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Effect of starches and PVA binder on tear strength of bleached cotton material

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ABSTRACT

Tearing strength is one of the most important properties of fabric and while assessing the fabric quality, emphasis should be laid on this property as it directly affects the serviceability of a fabric. Results of the study indicated that, as the concentration of PVA was increased, there was moderate increase in fabric weight and thickness. Tear strength was higher for 1.5 per cent PVA treated samples. There was decrease in tear strength values as the percentage concentration of PVA increased.

KEY WORDS : Starch, PVA binder, Tear strength, Concentration

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A number of finishing agents used in various processes to which grey, bleached, dyed and /printed fabrics are subjected to get a variety of useful effects suiting different end uses. These chemicals are applied onto or deposited in the textile materials and retained there either by mechanical deposition or held therein by physical forces or chemical reaction thereby having durability to various degrees to the after treatments involving washing, dry cleaning, exposure to sunlight, perspiration, heat etc. Such finishing chemical and stiffening agents are starch and PVA binders which produce full and stiff finish on textile materials. Acrylics can impart desirable modification and still not change the appearance of the fabric because of their transparency. Flimsy fabric can be given a firm full hand and a heavy body by their use, weak weaves can be increased in tensile strength and made to hold their shape with acrylate treatment.

Tear strength is the work done in tearing the test samples through a fixed distance. The tearing strength is one of the most important properties of fabric and while assessing the fabric quality emphasis should be laid on this property as it directly affects the serviceability of a fabric. Tear strength is highly sensitive to slight variations in fabric construction and finishing. Hence, the study on effect of starches and PVA binder on tear strength of bleached cotton material was taken up.

RESEARCH METHODS

Bleached white cotton material was selected for the study. Sizing agents arrowroot powder, sago, commercial starch revive were selected for the study. Fabric samples were cut into 40 x 40 cms and were starched using arrowroot powder, sago, sago combined with arrowroot (50: 50), and commercial starch revive (Dantayagi). The fabric was treated with 1, 2, 3, 4 and 5 per cent concentrations using hot and cold processes. To treat the fabric with PVA solution, 1.5 to 4.5 per cent concentrations were prepared and fabric was treated and further tested.

Preparation of fabric samples for testing:

After starching, the fabric samples were cut the warp and the weft way to the test specimen of the required size with the help of template from different portions of the sample under the test. Prior to testing, the specimens were conditioned to moisture equilibrium and tested in standard atmospheric conditions of 65 ± 2 per cent relative humidity and 27 ± 2º temperature in conditioning cabinet. Then the preconditioned samples were tested for tear strength. The PVA treated fabric was tested for weight, thickness, crease recovery, bending length and tear strength.

Statistical analysis:

Percentages and ANOVA tests were used for statistically analyzing the data.

RESEARCH FINDINGS AND DISCUSSION

The effect of sizing agents on cloth tear strength using cold method of starching is presented in Table 1. Results revealed that warp tearing strength of fabric samples starched with revive and sago was higher when compared to sago + arrowroot and arrowroot starched samples. The tearing strength of sago starched fabric samples was more compared to revive in weft direction for all different size concentrations. Weft tearing strength was same for arrowroot and Sago + Arrowroot starched

samples.

Tearing strength increased as the concentration of starch increased (Fig. 1). This might be because starch gets deposited at higher concentrations making fabrics stiffer, hence the force required to tear the fabric was also more. However, it was noticed that, there was significant difference at 1 per cent level of significance between fabric samples for tear strength when treated with different starches and with different concentrations.

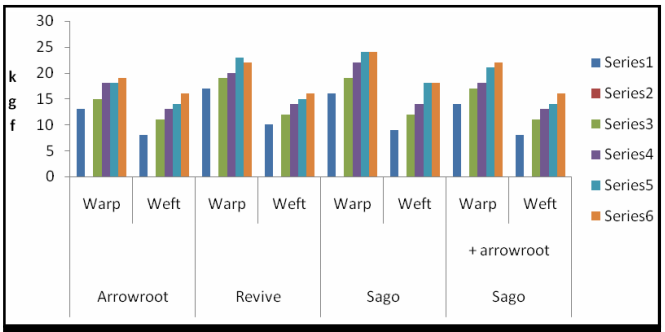

Fig. 1: Effect of sizing agents on fabric tear strength (cold method)

A perusal of Table 2 reveals that effect of sizing agents on fabric tear strength when treated with hot process of starching. It was noticeable that, warp tear strength was maximum for sago starched samples followed by revive, Sago + Aarrowroot and arrowroot. Whereas, weft tear strength was found to be maximum for Sago + Arrowroot starched samples followed by revive, sago and arrowroot.

In general, a trend of increase in cloth tear strength was observed from 1-5 per cent which revealed that, with the increase in the concentration of size, greater amount of starch globules being deposited in the interspaces between the adjacent yarns and probably formed a thick coating for the yarn. Hence, yarns became stronger and stiffer so the required force to tear the fabric was more. It was also noticed that at 1 per cent level of significance existed between fabric samples for tear strength in both warp way and weft way.

Table 3 presents the data on effect of PVA on handle and mechanical properties of 4 per cent sago + arrowroot starched fabric sample. It was obvious from the data that as the concentration of PVA was increased, there was moderate increase in fabric weight and thickness. Crease recovery was more at 1.5 per cent PVA concentration when compared to 3.5 per cent and 4.5 per cent PVA concentration in warp way and weft way. Stiffness of the starched fabric samples improved slightly as the concentration of PVA increased (Fig. 2). Tear strength was higher for 1.5 per cent PVA treated samples. There was decrease in tear strength values as the percentage concentration of PVA increased (Fig. 3).

The results were in line with a study conducted by

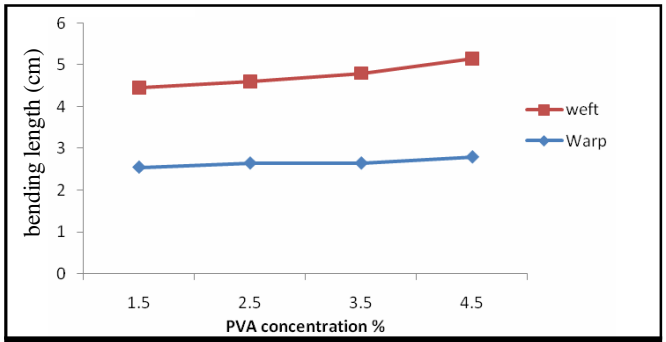

Fig. 2: Effect of PVA on blending length of fabric starched with 4% sago + arrowroot (50:50)

Table 1: Effect of sizing agents on cloth tear strength (kgf) cold method

Sizing concentration (%)	Arrowroot		Revive		Sago		Sago + Arrowroot	
	Warp	Weft	Warp	Weft	Warp	Weft	Warp	Weft
1.	13.00	8.00	17.00	10.00	16.00	9.00	14.00	8.00
2.	15.00	11.00	19.00	12.00	19.00	12.00	17.00	11.00
3.	18.00	13.00	20.00	14.00	22.00	14.00	18.00	13.00
4.	18.00	14.00	23.00	15.00	24.00	18.00	21.00	14.00
5.	19.00	16.00	22.00	16.00	24.00	18.00	22.00	16.00

Table 2: Effect of sizing agents on cloth tear strength (kgf) hot method

Sizing concentration (%)	Arrowroot		Revive		Sago		Sago + Arrowroot	
	Warp	Weft	Warp	Weft	Warp	Weft	Warp	Weft
1.	14.00	9.00	19.00	11.00	19.00	10.00	17.00	9.00
2.	14.00	11.00	23.00	12.00	21.00	12.00	19.00	12.00
3.	15.00	12.00	23.00	14.00	25.00	13.00	22.00	14.00
4.	19.00	12.00	25.00	16.00	26.00	14.00	23.00	16.00
5.	21.00	13.00	27.00	18.00	28.00	18.00	25.00	19.00

Table 3: Effect of varying concentrations of PVA on handle and mechanical properties on fabric starched with 4 % sago + arrowroot powder (50:50)

PVA concentration (%)	Fabric weight (g)	Fabric thickness (mm)	Crease recovery angle (deg)		Bending length (cm)		Tear strength (kg)	
			Warp	Weft	Warp	Weft	Warp	Weft
1.5	18.145	0.33	29	34	2.55	1.90	22.60	15.20
2.5	18.549	0.33	29	34	2.65	1.95	22.00	15.00
3.5	18.653	0.34	27	33	2.65	2.15	21.50	14.20
4.5	19.216	0.34	26	32	2.80	2.35	21.10	13.60

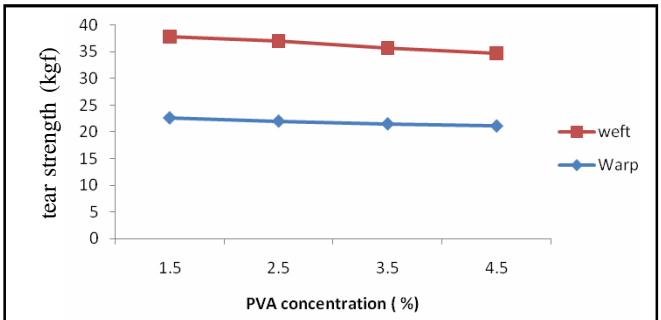

Fig. 3: Effect of PVA on blending length of fabric starched with 4% sago + arrowroot (50:50)

Singh and Bhargava (1998). The results of the study showed that, finishing process with increased amount of PVA reduced the tearing strength of the fabric, whereas finishing treatment with increased amount of amino silicone improved the tearing strength of the fabric. A better fixation of PVA reduces the slippage of threads, thereby restricting accumulation of threads at the tear. Increase of PVA, in finishing process causes decrease in tearing strength of the fabric. Such a trend may be due to deposition of PVA on the surface yarn which makes the rough surface.

The decrease in tear strength might be due to reason that, on application of force to the fabric by testing machine, the yarns held longitudinally between the jaws stretched and lose crimp and then started slipping across the transverse yarn and forming a large number of frictional points of contact in a small area of fabric (Walker and Perkins, 1985). As the number of these contact points built up it became more and more difficult for slippage to occur, and the load was progressively transferred to the transverse yarns which were held in tension hence load was equally shared either warp way/ weft way or overall and as the pick density increased tearing strength decreased.

Conclusion:

The tearing strength of sago starched fabric samples was more compared to revive in weft direction for all different size concentrations. There was significant difference at 1 per cent level of significance between fabric samples for tear strength when treated with different starches and with different concentrations. As the concentration of PVA was increased, there was moderate increase in fabric weight and thickness. Tear strength was higher for 1.5 per cent PVA treated samples. There was decrease in tear strength values as the percentage concentration of PVA increased.

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