

THE EFFECT OF DETERGENTS ON COLOUR DETERIORATION OF WHITE SCHOOL UNIFORM SHIRTING MATERIALS USED IN SRI LANKA

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INTRODUCTION

Colour fastness is one of the most important factors of buyers' demand. Colour fastness refers to the resistance of colour to fade or bleed of a dyed or printed textile materials to various types of influences e.g. water, light, rubbing, washing, perspiration etc. (Lawal and Nnadiwa, 2014). As per the standard "Boys' shirting and Girls' dress fabrics" developed by the Sri Lanka Standards Institution, the white colour school uniform shirting materials can be tested for colour fastness. The white is also considered as a colour agreed between the purchaser and the supplier (SLS 1060 part I, 1995).

White school uniform shirting materials are used by most of the school children in Sri Lanka. Most of the school children have only 2-3 uniforms at a time, so that they have to wash them once or twice a week. One of the major complaints is that the deterioration of color of the uniforms with the usage. People in Sri Lanka use different types of detergents for washing. They also employ different washing conditions. There may be large number of possible reasons for the deterioration of colour during the usage of the white school uniforms. One of the major factors could be the detergents used in washing. The main objective of this research is to investigate the effects of detergent types on colour deterioration of white school uniform shirting material. ISO 105 C06 testing standard was used to investigate and for comparison purposes of the above mentioned aspect. The Delta E values were used to determine the degree of colour deterioration. The recent studies have proposed that when Delta E value exceeds 2.3, the change of colour is noticeable to the human eye (Mahy et al, 1994).

METHODOLOGY

The study was carried out as mentioned below.

1. A literature survey was carried out to identify the factors, which may influence the colour deterioration of textile materials.
2. The testing standard, white school uniform shirting materials, machines and equipment for testing were selected and the most frequently used three (03) detergent types for washing of school uniforms were identified.
3. Fabric samples for washing were prepared.
4. The samples were washed as per the standard using three detergents using only water. They were tested for colour deterioration using the "Data Color Machine 600" and the necessary data was collected and analyzed to determine whether the used detergent types have an impact on the deterioration of colour of white school uniform shirting materials.

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EXPERIMENTAL DESIGN

The composition of white school uniform shirting material, details about the machines, equipment and the testing standard used are shown in the Table 1.

Table 1. Selected conditions for the experiment

Selected conditions for the experiment	
Fabric	Fibre content: 65% Polyester and 35% Cotton, Fabric structure: Plain weave, Weight: 101 g/m ² , Warp yarn count: 13.1 tex, Weft yarn count: 13.1 tex, Ends per inch: 116, Picks per inch: 78
Washing Fastness Tester	Washing Fastness Tester (B-Test) , which confirms with the international standard ISO 105-C06
Color Assessing Machine	Data Color Machine 600
Testing Standard	ISO105-C06
Water	Grade 3 water as per the standard ISO 3696
Bath conditions	MLR: 1:50, Temperature: 40 ⁰ C, Detergent concentration: 4g/l
Duration of Testing	30 minutes

The Table 2 shows the details about the detergents used in this experiment. This is the only variable parameter of the experiment. Water without any detergent was used for comparison purposes.

Table 2. Selected detergents for the experiment

Detergent type	Chemical composition
Detergent type A	Sodium metasilicate, Sodium carbonate, Sodium chloride, Alcohol ethoxylate and Water
Detergent type B	Sodium carbonate, Sodium aluminosilicate, Sodium alkylbenzene sulfonate, Alcohol ethoxylate , Sodium perborate monohydrate
Detergent type C	Oxygen cleaner, Simple green cleaner, Water, Softening powder

PREPARATION AND TESTING OF SAMPLES

Twelve panels from the white school uniform shirting material were cut. The dimensions of a cut panel were 4 cm x 10 cm. Each cut panel was kept between a 100% polyester cut panel and a 100% cotton cut panel of the same size and stitched loosely along one of the shorter edges by using a single needle lock stitch machine. With each detergent type three samples were washed. The other three samples were washed with water. Then the samples were rinsed and dried. After that the outer materials were removed and by using the Data Color Machine 600 Delta E values were obtained.

The washing procedure was repeated 20 times with fresh washing solution each time for the same white uniform shirting materials stitched with new 100% polyester and cotton cut panels. The samples used for comparison were also washed 20 times only with fresh water. The average Delta E values of the three samples washed with each detergent and water were calculated individually after each washing cycle.

RESULTS AND DISCUSSION

Table 3 gives the average Delta E values of the three samples washed by using three types of detergents and water. The values are given for 20 washing cycles.

Table 1. Average Delta E values of the four washing experiments against washing cycles

Washing cycles	Washed with detergent A	Washed with detergent B	Washed with detergent C	Washed with water
1	0.39	0.73	0.53	0.23
2	0.41	0.80	0.84	0.32
3	0.49	1.24	0.98	0.37
4	0.83	1.31	1.00	0.50
5	0.93	1.43	1.09	0.51
6	1.06	1.63	1.07	0.53
7	1.32	1.73	1.17	0.54
8	1.36	1.69	1.27	0.62
9	1.38	1.81	1.38	0.66
10	1.62	1.92	1.84	0.70
11	1.83	1.90	2.65	0.74
12	1.92	2.05	2.69	0.74
13	2.01	2.07	2.93	0.77
14	2.10	2.42	2.97	0.82
15	2.36	2.48	3.27	0.92
16	2.42	2.52	3.19	1.20
17	2.66	2.62	3.48	1.26
18	2.79	2.68	3.85	1.34
19	2.83	2.71	4.01	1.36
20	2.89	2.75	4.19	1.40

The columns 2, 3, 4 and 5 of the Table 3 show the average Delta E values for 20 washing cycles of the samples washed by using detergents A, B, C and water respectively. The lowest Delta E value after 20 washing cycles was 1.40 and it was resulted by the samples washed with water. The highest Delta E value after 20 washing cycles was 4.19 and it was resulted by the detergent type C. The maximum Delta E values given by the samples washed by detergent A and B are 2.89 and 2.75 respectively.

As per the Figure 1, that there is a gradual increase of Delta E values with increase number of washing cycles. This trend is common for all three detergents and water. Washing with water has resulted the lowest changes of Delta E values. The rate of increase of the Delta E values for the samples washed with detergents A, B and water have become very low after 16 washing cycles, whereas the samples washed with detergent C show upward trend even after 16 washing cycles.

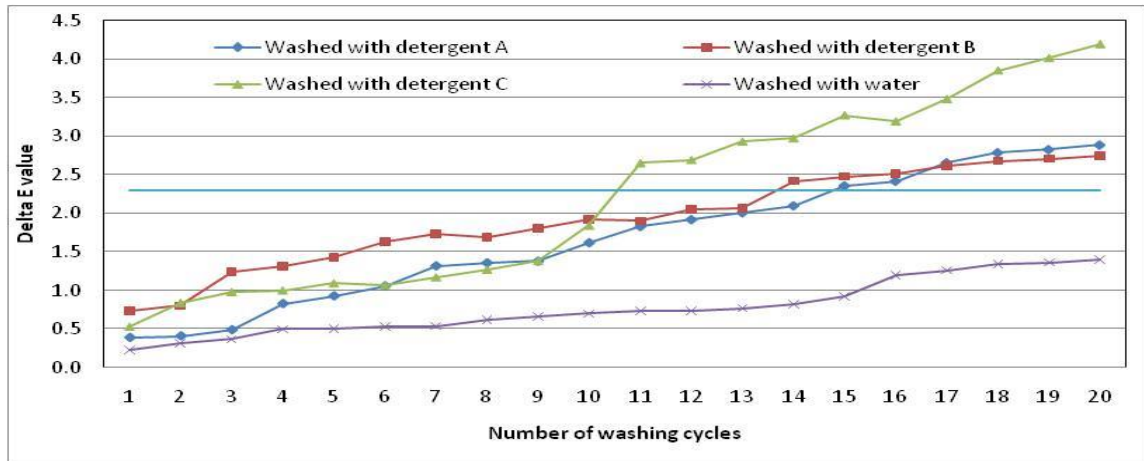


Figure1. Variation of the Delta E values against number of washing cycles

CONCLUSIONS AND RECOMMENDATIONS

The value Delta E is used to express the colour change in many applications. The recent studies have proposed that when Delta E value exceeds 2.3, the change of colour is noticeable to the human eye. This value is termed as the “Just Noticeable Difference”. The samples washed with detergents A, B and C have crossed the “Just Noticeable Difference” value 2.3 after 15, 14 and 11 washing cycles respectively. Therefore, the colour deterioration is visible to human eye after the above mentioned washing cycles for the studied detergent types.

As per the results, it is obvious that all the detergent types affect the colour of the selected white school uniform shirting materials. It appears that detergent C continuously affects the colour even after 20 washing cycles. This detergent may be probably harmful to the fibre materials as well. Hence it is necessary to carry out further research to ascertain whether it causes any measureable reduction in strength. Therefore, attention must be given when selecting detergents for washing white school uniforms. Though the water without any detergent has given the least colour change, washing with only water is less effective in removing dirt and soils from the white school uniforms.

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