THE DETECTION OF COTTON IDENTITY THEFT: EVALUATION OF PRODUCT'S DURABILITY

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Abstract

In Part II of this study, the emphasis was on fiber testing for the sake of detecting identity theft of cotton fibers. Since fiber type is the most critical factor that affects the durability of products, the main concern of this part of the study is to examine whether it is possible to identify different cotton fibers through their performances in the end products. This paper presents a comparison between the durability of commercial products made from different cotton types. Samples were bought from the market are bed sheets and knit shirts made of Pima, Egyptian and standard cottons. Results showed a significant difference between the quality parameters measured for new products as well as those measured after repeated cycles of washing and drying for products of different cottons. This difference can easily be used to detect cotton identity theft.

Introduction

The reason for detecting identity theft of cotton fibers is not only to stop an illegitimate practice by some textile producers but also, and perhaps more importantly to protect the consumers who pay premium for textile products that are claimed to be made from high-quality cotton while the fact is otherwise. Ironically, textile products made from cheap and low quality cottons may indeed appear to be similar to those made from high-quality fibers particularly at the purchasing stage. Some textile producers have practiced this approach for many years through masking the problems associated with cheap-low-quality cottons using different dyeing and finishing treatments that give the illusion of good and fine appearance. Other textile producers have used blends of small percent of high-quality cotton with a high percent of cheap and low-quality cotton to justify their claims in the marketplace.

The ultimate test of detecting cotton identity theft is the actual performance of textile products made from high quality cotton in comparison with that of low quality cotton particularly over time and after the product has been subjected to repeated washing, drying and wearing. This was the focus of this part of the study.

This study examines whether it is possible to identify different types of cotton fibers through their performance and durability in the end products. This type of analysis is based on the fact that different cotton types can indeed have different effects on end product performance through which the identity of fiber can be traced back to its type and sources.

Materials and Methods

For this study, we selected from the market several end products especially bed sheets and knit shirts as shown in Table 1 and Table 2. Types of cotton are Pima, Egyptian and standard cottons. Obviously, when commercial products are considered, it is typically difficult to obtain samples that are comparable in every aspect. For this reason, most comparable samples collected to be produced by the same company to minimize variability. Because of the limited space, we will present in this paper the results of only one set from each group of bed sheets and knit shirts those are similar in every aspect except the cotton type. Bed sheets are 500 thread count while knit shirts are men’s Single-Jersey.

Table 1. Bed sheets of different cotton types

Sample Code	Thread Count	Weave	Fiber type
S-300-1	300	Standard (Plain) Weave	100% Egyptian Cotton
S-300-2	300	Standard (Plain) Weave	Regular Cotton
S-300-3	300	Standard (Plain) Weave	60%Egyptian Cotton/40% Polyester
S-300-4	300	Standard (Plain) Weave	100% Supima® Cotton
SA-500-1	500	Sateen Weave	100% Egyptian Cotton
SA-500-2	500	Sateen Weave	Special Cotton Blend
SA-500-3	500	Sateen Weave	100% Supima® Cotton
SA-540-3	540	Sateen Weave	100% Supima® Cotton
SA-778-3	778	Sateen Weave	100% Supima® Cotton

Table 2. Knit shirts of different cottons

Code	Knit Shirt Type
T1	Men-T-Shirt-Single-Jersey-100% Supima Cotton
T2	Men-T-Shirt--Single-Jersey-100% Egyptian Cotton
T3	Men-T-Shirt--Single-Jersey-100% Regular Cotton
T4	Men-T-Shirt-Lacoste knit100% Supima Cotton
T5	Men-T-Shirt-Lacoste knit100% Egyptian Cotton
T6	Men-T-Shirt-Lacoste knit100% Regular Cotton
T7	Women-Shirt-Single Jersey- knit100% Supima Cotton
T8	Women-Shirt-Single Jersey-Knit 100% Egyptian Cotton
T9	Women-Shirt-Single Jersey-Knit 100% Regular Cotton
T10	Women-Under-Shirt-Lacoste knit100% Supima Cotton
T11	Women-Under-Shirt-Lacoste knit100% Egyptian Cotton
T12	Women-Under-Shirt-Lacoste knit100% Regular Cotton

The parameters affecting the durability were measured before and after repeated washing and drying of up to 50 cycles. Properties measured are: strength, abrasion, dimensional stability, pilling resistance, and skewness. ASTM standards and AATCC test methods were followed whenever applicable.

Results and Discussions

Strength

Tensile strength of the woven fabrics of the bed sheets was measured according to ASTM D5035, while the ball bursting strength of the knit shirt fabrics was measured according to ASTM D3787. Changes in fabric strength for 500TC-Sateen bed sheets and the Single-jersey knit shirts are shown in Figures 1 and 2 respectively. In general, the more washing-drying cycles the stronger the woven and the weaker the knit fabrics. Fabrics made of ELS cottons are much stronger than the standard cotton. Strength of ELS products are also distinguishes amongst themselves. Same behavior holds for the other materials that are not presented here.

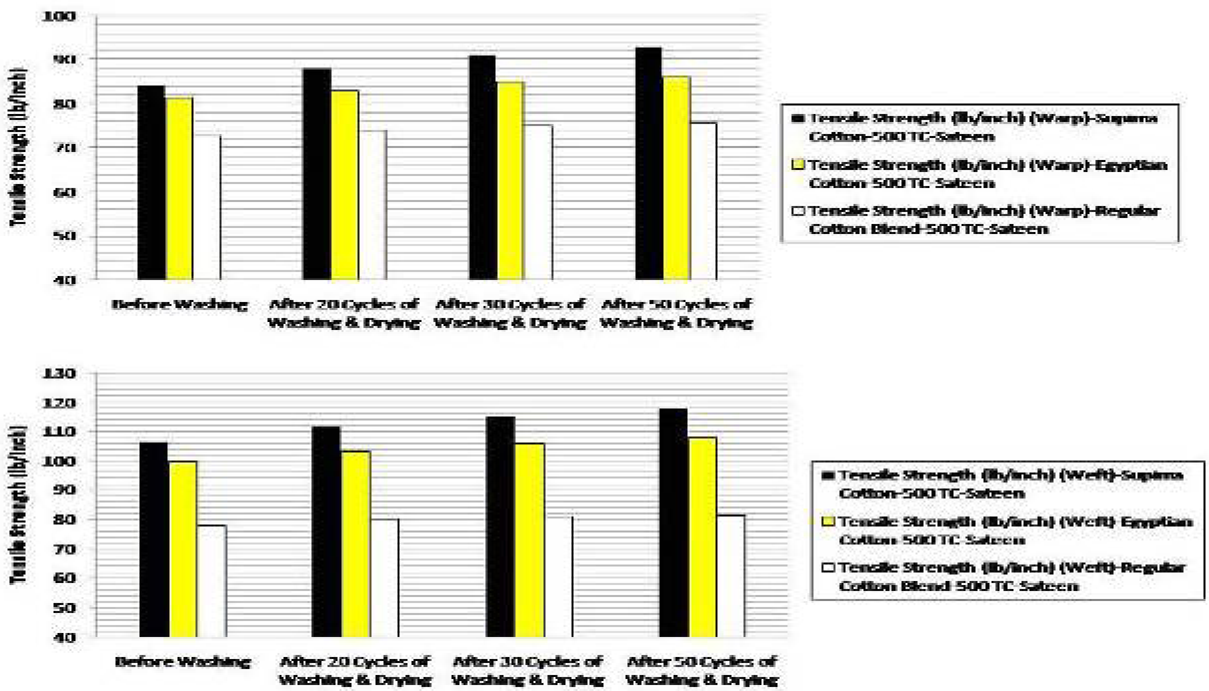


Figure 1. Change in tensile strength of bed sheets with repeated washing and drying cycles

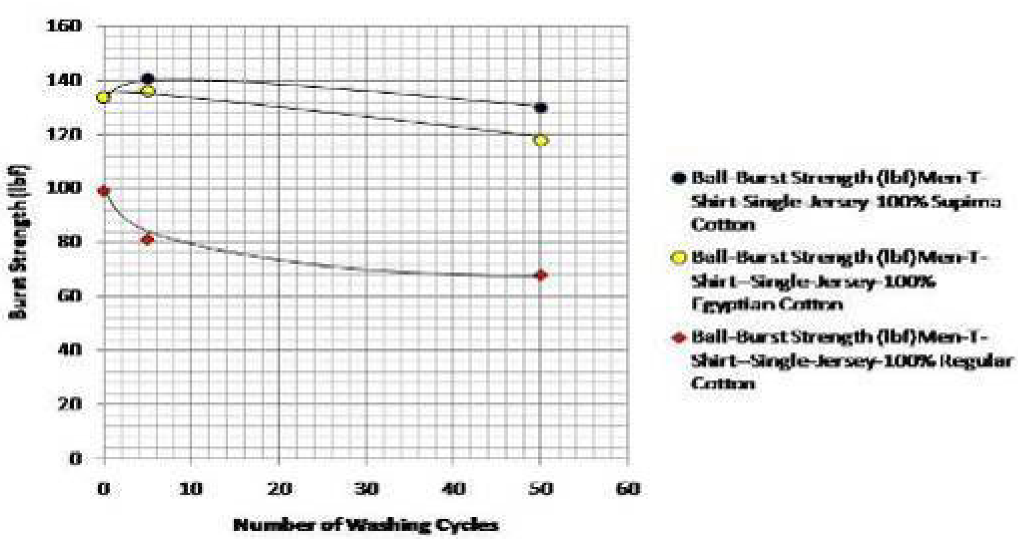


Figure 2. Change in burst strength in Single-Jersey knit with washing and drying cycles

Abrasion

In this work, abrasion resistance is measured only on the woven fabrics as bed sheets suffer a great deal of abrasion during normal daily use. Flex abrasion was measured according to ASTM D3885, while the Taber abrasion was measured according to ASTM D3884. Changes in fabric abrasion resistance for 500TC-Sateen are shown in Figures 3 and 4. In general, the more washing-drying cycles the less abrasion resistant the fabric becomes. Fabrics made of ELS cottons are much resistant than the standard cotton. Same behavior holds for the other materials that are not presented here.

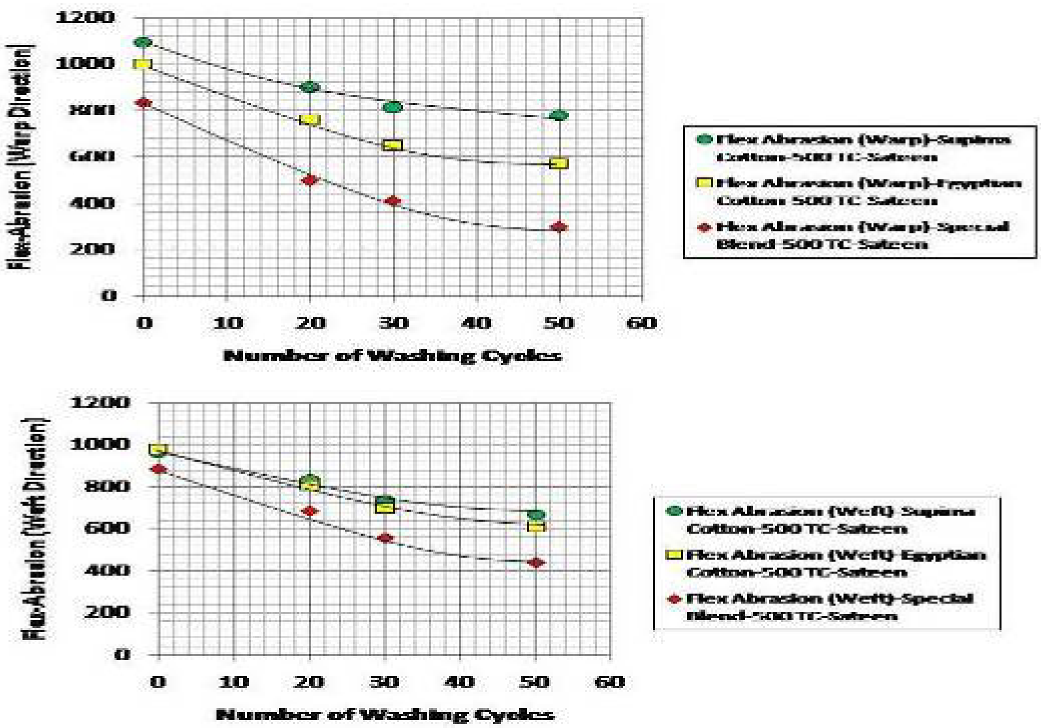


Figure 3. Change in Flex-Abrasion cycles to break of bed sheets with washing and drying cycles

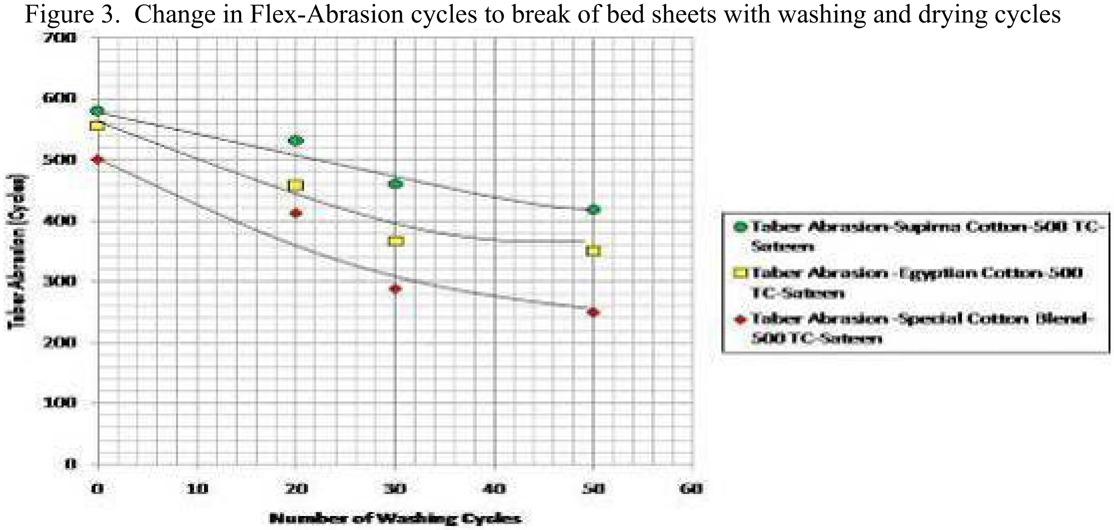


Figure 4. Change in Taber-Abrasion cycles to break of bed sheets with washing and drying cycles

Pilling

In this work, both bed sheets and knit shirt fabrics were tested for pilling resistance according to ASTM D3512. Changes in fabric pilling resistance for 500TC-Sateen and Single-Jersey knit shirts are shown in Figures 5 and 6 respectively. In general, the more washing-drying cycles the less pilling grade the fabrics get. Fabrics made of ELS cottons have higher ranks at the beginning and hold the same even after repeated washing and drying. Regular cotton starts at lower pilling rank and degrades with repeating the washing and drying cycles. Same behavior holds for the other materials that are not presented here.

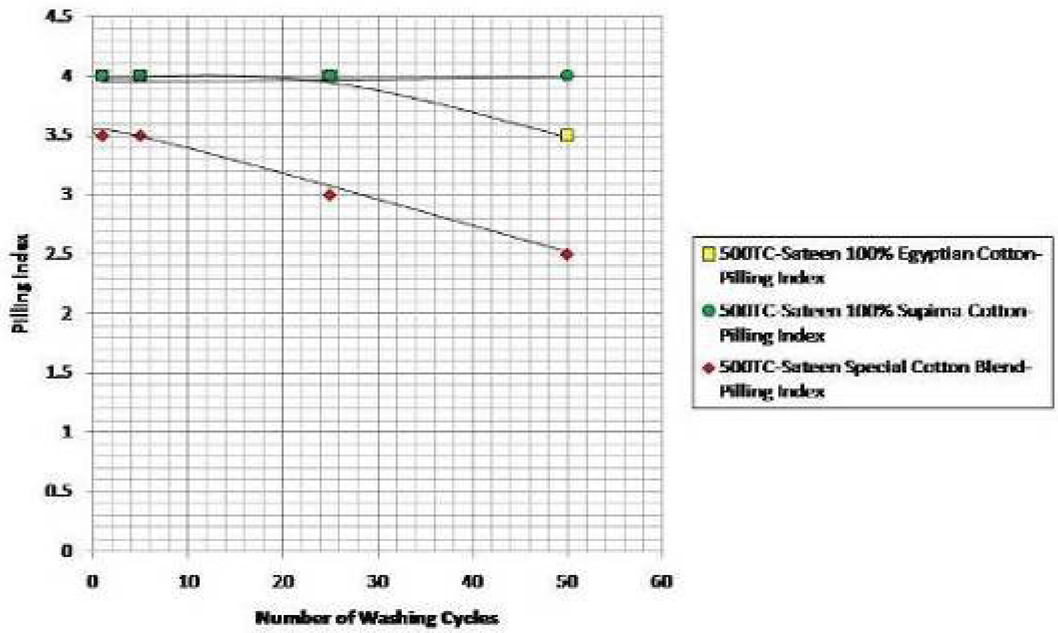


Figure 5. Change in pilling index of bed sheets with repeated washing and drying cycles

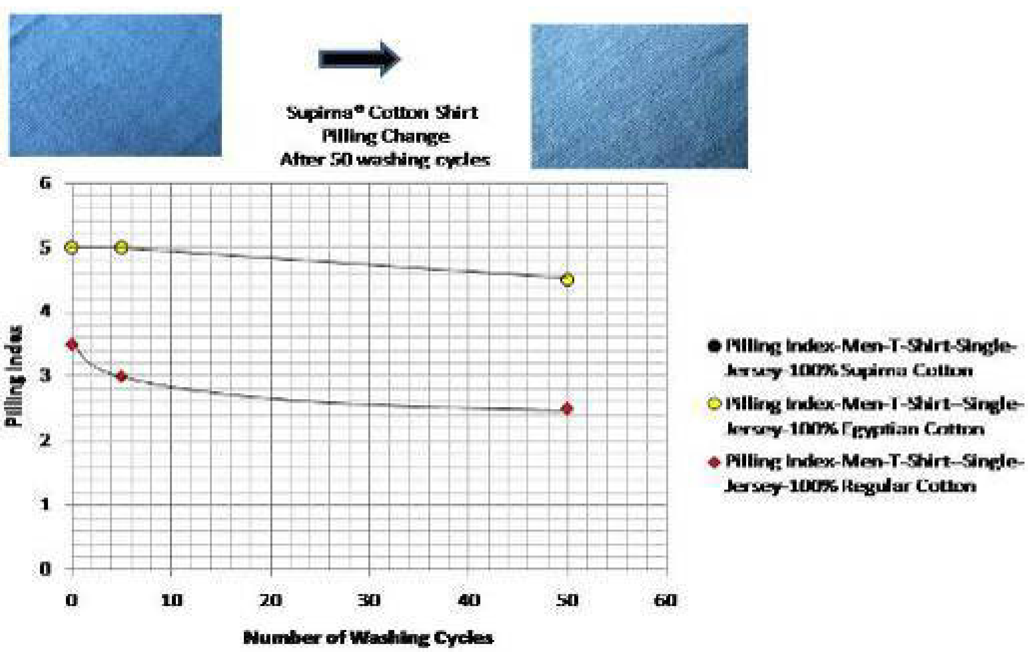
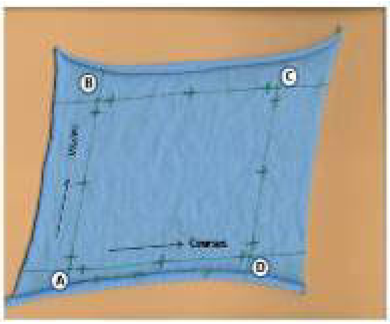


Figure 6. Change in pilling in Single-Jersey knit with washing and drying cycles

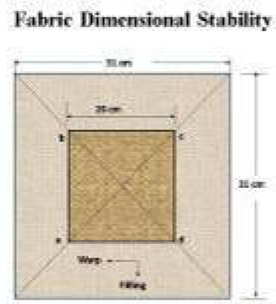
Dimensional stability and skewness

Both bed sheets and knit shirt fabrics were tested for dimensional stability according to AATCC Test Method 135 and for skewness according to AATCC Test Method 179, illustrated in Figure 7. Changes in woven fabrics dimensions and skewness were found very limited compared to what happens to the knit fabrics. Change in dimensions of 500TC-Sateen and Single-Jersey knit shirts are shown in Figures 8 and 9 respectively. In general, fabrics shrink the most during the first few cycles then start to stabilize. Skewness of 500TC-Sateen and Single-Jersey knit shirts are shown in Figures 10 and 11 respectively. Skewness was found to increase continuously with the repeat of washing/drying cycles for the products made of non ELS cotton. Fabrics made of ELS cottons stabilize after few washing and drying cycles. Same behavior holds for the other materials that are not presented here.



Area = Wale Length (cm) x Course length (cm)
Skewness Calculation:

X = 100 x [2x(AC-BD)] / (AC+BD)] — AATCC Test Method 179-2001
Where:
X = % change in skewness
positive percent change indicates skewness to the left, negative percent change indicates skewness to the right.



$$D.C(\%) = 100 \times \frac{A_{after-laundry} - A_{before-laundry}}{A_{before-laundry}}$$

$$Skewness\ (\%) = 100 \times \left(2 \times \frac{|AC| - |BD|}{|AC| + |BD|} \right)$$

Figure 7. Principle of calculating the percentage change in fabric dimensions and skewness

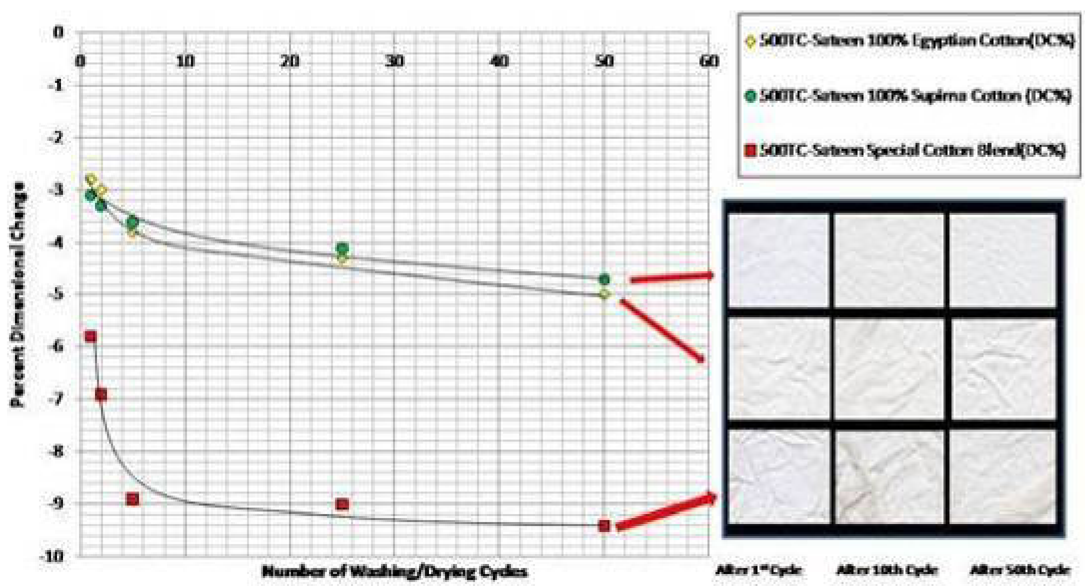


Figure 8. Percent dimensional changes of bed sheets with washing and drying cycles

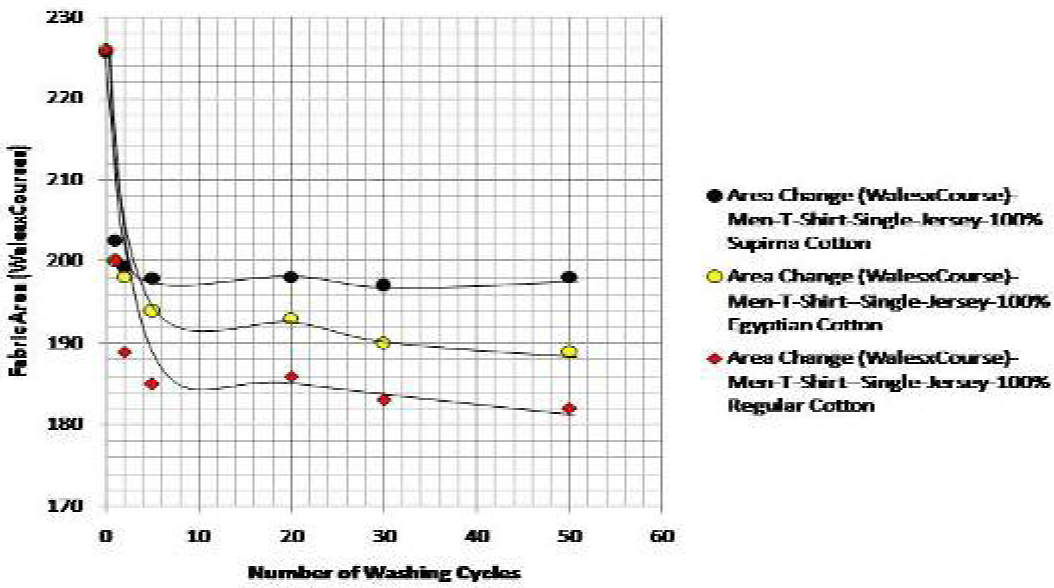


Figure 9. Change in area in Single-Jersey knit with washing and drying cycles

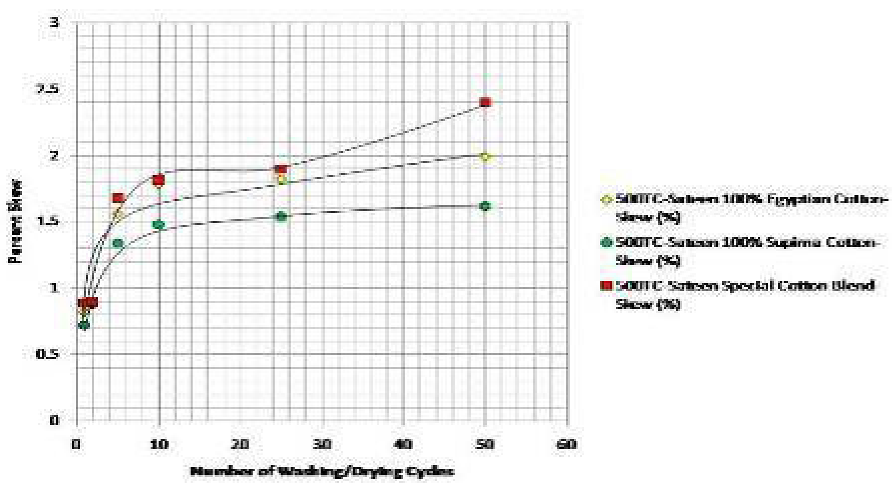


Figure 10. Change in skewness of bed sheets with washing and drying cycles

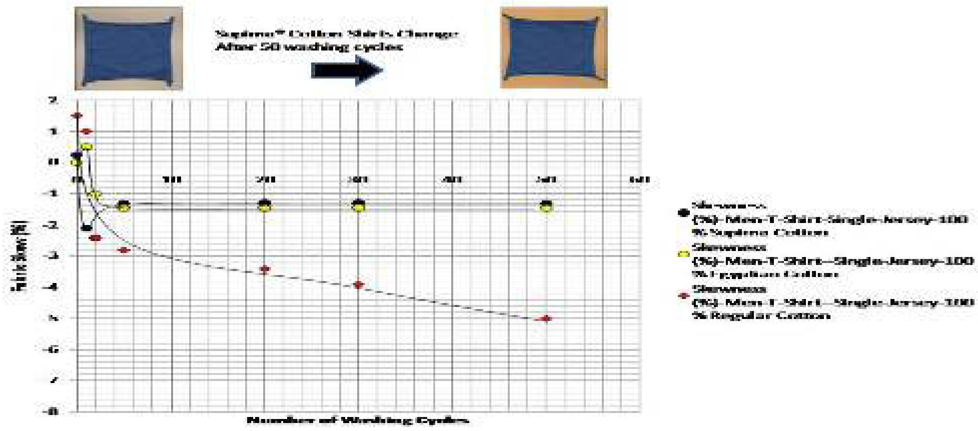


Figure 11. Change in skewness in Single-Jersey knit with washing and drying cycles

Conclusions

Results showed that it is possible to detect the effect of fiber used in the end product. Fabrics made from ELS cottons have better tensile properties, pilling and abrasion resistance, and dimensional stabilities. Under the extreme washing test, fabrics made from ELS cottons kept their superiority.

We should point out that the issue of Cotton Fiber Identity Theft is far from being resolved. This study only pointed out some of the possibilities but much more work need to be done. We would certainly encourage producers of high-quality cottons to seek ways to develop a database for the performances of their cotton varieties if they wish to protect their cottons from being claimed with other cheap varieties, which will eventually result in poor quality perception for these high-quality cottons. Our research program at Auburn University is more than capable in assisting in building these databases for different cotton producers.

Acknowledgements

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