Effect of Performance Finish on Woven Fabric Properties

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Abstract- This study investigates influences of oil and water repellency finish, non-iron with soft finish, non-iron with oil and water repellency finish (OWR) on woven fabric with respect to physical properties, mechanical properties, color fastness properties of fabrics. Each process was applied on fabric to see how these applications affect on fabric characteristics. All the fabrics were tested for GSM, pH, stretch and recovery, dimensional stability to wash, tear strength, tensile strength, skewness. Fabric with oil and water repellency finish was also gone through spray rating test. Same fabric shows different characteristics after different performance finish and the results will be presented further ahead with comparing tables and charts.

Index Terms- OWR finish, non-iron finish, fabric strength, stretch, recovery, dimensional stability.

I.INTRODUCTION

Oil and water repellency finish is defined as the ability of a textile material to resist oil and water. The spreading out of water and oil over a fiber or fabric surface is dependent on the angle of contact made by water and oil drop and the surface. The desire of the oil and water repellent finish is to make the fabric impermeable to oil and water so that the drop will rest up on the surface and will not penetrate into the fiber or fabric. [1]

Non-iron finish is done by resin treatment. Despite of some disadvantages such as changing shades, reducing whiteness, and containing formaldehyde content, resin finishing till now maintain its position in the finishing of textiles based on cellulosic fibers.[2] Resin finishing is done with products known as cross linking agents. These change woven and knitted fabrics composed of cellulosic fibers and their blends with synthetic fibers in such a way that the resulting textiles are easier to care for.

Considering the composition and properties of the fabric,soft finish is carried out when the softness characteristics of a fabric must be increased. The fabrics become harsh and stiff generally after dyeing and printing. Finishing and softeners altogether can solve this problem and improve on the original softness. The softening treatments greatly impart soft handle (supple, pliant, sleek and fluffy), smoothness, enhance flexibility, drape and pliability in fabric.

These three finishes have shown different effect on the test fabric. They change some characteristics of the fabric and it becomes difficult to meet the customer requirement and criteria. This study will point out the differences of the fabrics treated by OWR, non-iron and soft finish.

II.MATERIAL AND METHOD

A. Material Preparation

Fabric produced form 97% cotton, 3% spandex, having 3/1 S Twill and identical physical properties was selected for performance finish (Table 1). Before finishing fabric was dyed on black color using common recipe. Dyed fabric was treated using fixing agent- 5g/l, acetic acid- 2 g/l for excellent post setting stability, leveling effect and enhanced wet fastness ability. pH was kept 4 during the process and m/c speed was 35 m/min. Pad steam machine was used for this process. Temperature in steamer were 115°C,1st chamber 30°C, 2nd to 7th chamber 70°C, and in dryer 140°C.

Table 1: Test fabric specification

Fabric Composition	97% Cotton , 3% Spandex
Weave	3/1 S Twill
Yarn Count	Warp Count: 20, Weft Count: 16+70D
Yarn Quality	Warp quality: 20/1 Auto Coro Yarn Weft Quality: 16+70D (CW Lycra Core yarn)
Warp – Weft /Inch	142-78
Cover Factor	49.03 (SI Unit)
Weight gm/m^2	305
Fabric	Solid dyed

B. Methodology

Three type of finish: non-iron + OWR, oil and water repellent and non-iron + Soft Finish were done on same dyed fabric. Table 2 shows fabric code according to performance finish. As seen in table 2, selected chemical and mechanical finishes were applied separately or in combinations on fabric sample. Process condition of applied finishing process were summarized in table 3.

Table 2: Fabric Code according to applied finishing process

Fabric Code	Fabric Finish			
	Oil and water repellent finish	Non iron finish	Soft finish	Sanforising
0 (Test specimen)	×	×	×	×
1 (OWR+ NI+SAN)	✓	✓	×	✓
2 (NI+ SF+SAN)	×	✓	✓	✓
3 (OWR+SAN)	✓	×	×	✓

Table 3: Details of the finishing processes

Finishing treatment	Parameter
Oil and water repellent finish	Oil and water repellent agent (Phobol CP 2G– 150 g/l, Zelan R3 – 60 g/l, Extender XAN- 20 g/l) , Wetting agent- 5 g/l, Softener- 3g/l , M/c name:Brückner,Germany, Temperature: 180 °C, M/c speed: 22 m/min, Pick up- 55%
Non Iron finish	Cross linking agent (Knittex RCT- 120 g/l, Turpex ACN- 50g/l), $MgCl_2$– 20 g/l, Wetting agent- 5 g/l, M/c name: Brückner, Germany, Padder pressure: 2 bar, Temp- 140 °C, Pick up – 54%, M/c speed: 20 m/min
Soft finish	Softener for textile finishing(Ultratex SI + Ultratex FMI+ Turpex ACN - 90 g/l) Highly effective detergent - 1g/l, M/c speed: 25 m/min, M/c name: Brückner,Germany, Pick up-51 %, Temp-160°C, Padder pressure: 2 bar
Sanforising	Pressure : 1 bar,2% shrinkage control, M/c speed: 30 m/min

C. *Performance tests*

To determine physical properties fabric weight(gm/m^2),pH, dimensional stability to wash, skewness, tensile strength, tear strength, seam slippage tests were done on all sample. Fabric weight was determined according to ISO 3801. For pH test ISO 3701 method was followed. Dimensional stability to wash on both warp and weft direction were determined according to ISO 6330,2A,60°C.Tear strength, tensile strength and seam slippage test both on warp and weft direction were determined according to ISO 13934-2, ISO 13937-1, ISO 13936-1 method respectively. For stretch and recovery test ASTM D-3107 was used. Spray rating was determined according to ISO method. Color fastness was assessed by international standards. The specific tests were used: ISO 105-C06(color fastness to wash), ISO 105-E04(Color fastness to alkaline and acid perspiration), ISO 105 X 12(Color fastness to rubbing), ISO 105-E01(Color fastness to water), ISO 105-B02 (Color fastness to light).

III.RESULTS AND DISCUSSION

A. *Fabric Weight*

Weight changes of the fabrics vary in a great range according to the applied finishing processes but thereis an increase trend for weight values because of chemical add on occurred after finishing processes, especially after non-iron finish with soft finish (Fabric code 2). Weight decrease was observed in Fabric Code 1(OWR+NI+SAN) than Fabric Code 3(OWR+ SAN). Weight increase in Fabric Code 1, Fabric Code 2,FabricCode 3 are respectively 2.3%, 6.88% and 4.26%.

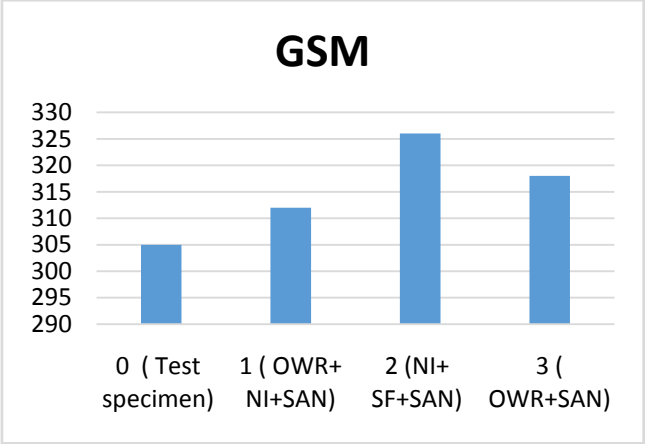

Fig 1: Effect of finishing processes on fabric weight (gm/m^2)

B. *Fabric pH*

It is clearly seen that fabric pH decreases after each finish. The change of pH was higher in fabric code 2 (NI+SF+SAN). After this finish pH decreased by 0.13. (Figure 2)

C. *Tensile strength*

Fabric tensile strength values was seen to decrease significantly after all the applications. Warp way tensile strength is higher than weft way strength except fabric code 3. And difference between strength in warp and weft direction is higher in fabric code 2 as seen in figure 3.

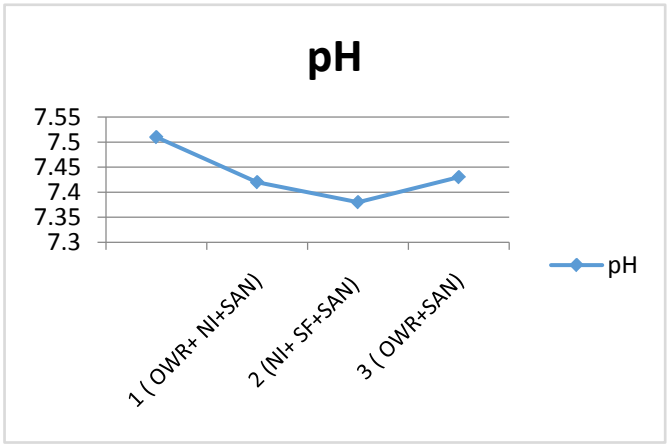

Fig 2: Effect of finishing processes on pH of fabric

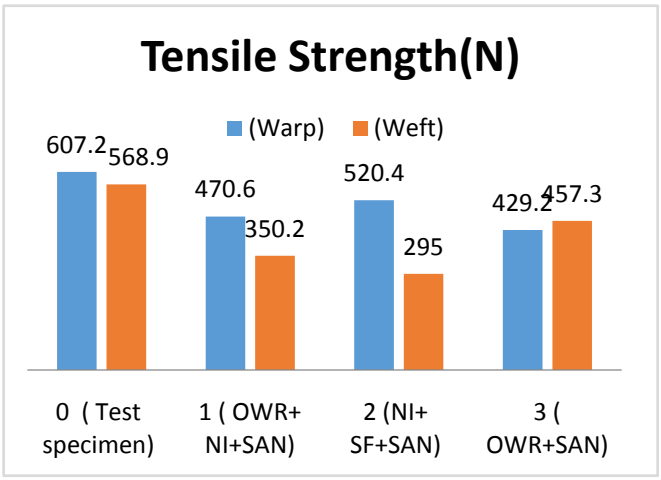

Fig 3: Effect of finishing processes on tensile strength of fabric

D. Tear strength

After all finishing process tear strength was seen to increase than

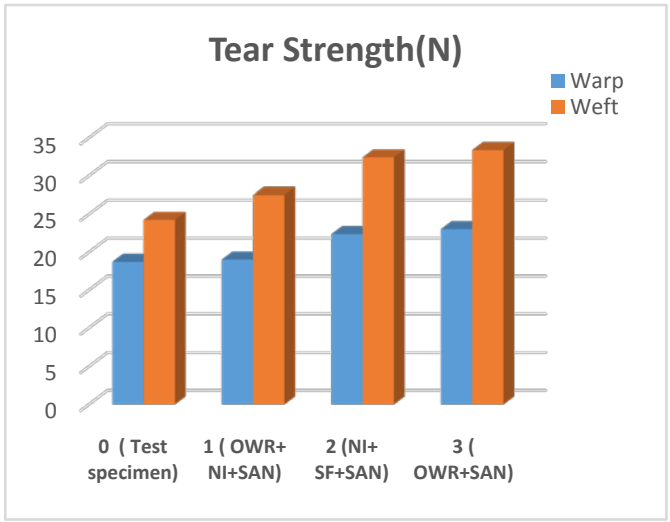

Fig 4: Effect of finishing processes on fabric tear strength

the test specimen. Tear strength is the highest in fabric code 3. Tear strength in warp increases in fabric code 1,2,3 consecutively 1.6%, 19%, 23%. Tear strength in weft increases in fabric code 1,2,3 consecutively 13%, 33%, 37%. This may because the threads group closer together more in finished fabric under the force of the tearing agency. [3]

E. Spray rating

Spray rating tests were done on the fabric with OWR finish only. It is seen that fabric with only OWR finish has better spray rating than fabric with OWR and non-iron finish altogether.

	Before Wash	After 1 Wash	After 3 Wash	After 5 Wash
1 (OWR+ NI+SAN)	5	3	2	2
3 (OWR+SAN)	5	4	3+	3

Grade Description: [4]

1. Complete wetting of the whole of the sprayed surface
2. Wetting of more than half the sprayed surface
3. Wetting of the sprayed surface only at small discrete areas
4. No wetting of but adherence of small drops to the sprayed surface
5. No wetting of and no adherence of small drops to the sprayed surface.

F. Stretch and Recovery

Elongation, growth and recovery of all the specimen were measured after the finishing processes, and again after washing (normal wash). All the findings are shown in the graphs below. From the graphs of elongation and growth, it has been clearly seen that both the properties have increased after washing, though increase in growth is not very expected properties in fabric.

After washing of the finished fabrics, elongation increases because of shrinkage and tends to more stretch. On the other hand the graph of recovery shows the decreasing manner in after wash samples. Fabrics which are treated with non-iron finish i.e. fabric code 1 and 2 pose better performance than the other. However fabric code 2 i.e. the fabric with non-iron and soft finish shows overall good performance, as this fabric has comparatively better recovery properties with good elongation and low growth than the other finished fabrics after washing.

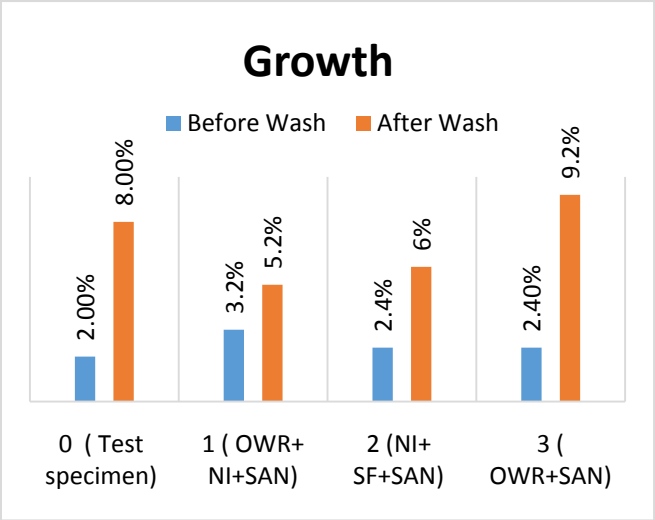

Fig 6: Effect of finishing processes on growth of fabric

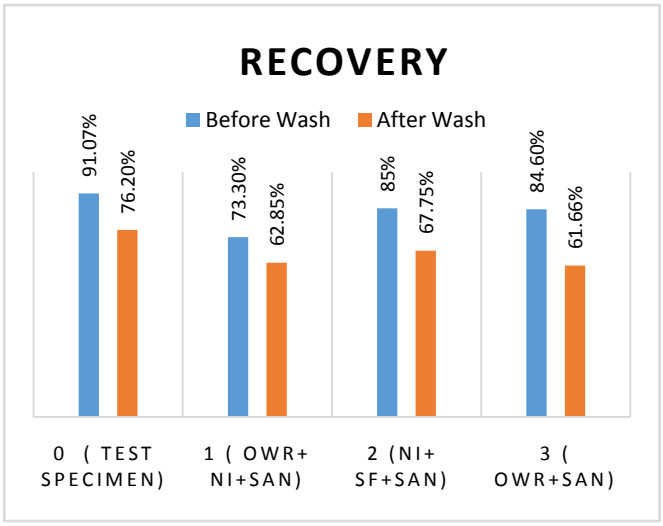

Fig 7: Effect of finishing process on recovery

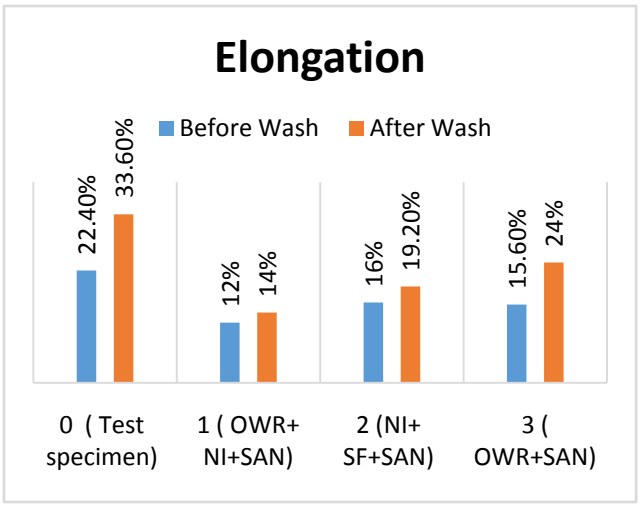

Fig 5: Effect of finishing process on elongation properties

G. Skewness

From the graph it has been seen that specimen 1 which has both OWR and NI finish shows only 0.50% skewness after the finishing process.

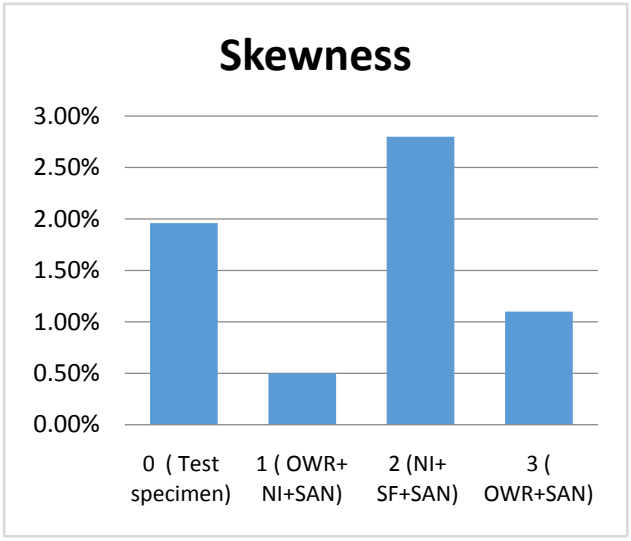

Fig 8: Effect of finishing processes on skewness

Specimen 3 which has only OWR finish also shows low skewness property. On the other hand specimen 2 which has NI and SF finish shows comparatively higher skewness (2.80%) than the test specimen (1.96%).

H. Dimensional Stability to wash

This property of fabric is one of the most important requirement for commercializing a finished fabric. From this experiment, it is seen that fabrics with non-iron finish shows low shrinkage and NI finish with OWR finish makes the fabric the most dimensionally stable.

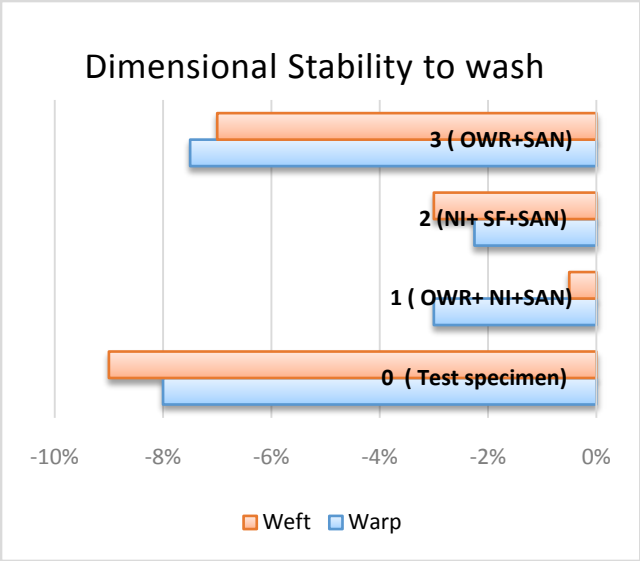

Fig 9: Effect of finishing process on dimensional stability of fabrics.

I. Color Fastness

The rating of color fastness does not show significant difference after different finishing. But it is seen that wet rubbing fastness and color fastness to wash improve a little after NI finish. Here 5=excellent,4=good, 3=Average, 2=Poor, 1= Very poor.

		0 (Test specimen)	1 (OWR+ NI+ SAN)	2 (NI + SF +SAN)	3 (OWR+SAN)
Color Fastness to Rubbing	Dry	4-5	4-5	4-5	4
	Wet	3-4	4	4	3
Color Fastness to Washing	Color Change	4	4-5	4-5	4
	Color Stain	4-5	4-5	4-5	4-5
Color Fastness to Water	Color Change	4-5	4-5	4-5	4-5
	Color Stain	4-5	4-5	4-5	4-5
Color Fastness to Perspiration	Color Change (Acid)	4-5	4-5	4-5	4-5
	Color Stain (Acid)	4-5	4-5	4-5	4-5
	Color Change (Alkaline)	4-5	4-5	4-5	4-5
	Color Stain (Alkaline)	4-5	4-5	4-5	4-5

V.CONCLUSION

From the finding of study it can be summarized that fabric properties changes after different finish. According to the results, finishing process groups on mechanical properties were determined as statistically significant. More detailed conclusions are summarized below:

Fabric weight gaining wasthe maximum for fabric with non-iron and soft finish together (fabric code 2). Tensile strength value is affected more in weft and tear strength values increases for all finishes may because the threads group closer together more in finished fabric under the force of the tearing agency. Resin treatment created a significant tensile strength loss in weft direction.

If fabric code 1(OWR+NI+SAN) and fabric code 3 (OWR+SAN) are compared in caseof spray rating , it was seen that fabric with OWR and NI finish altogether shows low spray rating than fabric with OWR finish alone. However fabric code 2 i.e. the fabric with non-iron and soft finish shows overall good performance for stretch and recovery, as this fabric has comparatively better recovery properties with good elongation and low growth than the other finished fabrics after washing. Due to NI finish shrinkage was seen significantly low in fabric code 1 &2 and color fastness properties does not vary significantly due to different type of finishes.

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