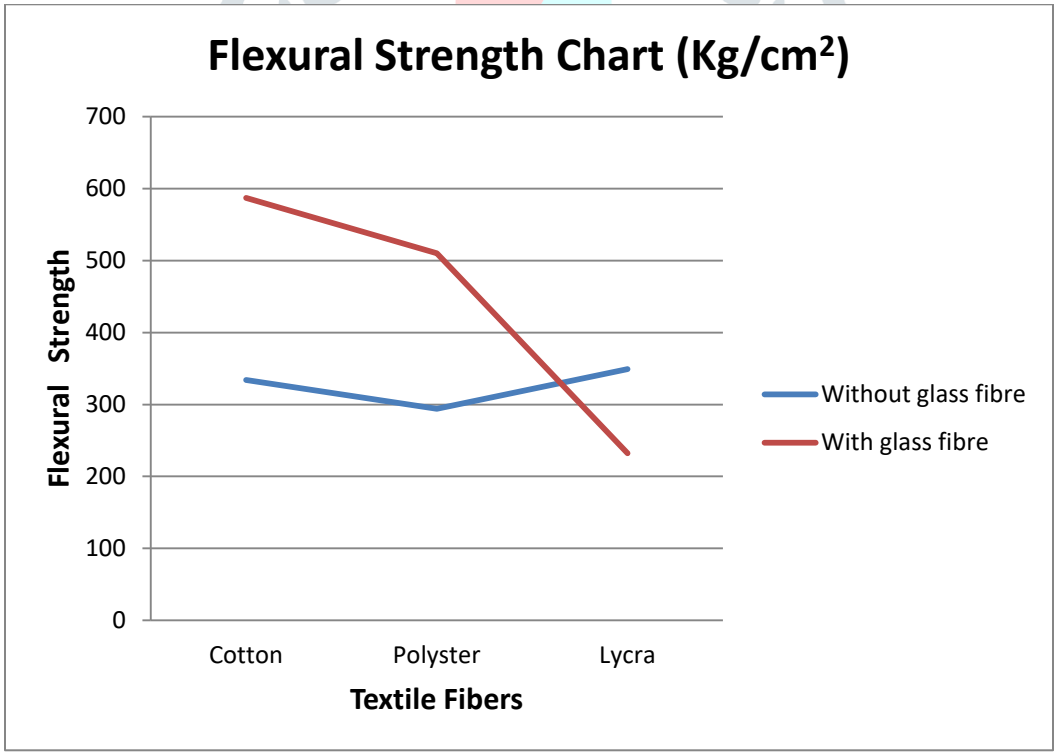
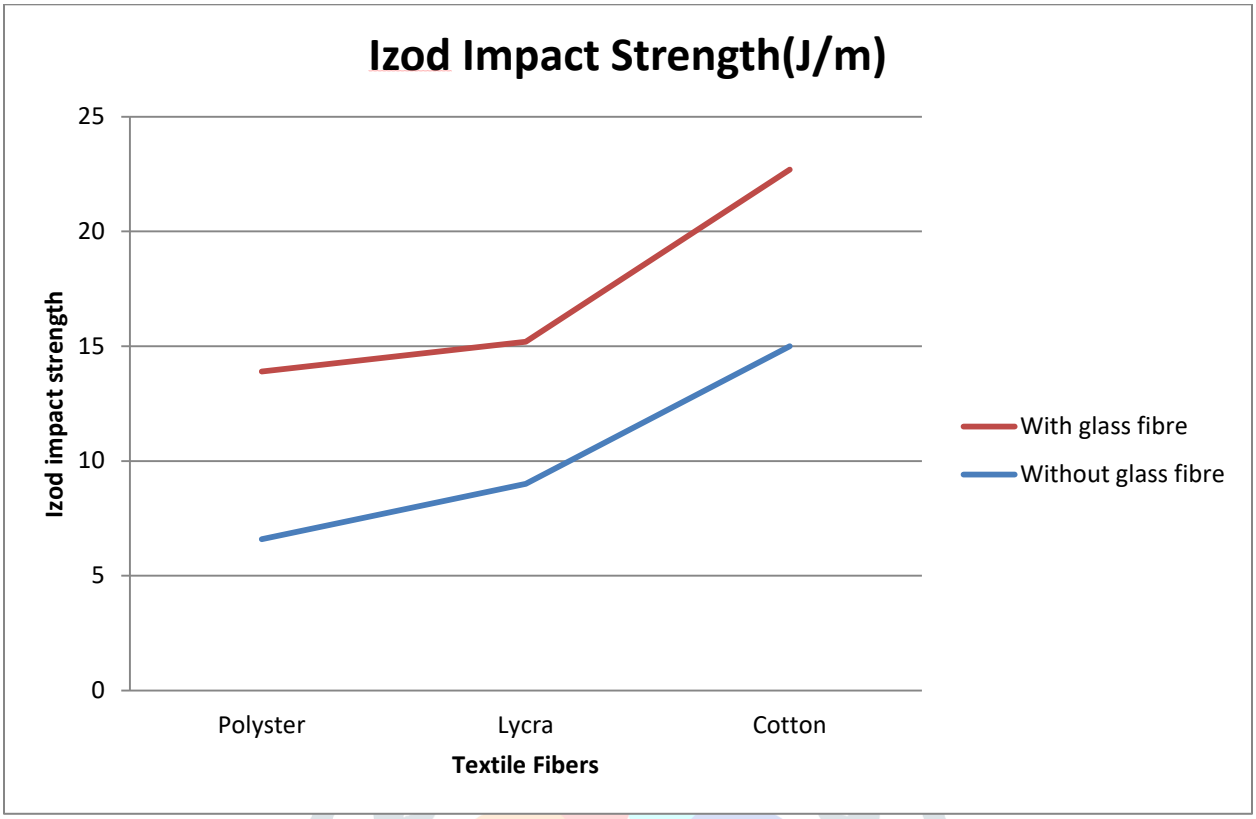


Chart III Comparison between Impact strength of fibers to their glass blended counterparts




**Conclusion:**

The test observations indicate that though strength of lycra seems high in actual it is the lowest among all yarns tested. Mixing of lycra with glass shows decrease in tensile, flexural and impact strength thus making it more brittle as well affecting its overall performance of hardness and rigidity.

On the other hand the test results shows mixing of cotton and polyester waste yarns with glass yarns yield increase in tensile and flexural strength but decrease in impact strength. Thus , the tensile strength of cotton and polyester yarn can be increased by blending it with glass yarns.

Mixing glass yarns with porous textile fibers like cotton and polyester has increased the flexural strength of sheets thus, imparting increased flexibility.

On the contrary, the glass yarns impart toughness and hardness but addition of fiber content decreases the flexural strength thus decreasing the rigidity of the product. Blending of glass yarns decreases the impact resistance in cotton and lycra. The textile industry waste yarns i.e. cotton, polyester if mixed with industrial glass waste yarn can be used to produce light weight roofing sheets, furniture, parting walls etc. which requires moderate strength accompanied with mold ability. Major advantage is lowering of the cost with increase in smoothness and aesthetic appeal. Products requiring moderate strength and flexibility can be designed using these industrial wastes for industrial and domestic uses too. In industrial applications glass fiber cost can be reduced and uses can be increased with more researches on alternative resins. Further researches on blending textile waste with other fibers can

be carried out to replace plastics. Studies can be done on garment application of mixtures of glass fibers with cotton and polyester for improved chemical and ballistic resistant clothing.

Such developments can reduce environmental concern and make use of alternative resources to its fullest.

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