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INFLUENCE OF SILICONE FINISH ON CREASE RECOVERY OF COTTON, POLYESTER AND ITS BLEND

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ABSTRACT

Silicone chemicals are eco-friendly and do not have any adverse effect on the environment, it is mainly recognized in textile industry as a softener. Silicones are classified into three groups according to particle size; macro, micro and nano silicones. In this study commercial macro amino silicone finish (Ultrafab EMS) and micro amino silicone finish (Ultrafab UHF) were used, on three widely used fabrics: cotton, polyester and their blends, to study the crease recovery property. Result showed that both silicone finishes improved crease recovery angle of all finished fabrics. Micro amino silicone finish showed better results than macro amino silicones.

Keywords: *Cotton, polyester, cotton-polyester blend, macro amino silicone, micro amino silicone, crease recovery angle.*

INTRODUCTION

Cotton is an important natural cellulosic fiber. It is very nearly pure cellulose. Cotton fabric has excellent hand and its drapability is quite acceptable. Its low resiliency and poor recovery from deformation means that is wrinkles easily in both the dry and wet states and exhibits inferior crease retention. Starching of cotton improves these properties, but the effect is only temporary, and it is necessary to renew this finish after each laundering.

Polyester is hydrophobic and non absorbent without chemical modification. This lack of absorbency limits the comfort of polyester fabrics. Polyester possesses good strength and durability characteristics but exhibits moderate to poor recovery from stretching [1].

Consumer generally accepts cotton-polyester textile fabrics. The selection of these fibers ensured sufficient comfort resulting mainly from the use of cotton fibers, as well as suitable mechanical properties such as the tensile strength characteristics of synthetic fibers [2].

Silicones have wide application in textile processing and finishing. They have been used as a premium finishing agents especially in the last few years as they offer durable, longer lasting, surface modifications to the fabric. In the case of textiles, finishing is accomplished through either the padding or the exhaust process. In both of these processes finishing compounds are transferred from aqueous solution phase to the fabric surface and then cured through the application of heat, leading to the desired surface finish. While the finishing compounds are transferred to the fabric through the physical entrapment in the padding process, the actual exhaustion of the compound from the solution phase on to the fabric is accomplished through specific adsorption in the exhaust process [3].

As textile processing is predominantly an aqueous process, silicones are likely to enter the environment via, waste water, either from scouring operations or through softener baths. Silicones have been extensively tested in both fresh and marine water and show no harmful effect on environment [4].

The silicone emulsions are available in various particle sizes – macro (milky, particle size-150-300 nm), semi-micro (hazy, particle size-80-120nm) or micro (transparent, particle size below 40 nm) forms. The micro emulsions are mostly preferred due to their higher shear stability, but can only be obtained from amino silicones. Recently, the nano forms of silicone have been developed which have particle sizes < 10nm [5].

Functionally modified silicones:

Silicone is initially formed as dimethylpolysiloxane only, the organic groups attached to the silicone atom via silicone – carbon bonds define the class of silicone. The most common example is poly-dimethylsiloxane or PDMS. This synthetic polymer has a repeating $[(CH_3)_2\ SiO]$ unit. This is the basic building block of silicone [6]. To improve various properties on substrate the poly siloxanes are modified by substituting the organic group (R) on the silicone backbone. Amongst these, amino modified silicones are most extensively used; they impart excellent surface softness and bounciness to the fabrics. Carboxy modified silicones impart a silky finish along with bounciness and bulkiness to the fibre. Hydroxy modified silicones impart an elastomeric feel to the fibre. Epoxy modified silicones impart durable and soft finish to the fabric. Acrylic modified silicones impart durable finish with smooth handle [7].Macro and micro amino silicones have been reported to have influenced the physical properties of cotton. They reduce stiffness and improve crease recovery of cotton [8].

Though silicones are known for imparting softness in textile finishing, for the study the property of crease recovery was evaluated for two commercially available silicone finishes: macro amino silicone and micro amino silicone applied on (three plain – woven) cotton, polyester and cotton-polyester blend. Stiffness and tensile strength of all the samples were also

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determined, to check the influence of the finishes on the fabrics.

2. Materials and Methods

2.1 Materials

Commercial macro amino silicone and micro amino silicone finishes were procured from M/s. Resil Chemicals Pvt. Ltd.Widely used three different type fabrics: cotton, polyester and cotton-polyester blend (33/67) were selected.

2.2 Methods

2.2.1 The procured cotton, polyester and cotton-polyester blend, fabrics were further thoroughly scoured by using standard method and air dried.

2.2.2 Identification (AATCC test method 20-1976):

Confirmation of the fiber type was done through microscopic analysis, burning test and chemical solubility test [9].

2.2.3 Determination of preliminary data:

Preliminary data including fabric structure (weave), fabric count (the number of yarns/inch) helped to describe the tightness of the weave, fabric width, weight per unit area, thickness were determined using standard methods [10] and are given in table-1

Table -1: Preliminary Data of Fabrics

Fabric	Weave	Yarn Count (inch)		Fabric Width (cm)	Weight per Unit Area (gms/sq. mtr)	Thickness (mm)
		Warp	Weft			
Cotton	Plain	134	68	88	138.4	0.26
Polyester	Plain	112	90	90	84.0	0.17
Cotton-Polyester Blend	Plain	101	68	91	148.0	0.27

2.2.4 Preparation and application of finish:

Macro amino silicone (F1) and micro amino silicone (F2) were prepared. (50 g/l) 25x12 cm cotton, polyester, and cotton-polyester blend fabrics were finished by pad (2min)-dry (10 min) (4 times) iron-cure sequence, where curing was done for (3 minutes at 115°C temperature).

2.2.5 Evaluation of stiffness:

The samples were evaluated for stiffness using standard test method [10]. Eureka stiffness tester was used, five warp and five weft specimens of size 6 x 1 inches were placed on the instrument and the scale was slided till the edge of the sample was in line with the line in the reflection mirror. The reading on scale was taken and average was recorded.

2.2.6 Evaluation of tensile strength:

The strength of the samples was determined using elongation at break and breaking load using standard test method [10]. Fully computerized Lloyd LRX was used. Five warp and five weft samples of size 20x1 cm were cut and loaded on the instrument. The instrument was run and direct readings were obtained.

2.2.7 Evaluation of crease recovery angle:

To determine crease recovery by AATCC test method 66-1975 [9], Eureka make crease recovery tester was used. Five warp and five weft specimen of 50 x 25 mm size are cut and placed in a loading device one at a time for five minutes under a pressure of 5oo gm after being folded in half. The folded sample was then placed in a crease recovery tester which allowed the fabric to unfold, the recovery of fabric after five minutes was noted, and average has been recorded.

3. Results and Discussion

Two commercial finishes were evaluated to study their influence on creasing behavior of cotton, polyester and cotton-polyester blend. The fabrics were also evaluated for stiffness and tensile strength properties. As stiffness is related to crease recovery and application of finishes influences the strength of fabrics.

Details of stiffness are presented in table-2, comparing the stiffness result of untreated and treated samples; it was observed that, the finishes do not show any significant influence on stiffness of all the fabrics.

Table -2: Stiffness (cm) of Untreated and Treated Fabrics

Fabric	Cotton				Polyester				Cotton - Polyester blend			
	Warp		Weft		Warp		Weft		Warp		Weft	
	Warp Face	Warp Back	Weft Face	Weft Back	Warp Face	Warp Back	Weft Face	Weft Back	Warp Face	Warp Back	Weft Face	Weft Back
Untreated (F0)	2.6	2.6	2.1	2.1	1.9	1.9	1.7	1.6	2.3	2.3	1.9	2.0
Macro amino silicone finish (F1)	2.5	2.6	2.0	1.9	1.9	1.8	1.6	1.5	2.2	2.2	1.8	1.9
Micro amino silicone finish (F2)	2.4	2.5	1.9	1.9	1.8	1.8	1.5	1.4	2.1	2.2	1.7	1.9

The influence of tensile strength is given i table-3, on comparing the readings of untreated and treated samples it is observed that the load and elongation of all the treated samples has decreased except in the case of cotton-polyester blend, where the warp and weft, elongation has improved.

The phenomenon of creasing of a woven fabric is essentially governed by the residual force in the fibers enabling recovery from blending deformation and inter-fiber frictional restraint of the fiber assembly at the yarn stage.

The crease recovery readings of all the samples are presented in table - 4 and graph no.1. The crease recovery of cotton – polyester fabric blend is best, followed by polyester; least is for cotton. For untreated samples, in case of cotton and cotton-polyester blend the warp crease recovery is better than weft crease recovery; while in case of polyester the weft crease recovery is more than warp, this could be attributed to stiffer warps of cotton and cotton-polyester blend and stiffer wefts of polyester.

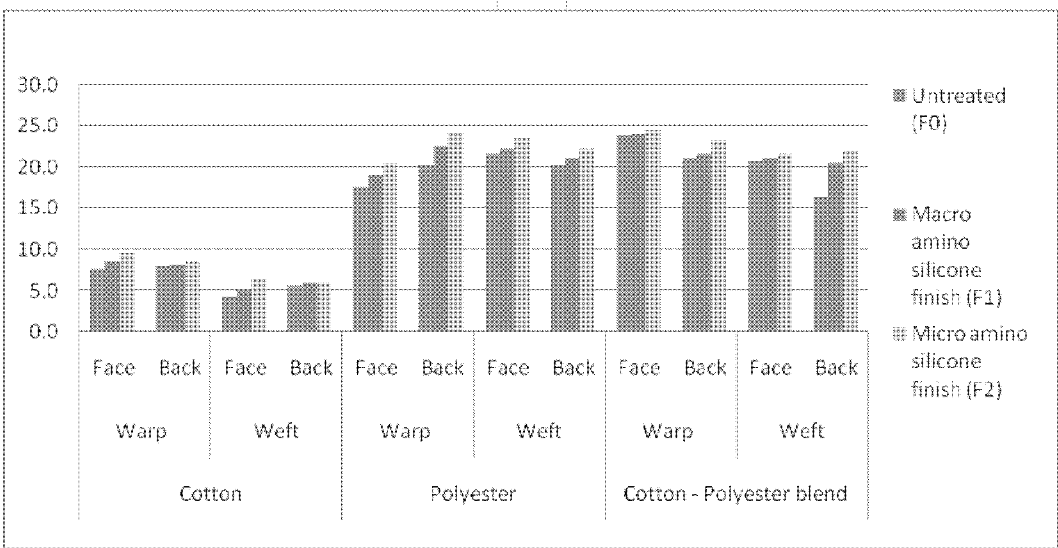
Table -3: Tensile Strength (kgf) of Untreated and Treated Fabrics

Fabric	Cotton				Polyester				Cotton - Polyester blend			
	Warp		Weft		Warp		Weft		Warp		Weft	
	Warp Load	Warp Elongation	Weft Load	Weft Elongation	Warp Load	Warp Elongation	Weft Load	Weft Elongation	Warp Load	Warp Elongation	Weft Load	Weft Elongation
Untreated (F0)	18.56	15.1	9.17	16.45	13.86	19.53	12.56	29.62	19.23	19.54	11.93	26.22
Macro amino silicone finish (F1)	⇩ 15.80	⇩ 14.28	⇩ 7.57	⇩ 14.35	⇩ 13.13	⇩ 18.16	⇩ 10.27	⇩ 28.80	⇩ 16.07	⇧ 20.79	⇩ 9.61	⇧ 26.61
Micro amino silicone finish (F2)	⇩ 14.76	⇩ 14.44	⇩ 7.66	⇩ 12.78	⇩ 13.33	⇩ 18.56	⇩ 9.95	⇩ 29.02	⇩ 15.96	⇧ 20.35	⇩ 9.46	⇧ 27.16

Table -4: Crease Recovery (Degree) of Untreated and Treated Fabrics

Fabric	Cotton				Polyester				Cotton - Polyester blend			
	Warp		Weft		Warp		Weft		Warp		Weft	
	Face	Back	Face	Back	Face	Back	Face	Back	Face	Back	Face	Back
Untreated (F0)	7.6	8.0	4.3	5.6	17.6	20.3	21.6	20.3	23.8	21.0	20.8	16.4
Macro amino silicone finish (F1)	⇧ 8.6	⇧ 8.1	⇧ 5.0	⇧ 6.0	⇧ 19.0	⇧ 22.6	⇧ 22.3	⇧ 21.0	⇧ 24.0	⇧ 21.6	⇧ 21.0	⇧ 20.6
Micro amino silicone finish (F2)	⇧ 9.6	⇧ 8.5	⇧ 6.6	⇧ 6.0	⇧ 20.6	⇧ 24.3	⇧ 23.6	⇧ 22.3	⇧ 24.6	⇧ 23.3	⇧ 21.6	⇧ 22.0

Graph-1: Crease Recovery (Degree) of Untreated and Treated Fabrics



On comparing the difference between the two finishes, it is clear that micro amino silicone shows better improvement in crease recovery of all the three fabrics. This could be attributed to the particle size of the finish. Macro amino silicone particles get deposited on the surface resulting into higher bending rigidity of the fiber as well as the reduction of constraint in inter fiber freedom, which restricts the fabric from recovery. Micro amino silicone finish gets defused in the fiber structure as its particle size is small and may have resulted into inter-polymer bond formation which leads to better recovery from creasing.

Due to the fact that particle size of the micro emulsion silicone softeners are smaller, they penetrate the inner structure of the yarn or the fabric while macro emulsion silicone softeners settle on the surface of the yarn or the fabric.

4. Conclusion

Both the finishes improved the crease recovery property of the fabric; the improvement was more in the case of micro amino silicone, than macro amino silicone finish, without affecting, the whiteness of fabrics.

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