

CLOSING THE LOOP: STEP ONE PRE-CONSUMER DENIM FABRIC WASTAGE RECYCLING PROCESS

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EXTENDED ABSTRACT

The purpose of this study is to make the preliminary work to investigate the potential of pre-consumer textile waste and recycling/reusing possibilities. For this purpose, the waste points from fabric to the final product in denim garment production process were determined. Then the fabric wastes arose from these points were collected.

The pre-consumer waste denim fabrics were then sent to yarn mill and deconstructed into scraps and shredded into raw cotton again. This cotton fiber is then blended with recycled and virgin polyester to ensure good tensile strength. This yarn used as the weft while virgin polyester used as the warp yarn in the weaving process. Produced fabric with indigo shade used as pocket fabric in denim cloths and compared with the conventional pocket fabric. The effect of fiber types on yarn or fabric characteristics were investigated in accordance with planning design and construction.

There is no significant effect was observed in the resultant tenacity properties between the recycled yarn and conventional yarn. The results of this investigation show that the washing conditions have a significant effect on the resultant fabric tear strength and shrinkage properties in all samples. These results show the fabric include recycled materials can be used as the pocket fabric of denim cloths.

Key Words: Sustainable, Denim, Recycle, Pocket fabric

1. INTRODUCTION

Every year million tons of textile waste is being sent to landfills. It is estimated that approximately half of the disposed textile waste consists of pre-consumer textile waste. Although the amount of pre-consumer textile waste is as high as post-consumer textile waste, recovering opportunities for pre-consumer textile waste is substantially disregarded. Pre-consumer textile waste is easier to recycle than post-consumer waste because it does not have the same hygiene and collection challenges [1].

Denim jeans are normally hard-wearing trousers traditionally made from cotton, with more modern versions using other fibres such as polyester and elastane, in twill weave structure. The classic Levi 501 jeans takes 33.4 kg of CO₂, 3.781 litres of water and 400.1 mJ of energy to produce, this is the equivalent of driving 69 miles, 246 hours of watching TV on plasma big screen [2].

According to Environmental Protection Agency [3] Americans throw away almost 31 kg of clothing and textiles per person per year. The results are similar in UK. An average UK citizen throws away 30 kg of clothing and textile waste every year [4].

2. MATERIAL AND METHOD

9363V1 is the code name of fabric that used in the denim pockets constantly. This fabric used as control fabric for comparing the results between recycled fabrics and conventional fabric.

Wlow refers to low degree washing conditions. Whigh refers to high degree washing conditions. P1 and P2 is the code name of fabric that were developed with recycled materials. Details are shown on the table below.

Waste of denim fabric containing different amount of raw materials such as polyester, cotton and lycra which were arose during the cutting process were collected. Then pre-consumer denim fabric wastes are deconstructed into scraps and shredded into raw material again. These fibres are then blended with recycled polyester to ensure good tensile strength by recovery mill in Turkey and woven into new denim pocket fabric by weaving factory in Turkey. At weaving process virgin polyester used as warp yarn.

Table 1 on the below, provides the properties of recycled yarns.

Table 1. Properties of recycled yarns

Desing Code	Blending Composition (w/w)	Blending Type	Yarn Count	Breaking Tenacity (Rkm)	Yarn Twist (twist/m)
9363V1	%70 virgin Co + % 30 recycled Co	OE	30/1 Nm	12.2	580
P1	%50 recycle PES + %50 recycle Co	Ring	24/1 Nm	10.5	870
P2	%50 recycle PES + %50 recycle Co	OE	24/1 Nm	9.5	870

Sustainable denim fabrics were produced from these yarns used in weft according to fabric details from Table 2. After that, 25x25 cm pieces drawn from the fabric produced. Followed by two different washes were carried out for measuring the tear strength and shrinkage properties of fabric. Tear strength of the fabrics were carried out by using TITAN tensile testing device in conformity with ISO 13937-2. All of performance the tests were carried out after conditioning in standard atmospheric conditions according to TS EN ISO 139. Shrinkage properties of fabrics were measured according to ISO 3759 standard.

Table 2. Fabric properties

Weft Yarn	Warp Yarn	Fabric Width	Warp End	Weft End	Mass per unit area (g/m ²)	Breaking Tenacity (Rkm)
						Weft yarn
30/1 Nm, OE	100 Denier PES	150 cm	58	23	90	12.2
24/1 Nm, Ring	70 Denier PES	150 cm	36	25	114	10.5
24/1 Nm, OE	70 Denier PES	150 cm	36	25	115	9.5

3. RESULT AND DISCUSSION

Table 3 shows the average shrinkage and tear strength of fabrics obtained from the results of two repeated washings, respectively, Wlow and Whigh. Furthermore, the relationships of shrinkage values between preferred fabrics and washing conditions were investigated (Figure 2). According to Figure 2 there is a significant difference between washing conditions on the shrinkage values. Also, it can be seen on the table, washing conditions affect the resultant tear strength values.

Table 3. Shrinkage and tear strength of the samples

Material	Mass per unit g/m ² (before wash)	Mass per unit g/m ² (after wash)	Washing Conditions	Shrinkage(%)		Tear Strength (N)	
				Mean Width	Mean Length	Warp	Weft
(P1)363670	114	115	Wlow	0	1.6	19.09	16.54
(P2)363671	115	117	Wlow	0	1.2	16.46	10.66
9363V1	86	88	Wlow	0	1.8	21.35	16.26
9363V1-H	86	83	Whigh	1	2.6	6.91	12.09
(P1)363670-H	114	108	Whigh	1	2.8	5.72	9.02
(P2)363671-H	115	112	Whigh	1	2	4.28	6.55

4. CONCLUSION

In this study, the recycle possibilities of pre-consumer denim waste fabrics as pouch fabric was investigated. The results shows that there is no significant difference was observed in the resultant tenacity properties between the recycled yarn and conventional yarn. Also when tear strength and shrinkage values of samples were examined there is no significant difference was observed according to fabric and yarn properties. Washing conditions affect the resultant tear strength and shrinkage values as expected. This study shows that recycle material can be used in denim products as a pouch fabric. In future work, the abrasion resistance of the developed fabrics and composition will be determined.

5. REFERENCES

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