Journal of Scientific Research & Reports
4(4): 382-385, 2015; Article no.JSRR.2015.039
ISSN: 2320-0227

SCIENCEDOMAIN *international*
www.sciencedomain.org

Influence of Wrinkle-resistant Treatment on UV Protection Properties of 100% Cotton Knitted Fabrics

C. W. Kan[1*] and Y. L. Lam[1]

[1]Institute of Textiles and Clothing, The Hong Kong Polytechnic University, Hung Hom, Kowloon, Hong Kong, China.

Authors' contributions

This work was carried out in collaboration between both authors. Author CWK designed the study, arranged experiments in factory, and wrote the first draft of the manuscript. Author YLL managed the literature searches and analyses of the study. Both authors read and approved the final manuscript.

Article Information

DOI: 10.9734/JSRR/2015/13885
Editor(s):
(1) Luigi Rodino, Professor of Mathematical Analysis, Dipartimento di Matematica, Università di Torino, Italy.
Reviewers:
(1) Anonymous, National Research Centre, Egypt.
(2) Salah A/Latief Mohammed, Dept. of Textile Engineering, Sudan University of Science and Technology, Sudan.
Complete Peer review History: http://www.sciencedomain.org/review-history.php?iid=743&id=22&aid=6607

Short Communication

Received 8th September 2014
Accepted 4th October 2014
Published 23rd October 2014

ABSTRACT

This paper investigated the influence of wrinkle-resistant treatment on the UV protection properties of 100% cotton knitted fabric with different structures. UV measurement was carried out using a spectrophotometer. The results revealed that the wrinkle-resistant treatment has less an effect in UV protection properties but the fabric structure did.

Keywords: Wrinkle-resistant; UV protection; cotton; Knit.

1. INTRODUCTION

Fabrics made of cotton have many benefits, such as being hydrophilic to absorb moisture, wash durable and comfort. However, when fabrics are made of 100% cotton fibers, they have problems including wrinkle with crease mark and relative high shrinkage after washing. Nowadays, customers are more willing to purchase garments which are 'easy-care' to suit their aspirational lifestyles; as a result, wrinkle-resistant finish, referred to as resin finish, becomes a topical

**Corresponding author: Email: tccwk@polyu.edu.hk;*

chemical treatment on garments to retain the shape after washing [1-3].

In order to reduce the fabric shrinkage and improve its crease recovery by this topical wrinkle-resistant finishing, cellulosic fabric is treated with crosslinking agent and catalyst [4]. Dimethyloldihydroxyethylene urea (DMDHEU) is an important crosslinking agent; with an acid catalyst such as magnesium chloride, it creates a crosslink between the fibers constituting the yarn. Optimum temperature and time should be acquired to allow a completed chemical reaction [4]. This wrinkle-resistant finishing not only produces good easy-care property, but also provides minimal shrinkage and abrasion resulting in a desirable hand-feel with good pilling resistance [4,5]. Previous study reveals that fabric structure and parameters such as weight and fabric density would affect the UV blocking effect of 100% cotton knitted fabrics [6,7]. In addition, the stretch and wet condition in knitted fabrics may also affect their UV protection properties [8,9]. In fact, much work has been reported on the effect of wrinkle-resistant on the UV protection properties of 100% cotton knitted fabrics in relationship to fabric structure is seldom reported. Thus, this paper will investigate this issue under industrial setting. All the experiments were conducted in a dyeing and finishing mill in China.

2. EXPERIMENTAL DETAILS

2.1 Material Preparation

Six 100% cotton knitted fabrics different structure were used in this study and their specifications are summarized in Table 1 [10].

2.2 Material Treatment

The fabrics were treated with commercially available DMDHEU (Fixapret F-ECO) for wrinkle-resistant treatment. The fabrics were treated with the recipe given below using Pad-Dry-Cure process with a wet pick-up of 100% using stenter machine. The pH value of solution was controlled by using malic acid at pH 5-6. The fabric were dried at 130℃ and then cured at 175℃ for 40 seconds.

Fixapret F-ECO (DMDHEU, wrinkle-resistant agent) 35g/l; Magnesium chloride (catalyst for wrinkle-resistant treatment) 10g/l; Siligen SIE (softening agent to retain the tearing strength of treated fabric) 20g/l; Malic acid (control pH value of the treatment) 0.5g/l

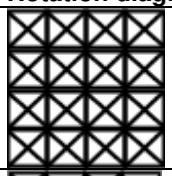
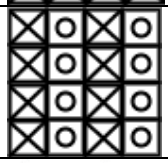
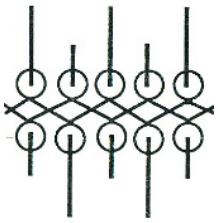
2.3 UV Measurement

After wrinkle-resistant treatment, all the fabrics were then stored in conditioning room with temperature of 20±1℃ and relative humidity of 65±2% for four hours. After conditioning, three square samples 3 x 3 inches were randomly cut from each treated fabric and UV measurement was carried out with a Cary model 50 UV/VIS Spectrophotometer in accordance with AS/NZS 4399:1996 standard. The mean of UPF, average percentage of UVA and UVB transmittance values were obtained. All the measurements were within 95% confidence level.

3. RESULTS AND DISCUSSION

Table 2 summarised the UV transmission and UV protection factor (UPF) of the control and wrinkle-resistant treated fabrics. The UV transmissions and UPF can be used for describing the UV protection effect of a material. As can be seen from Table 2, there is difference in UVA and UVB transmission percentages between control and wrinkle-resistant treated fabrics. In addition, the UPF rating between control and wrinkle-resistant treated fabrics were same. Thus, it can reveal that the DMDHEU could not absorb or reflect the UV radiation. If the fabric structure is taken into consideration, the single jersey structure generally gives the lowest UPF value while the rib and interlock structures give a better UPF value no matter with wrinkle-resistant treatment or not. This is because single jersey is a single knitted structure while the rib and interlock are double knitted structure. Generally, double knitted structure would have better UPF than single knitted structure [6,7]. The interlock structure is able to provide excellent UV protection because of the high fabric thickness, weight, density and tightness [6,7]. The characteristics of interlock structure are able to minimize the fabric openness and UV radiation transmittance. Hence, it results in high UPF in interlock structure. Based on the result of this study, it can be concluded that wrinkle-resistant treatment may not introduce significant improvement in the UV protection effect on the 100% cotton knitted fabrics but the fabric structure does.

Table 1. Specification of fabrics

Fabric	Structure	Yarn count (Ne)	Notation diagram
1	Single Jersey	30	
2	Single Jersey	32	
3	One-by-one Rib	30	
4	One-by-one Rib	32	
5	Interlock	40	

 *= knit stitch (technical face)*

 *= knit stitch (technical back)*

Table 2. UV protection properties (95% confident level)

Fabric	UVA transmission (%)		UVB transmission (%)		UPF	
	Control	Wrinkle-resistant treated	Control	Wrinkle-resistant treated	Control	Wrinkle-resistant treated
1	7	6	9	8	15	15
2	8	7	8	7	15	15
3	5	5	6	5	40	40
4	5	5	6	6	40	40
5	3	3	3	3	50+	50+

4. CONCLUSION

UV protection effect was measured for different wrinkle-resistant treated 100% cotton knitted fabric with different structures. The experimental results revealed that wrinkle-resistant treatment has less effect on the UV protection property. However, the fabric structures played an important role in altering the UV protection properties of the cotton knitted fabrics.

ACKNOWLEDGEMENTS

Authors would like the financial support from the Hong Kong Polytechnic University for this work.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Huang KS, Hwang MC, Chen JS, Lin SJ, Wang SP. Application of mixed gel solution in the anti-wrinkle finishing of cotton fabrics. Journal of the Textile Institute. 2007;98(2):169-176.
2. Hashem M, Ibrahim NA, El-Shafei A, Refaie R, Hauser P. An eco-friendly–novel approach for attaining wrinkle–free/soft-hand cotton fabric. Carbohydrate Polymers. 2009;78(4):690-703.

3. Hashem M, Hauser P, Smith B. Wrinkle recovery for cellulosic fabric by means of ionic crosslinking. Textile Research Journal. 2003;73(9):762-766.
4. Yang RH, Yim KY, Kan CW. Some physical properties of resin-treated 100% light-weight plain knitted cotton fabric. Fibers and Polymers. 2013;14(1):110-114.
5. Lo WS, Lo TY, Choi KF. The effect of resin finish on the dimensional stability of cotton knitted fabric. Journal of the Textile Institute. 2009;100(6):530-538.
6. Kan CW. A study of ultraviolet protection of 100% cotton knitted fabric: effect of fabric parameters. The Scientific World Journal; 2014. Article ID 506049.
7. Chong HKS, Kan CW, Lam JKC, Ng SP, Hu H, Yuen CWM. Study on the relationship between UV protection and knitted fabric structure. Journal of Textile Engineering. 2013;59(4):71-74.
8. Kan CW, Yam LY, Ng SP. Effect of stretching on ultraviolet protection of cotton and cotton/coolmax blended weft knitted fabric – in wet state. Materials. 2014;7:58-84.
9. Kan CW, Yam LY, Ng SP. Effect of stretching on ultraviolet protection of cotton and cotton/coolmax blended weft knitted fabric – in dry state. Materials. 2013;6:4985-4999.
10. Kan CW, Lam YL. Influence of mercerization on the UV blocking property of 100% cotton knitted fabric. Journal of Scientific Research and Reports (revised).

Peer-review history:
The peer review history for this paper can be accessed here:
http://www.sciencedomain.org/review-history.php?iid=743&id=22&aid=6607