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Comfort Properties of Ecologically Friendly Sisal Union Fabrics

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Abstract: ***The concern of the consumers for variety in textiles is driving the textile industry for designing and producing new textiles from time to time. The efforts were taken to develop Eco-friendly and biodegradable fibres to control non-polluting environment. The renewed sisal fibre is produced because of its high potential applications. Enzymes are playing a major role in finishing of textiles in an eco-friendly way, protecting the environment on one side and providing gentle finish on the other side. The bio-polishing was carried out on sisal fibre in order to soften the fibre for good pliability and impart the smooth feel and handle of the fabric. Enzymes are advantageous because of their low activation energy requirement. Various scientists have reported that enzymes are safe to use and easily bio-degradable. Therefore the present study was undertaken to assess the performance characteristics of the enzyme treated sisal fibres with three different enzymes New smooth (2%), Microsil (1.5%), Sibasof (0.5%) with cellulase enzyme Britacel L+. After enzyme treatment the sisal fibres were used to weave union fabrics with cotton yarn and subjected to various laboratory tests to evaluate the geometrical, handle, comfort and mechanical properties, the standard BIS and ASTM procedures were followed for the above.The data obtained in the study was compiled, tabulated and statistically analyzed using frequency and percentage for subjective evaluation and by two way ANOVA (factorial CRD) for laboratory tests***

Keywords: eco- friendly, sisal, union fabrics, enzymes

1. Introduction

Today's world is increasingly environment conscious and natural clothing lifestyles are advancing. The inclination towards eco friendly textile alternatives and the emergence of innovative fabrics is vivid. Today's growing concerns are health, sustainability of waste management and environmental awareness which is reflecting on renewed interest in plant fibers. The hunt is on for ecologically friendly fabrics. The movement toward trendy organic fashions and alternative fashion has led to the revival and revision of traditional fibers with natural and organic approaches. New fibers are being developed and are valued for their sustainable and biodegradable characteristics. The highly competitive atmosphere and stringent ecological parameters become the prime concern of the textile industry to be conscious about ecology. Due to the performance characteristics, ecofriendly fibres can be incorporated as whole or parts of materials and products of various forms for a wide range of applications. Natural fibres such as jute, bamboo and pineapple are known to have very high strength and can be effectively utilized for various applications. Among all natural fibres, sisal fibre has huge application in many fields.

The environmental issues associated with textile processing are not new. A large number of chemicals of diverse nature are involved in the process which may be present as such or converted into some other chemicals in the process and thus the effluents pose threat to environment. As enzymes are effective over mild conditions of pH and temperatures and as they are easily biodegradable, they pose practically no threat to environment. Hence enzyme for sisal fibre was considered to improve its pliability.

The union fabrics used in this experiment is made from cotton and sisal. The pre-treatment with enzymes was carried out on available varities of sisal in Andhrapradesh namely Agave cantala, Agave veracruz and Agave webert the three laboratory grade cellulase enzymes i.e. New smooth, Microsil and Sibasof (Britacel limited, Mumbai) were used for the study. Three enzymes of different concentrations were selected based on the standardization of the enzymes. Among the fibre varities agave webert was found to have better physical characteristics before and after pretreatment at these concentration levels 2%, 1.5% and 0.5% (New smooth -2%, Microsil 1.5% and Sibasof 0.5%) the raw sisal fibre was enzyme treated, processed and used in weft at three different percentages with cotton as warp

Union fabrics are produced by incorporating sisal fibre in different proportions with cotton yarn in the following ways:

- 100% sisal union fabric is produced by weaving the cotton yarn in warp and sisal in weft direction
- 50% sisal union fabric is produced by using cotton yarn in warp and both sisal and cotton yarn in weft.
- 25% sisal fiber and 75% cotton union fabric is obtained by using cotton yarn in warp and both cotton yarn and sisal fiber in weft direction

The test fabrics were conditioned and exposed to laboratory tests for assessing their performance characteristics of the fabrics over control fabrics. The standard BSI procedures and ASTM were followed to analyze performance characteristics of fabrics. Tested samples were conditioned in an atmosphere with relative humidity of 65±2% and a temperature of 20±2ºC prior to testing for 24 hours as per BIS standards. The results were statistically analyzed using ANOVA (Two factorial, CRD) test to investigate the cumulative action of enzyme on various fabrics and correlation was used for quantifying the dependency of various characteristics on one another. The tested fabrics (treated and untreated) are coded for convienience the details were furnished below in table 1

Table 1: Sample coding of tested fabrics

Sample code	*Treated*	*Untreated*
Sample 100%	100% sisal	100% sisal
Sample 50%-50%	50% cotton -50% sisal	50% cotton -50% sisal
Sample 25%-75%	25% sisal-75% cotton	25% sisal-75% cotton

2. Geometrical Properties

The geometric properties of developed sisal union fabrics are furnished below in table 2

Table 2: Geometrical properties of sisal union fabrics

S. no	*Sample*		*Yarn count*		*Fabric count*		*Fabric weight*
			Warp	*Weft*	*Warp*	*Weft*	*(g/m²)*
1.	100%	Control	77	69	81	58	0.898
		Enzyme I	100	40 (-29)	80	66 (1.37)	1.082 (20.5)
		Enzyme II	90	41 (-40.5)	80	58 (0)	0.89 (-0.8)
		Enzyme III	87	46 (-33.3)	80	58 (0)	1.046 (16.4)
2.	50%-50%	Control	85	60	81	68	0.864
		Enzyme I	95	57 (-5)	81	65 (-4.4)	0.868 (0.5)
		Enzyme II	80	56 (-6.6)	80	70 (2.9)	0.968 (12.0)
		Enzyme III	88	67 (11.6)	80	68 (0)	0.952 (10.1)
3.	25%-75%	Control	88	76	81	69	0.928
		Enzyme I	87	79 (3.9)	80	75 (8.6)	0.82 (-4.4)
		Enzyme II	87	74 (-2.6)	79	69 (0)	0.918 (-1.07)
		Enzyme III	85	80 (5.26)	79	71 (2.8)	0.919 (-0.97)

(Values in parenthesis indicate gain or loss over control)

From the above table it was inferred that the yarn count of the sample 25%-75% treated with enzyme III had improved the yarn count than other treatments and fabric count of sisal union fabrics has improved after treatment with three enzymes but the highest percentage was observed with enzyme I in sample 25%-75%. While weight of the fabric was improved after the treatment with three enzymes in sample 100% and 50%-50% whereas the sample 25%-75% registered loss in weight.

3. Comfort Properties

Comfort properties of the enzyme treated sisal union fabrics were studied with respect to their air permeability, thermal conductivity and water repellency tests shown in table 3

Table 3: Comfort Properties of Tested Properties

S.No	*Sample*		*Air permeability (cm³/cm²/S)*	*Thermal conductivity (CLO)*	*Water repellency*
1.	100%	Control	277	0.6	70
		Enzyme I	227(22.0)	0.75(20)	70
		Enzyme II	272(-1.8)	0.85(29.4)	70
		Enzyme III	291(4.8)	1(40)	70
2.	50%-50%	Control	267	0.5	70
		Enzyme I	264(-1.1)	0.65 (23)	70
		Enzyme II	289(7.6)	0.7 (28)	70
		Enzyme III	277(3.6)	0.75 (33.3)	70
3.	25%-75%	Control	258	0.55	70
		Enzyme I	239(-7.9)	0.9 (38.8)	70
		Enzyme II	247(-4.4)	1.1 (50)	70
		Enzyme III	249(-3.6)	0.8 (31.2)	70

(Values in parenthesis indicate gain or loss over control)

From the above it was accentuated that the air permeability of treated fabrics was slightly decreased with the enzyme I than other two enzymes whereas the sample 25%-75% registered decreased air permeability with all three enzymes this change might be attributed to the shrinkage of the fabric during wet processing and the statistical analysis revealed that there was a significant difference between the samples and treatments. Positive correlation was found with water repellency (0.345) as the interstices present in the fabric influenced both the properties.

4. Thermal Conductivity

Thermal conductivity of the fabric influences its comfort. The higher the value of CLO the less is the conductivity of the material. Sample 50%-50% had lowest CLO value, which indicated good heat conductivity. After treatment the CLO values have increased but there was no major difference between the treatments. The statistical analysis indicates that there was significant difference between samples and treatments at 5 per cent level. Positive correlation was found with fabric count warp (0.483), weft (0.573) and pilling (0.0131) showed that the available area of the fabric influenced the thermal conductivity whereas negative correlation was observed with thickness (-0.280) and crease recovery (-0.449) it is an established fact that thermal conductivity is affected by the thickness of the fabric.

5. Water Repellency

The ratings of the control and treated was observed to be same for all the fabrics (70). This clearly indicated that there was no impact of enzyme treatment on water repellency of sisal union fabrics.

Table 4: Statistical analysis (ANOVA)

Test parameters	*Samples*		*Treatments*		*Samples Vs Treatments*	
	F cal value	*CD value*	*F cal value*	*CD value*	*F cal value*	*CD value*
Tensile strength (weft)	7.76***	13.64	2.72 NS	11.30***	1.86 NS	23.62
Abrasion resistance	2.03 NS	13.64	1.87 NS	11.81	0.31 NS	23.62
Air permeability	3.86**	8.484	22.43***	7.347	20.85***	14.695
Thermal conductivity	12.45***	22.455	1.15 NS	19.446	3.98**	38.893

*** - Highly significant difference at 5 % level, ** - significant difference at 5% level, NS – non significant

By considering the data from objective evaluation, it could be concluded that enzyme has good impact on all samples (100%, 50%-50% and 25%-75%) and the sample 25%-75% was best among all the fabrics. the decrease in comfort properties showed that superior characteristics of eco friendly fabrics can be produced by the use of enzymes for various end uses. Enzyme treatment could be safely used on these fibres to soften for better pliability there by better accepatability from consumers.

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