

Effect of Different Anti Pilling Agents to reduce Pilling on Polyester/ Cotton Fabric

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Summary: Pilling may be defined as a surface fabric fault comprising of circular accumulations of entangled fibers that cling to the fabric surface thereby affecting the appearance and handle of the fabric. The formation of pills occurs as a consequence of mechanical action during washing or wear. Pilling of fabric changes its aesthetic properties. Pilling prevention is an ongoing challenge for manufacturers of cotton, polyester and blended fabrics. For the textile finishers, there are many methods for reducing the pilling tendency of the Fabric. One of them is the application of Anti Pilling Finishes. In this method Fabrics are treated with special anti pilling agents to prevent pilling that promote adhesion of the fibres in the yarn or the fabric. This paper endeavors to optimize the application of different anti pilling agents at different concentration and pH levels on the P/C fabric for superlative results. The results revealed that different anti pilling finishes have significant effects on the fabric pilling at different concentration level however different pH levels have no considerable effects.

Introduction

Pilling is a phenomenon that has a long cause trouble in textile industry. It is the formation of pills or knops on the surface of woven or knitted fabrics caused by friction and abrasion. Pilling proceeds in two stages. Individual fibres start protruding from the surface of the fabric and form an uneven nap. The protruding fibres rolls together become entangled and felt together to form knops. Standard type polyester fibres have higher mechanical strength. Consequently, pilling is often a real problem with these fabrics. The smooth surface and round cross section of these fibres make it easy for them to work their way out of the textile fabric [1].

The pilling of fabrics is a serious problem for the apparel industry and in particular wool knitwear fabrics. It is realized that the problem of pilling is one of the biggest quality issues for the wool industry. The formation of pills occurs as a consequence of mechanical action during washing or wear. Under the influence of mechanical action, loose fibers that protrude from the fabric surface entangle. Subjected to further mechanical action the entanglements develop into roughly spherical accumulation of fibers (pills) that are distinct from the fabric surface. Wear-off of pills occurs under continued abrasion from laundering, drying, etc., and during wear. For a given fabric, the degree to which pills form and wear-off is determined by the physical

properties of the fiber, yarn and fabric constituents. At the fiber level, fiber tenacity, diameter, length and curvature have been proven to impact on the rate of fuzz formation, extent of entanglement and the degree of wear off. Among the yarn parameters to affect pilling, yarn type along with the degree of singles twist and/or fold twist are most influential parameters. Yarn hairiness and yarn linear density have also been shown to contribute significantly in fabric pilling [2]. For the textile finisher, there are many methods like Heat setting, Shearing and Singeing and Anti pilling finishes for reducing the pilling tendency of polyester staple fibre [3]. The finish has to cement the fibers within the yarn so that their dragging becomes more difficult, without affecting the handle adversely. Special polymer formers of acrylate type or latex type are useful but should form a film of good cohesion, should be hydrophilic and should not form a tacky surface. Padding in polymer dispersion or emulsion followed by drying at moderate temperature gives the desired effect. The influence of different anti pilling finishes at various concentration and pH levels on the quality parameters of fabric has been reported. However the manipulation of these factors to reduce the pilling of P/C fabric has not been studied in Pakistan. This paper evaluates the performance of the application of different anti pilling agents at various doze and pH levels to optimize the quality of P/C fabric in respect of its pilling grade.

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Results and Discussion

Fabric Pilling

The ratings of pilling treated with anti pilling agents on polyester/cotton fabric are shown in table-1(a,b,c) which revealed that different anti pilling agents have significant effect on the pilling of fabric. In case of all anti pilling, the pilling rating are between severe pilling (2) to slight pilling (4). The results also indicate that pH have no considerable effect on the pilling of fabric under study. The visual results obtained by pilling rating of fabric after treating with different finishes(F) at different Concentration (C) and pH of solution.

The results indicate that overall performance of F₃ (Appretan N 9211) between Slight pilling(4) to no Pilling(5) for polyester/cotton fabric. The grey scale rating(Pilling rating of fabric before applying anti pilling agents) for F₁ (Metastab ZC), F₂ (Texicil GC) ,F₄(Knittex RCT),F₅(Dicrylan PSF) and F₆(Wuxizyme RCL)is recorded moderate to slight pilling(3-4), slight pilling(4), moderate to slight pilling(3-4), slight pilling(4) and severe to moderate pilling(2-3).

In case of finish concentration (C) the results shows that as we increase the concentration pilling decrease. It shows better result from C₃ (50g/l) to C₆ (80g/l) as good results in case of F₁ (Metastab ZC) and F₄(Knittex RCT)but very good results (3-4) in case of F₃ (Appretan N 9211). The overall trend shows that with increasing finish concentration (C) pilling positively decreases.

Treated samples reduced the pilling in comparison with untreated samples the results show that the pilling of treated samples was reduced significantly. These results are in line with the finding that the fabric structure and the presence of pilling at the fabric. Surface is important factor that determine cellulose activity particularly at high levels of mechanical action treatments. Cellulose treatments change all properties that can be related to pill and micro fibril formation depending on the specific activities of the enzymes used [4]. Similarly for cotton processing there were a number of operations possible to realize by enzymatic procedure leading to a material having the following qualities, reduced pilling, higher softness, whiteness, better dyeing properties, etc[5]. Also biotechnology offers an environmentally friendly alternative way of finishing cellulose-based synthetics, reducing their tendency towards pilling, giving better fabric handling and improving dye ability [6].

Table-1a: Pilling rating of polyester /cotton fabric for various anti pilling agents at different concentration and pH.

Finish Types	Concentration	pHlevels	Pillingrating
F1	C1	P1	2
		P2	2
		P3	2
		P4	2
	C2	P1	2-3
		P2	2-3
		P3	2-3
		P4	2-3
	C3	P1	2-3
		P2	2-3
		P3	2-3
		P4	2-3
	C4	P1	3
		P2	3
		P3	3
		P4	3
	C5	P1	3
		P2	3
		P3	3
		P4	3
	C6	P1	3-4
		P2	3-4
		P3	3-4
		P4	3-4
F2	C1	P1	2
		P2	2
		P3	2
		P4	2
	C2	P1	2
		P2	2
		P3	2
		P4	2
	C3	P1	2-3
		P2	2-3
		P3	2-3
		P4	2-3
C4	P1	3	
	P2	3	
	P3	3	
	P4	3	
C5	P1	3-4	
	P2	3-4	
	P3	3-4	
	P4	3-4	
C6	P1	4	
	P2	4	
	P3	4	
	P4	4	

- 1 = Very severe pilling
- 2 = Severe pilling
- 3 = Moderate pilling
- 4 = Slight pilling
- 5 = No Pilling

Experimental

The research work was entitled in the Department of Fibre Technology, University of Agriculture Faisalabad, and mainly conducted in Arzoo Textile Mills Ltd. Faisalabad, Pakistan.

The dyed samples of polyester/cotton fabric having weaving construction 90×76 were collected from the running stock of the mill and treated with different anti pilling agents with various

concentration and pH levels as given in the table below.

Finish Type (F)	Concentration (g/L) (C)	pH (P)
F1= Metastab ZC	C1= 30	P1=3.5
F2= Texicil GC	C2= 40	P2= 4.5
F3= Appretan N 9211	C3= 50	P3= 5.5
F4= Knittex RCT	C4= 60	P4= 6.5
F5= Dicrylan PSF	C5= 70	
F6= Wuxizyme RCL	C6= 80	

Table-1b: Pilling rating of polyester /cotton fabric for various anti pilling agents at different concentration and pH.

Finish Types	Concentration	pH levels	Pillingrating
F3	C1	P1	2
		P2	2
		P3	2
		P4	2
	C2	P1	2
		P2	2
		P3	2
		P4	2
	C3	P1	3
		P2	3
		P3	3
		P4	3
	C4	P1	3-4
		P2	3-4
		P3	3-4
		P4	3-4
	C5	P1	4
		P2	4
		P3	4
		P4	4
	C6	P1	4-5
		P2	4-5
		P3	4-5
		P4	4-5
F4	C1	P1	2
		P2	2
		P3	2
		P4	2
	C2	P1	2-3
		P2	2-3
		P3	2-3
		P4	2-3
	C3	P1	2-3
		P2	2-3
		P3	2-3
		P4	2-3
C4	P1	2-3	
	P2	2-3	
	P3	2-3	
	P4	2-3	
C5	P1	3	
	P2	3	
	P3	3	
	P4	3-4	
C6	P1	3-4	
	P2	3-4	
	P3	3-4	
	P4	3-4	

1 = Very severe pilling
 2 = Severe pilling
 3 = Moderate pilling
 4 = Slight pilling
 5 = No Pilling

Application of Anti Pilling Agents

Procedure

Anti pilling agents were applied on the polyester/cotton blended fabric by using different concentrations and pH level as mentioned above at

same time and temperature that is different for different anti pilling agents. The process is accomplished by padding fabric through a water solution of the three components to a wet pickup of about 60%, drying and curing at an elevated temperature [7].

Table-1c: Pilling rating of polyester /cotton fabric for various anti pilling agents at different concentration and pH.

Finish Types	Concentration	pH levels	Pillingrating
F5	C1	P1	2
		P2	2
		P3	2
		P4	2
	C2	P1	2-3
		P2	2-3
		P3	2-3
		P4	2-3
	C3	P1	3
		P2	3
		P3	3
		P4	3
	C4	P1	3
		P2	3
		P3	3
		P4	3
	C5	P1	3-4
		P2	3-4
		P3	3-4
		P4	3-4
	C6	P1	4
		P2	4
		P3	4
		P4	4
F6	C1	P1	2
		P2	2
		P3	2
		P4	2
	C2	P1	2
		P2	2
		P3	2
		P4	2
	C3	P1	2
		P2	2
		P3	2
		P4	2
C4	P1	2	
	P2	2	
	P3	2	
	P4	2	
C5	P1	2-3	
	P2	2-3	
	P3	2-3	
	P4	2-3	
C6	P1	2-3	
	P2	2-3	
	P3	2-3	
	P4	2-3	

1 = Very severe pilling
 2 = Severe pilling
 3 = Moderate pilling
 4 = Slight pilling
 5 = No Pilling

Recipes

(Metastab ZC)

Recipe # 1

Metastab ZC 30-80 g/L
 Magnesium Chloride 15% (of resins weight)
 PH 3.5-6.5
 Pick up 60%

Drying temperature 120 °C
 Curing temperature 170°C
 Curing time 30 sec
(Texicil GC)

Recipe # 2

Texicil GC 30-80 g/L
 Softicone SME 10g/l
 Magnesium Chloride 15% (of resins weight)
 PH 3.5-6.5
 Pick up 60%
 Drying temperature 110 °C
 Curing temperature 150°C
 Curing time 30 sec
(Appretan N 9211)

Recipe # 3

Appretan N 9211 30-80 g/L
 Cassurit MFB Liq. 15g/l
 Tylose C6000 grl 6g/l
 PH 3.5-6.5
 Pick up 60%
 Drying temperature 120 °C
 Curing temperature 120°C
 Curing time 30 sec

(Knittex RCT)**Recipe # 4**

Knittex RCT 30-80 g/L
 Knittex catalyst Mo 5g/l
 Ultratex UM 5g/l
 Turfex CAN 4g/l
 PH 3.5-6.5
 Pick up 60%
 Drying temperature 130 °C
 Curing temperature 140°C
 Curing time 30 sec

(Dicrylan PSF)**Recipe # 5**

Dicrylan PSF 30-80 g/L
 Ultratex FSA 5g/l
 PH 3.5-6.5
 Pick up 60%
 Drying temperature 130 °C
 Curing temperature 150°C
 Curing time 30 sec

(Wuxizyme RCL)**Recipe # 6**

Wuxizyme RCL 30-80 g/L
 Ultratex FSA 5g/l
 PH 3.5-6.5
 Pick up 60%
 Drying temperature 110 °C
 Curing temperature 120°C
 Curing time 40 sec

Testing of Fabric Pilling

Pilling is the small entanglement of fibres on the surface of fabric. The method covers a procedure described by ASTM (2008) to determine the tendency of fabric to form pills or to fuzz under condition intend to simulate normal wear. In order to form pill that resemble pill formed in wear in appearance and structure, a small piece of fabric was placed and firmly rounded in a rubber tube. After tumbling the extent of pilling is assessed visually by comparing with arbitrary photographic standards of pilling with descriptive method of pilling on knitted and woven fabric that is simply based on five grades [8]. The five grades used were:

5 = No pilling

4 = Slight pilling

3 = Moderate pilling

2 = Severe pilling

1 = Very severe pilling

Statistical Evaluation of Data

The data thus obtained was analyzed statistically using Completely Randomized Design and M-Stat Micro-Computer Statistical Program [9, 10].

Conclusion

The study revealed that Different anti pilling finishes have different ability to reduce pilling on fabric. However among all the chemicals used, the Appretan N 9211 showed the best results to improve pilling performance. Similarly various level of chemical concentration showed significant effects on the pilling performance of the fabric. Among all the concentration level of chemical used in this research study, 80g/l gave the best results to improve anti pilling property of the P/C fabric. While Different pH levels of anti pilling finishes used in this study had no significant effect on the pilling performance of the fabric.

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