DIU Journal of Science and Technology Volume 9, Issue 1, January 2014

2014-01-12

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the Single Jersey Knit Fabric by Different Concentration of Naoh

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STUDIES ON THE COLOR DIFFERENCE (ΔE) OF THE SINGLE JERSEY KNIT FABRIC BY DIFFERENT CONCENTRATION OF NAOH

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Abstract: *Most of the knitted cotton fabric is scoured and bleached with caustic soda and hydrogen per oxide and dyed with reactive dye. For this reason caustic soda was used for scouring andsumifix yellow 3RS was used for dyeing of cotton fabric.To carry out the experiment 2.5,3.0,3.5 and 4.0 g/l concentration of NaOH was used to obtain the proper effect. Finally the samples were dried and tested to evaluate the performance. The experiment that was carried out for measuring thecolordifference with the help of spectrophotometer. To carry out the experiment2.5g/l NaOHwas taken as standard and compared with others concentration e.g. 3.0, 3.5 and 4.0 g/l. It was found that as the concentration of NaOH increases, color difference decreases significantly. However for the economic point of view, best result obtained for 3 and 3.5 g/l of caustic soda. The experiments are done in Fakir Apparels Limited during my thesis work at 22th may 2012.*

Keywords: *Color, spectrophotometer, ΔE(color difference), NaOH,(caustic soda).*

1. Introduction

Color as an aspect of visual perception dependent on the spectral comparison of observed radiant energy [1]. It is a physical impression of human mind. Modern concept of color was founded by Isaac Newton[2]. Newton was separated white day light into a sequence of colored light called 'spectrum', Violet-Indigo-Blue-Green-Yellow-Orange-Redand spectral range/visible range/spectral distribution 400-700 nm.There are three properties to color. First is hue, which simply means the name a color .The second property is intensity, which refers to the strength and vividness of the color described as bright or dull. The third and final property of color is value meaning lightness or darkness [3]. The committee on colorimetry of the optical society of America defined color[4]"Color is the general name for all sensations arising from the activity of the retina of the eye and its attached nervous mechanism, this activity being in nearly every case in the normal individual, a specific response to radiant energy of certain wavelength and intensity."Light is an electromagnetic radiation that can be perceived by the human eye and its electromagnetic waves with wavelengths between 4×10^{-7} and 7×10^{-7}meters. Electromagnetic [5] radiation has a dual nature as both particles and waves. When changing electric and magnetic fields, forming an electromagnetic wave .This wave has amplitude, which is the brightness of the light, and wavelength which is the color of the light, and an angle at which it is vibrating, called polarization. An electromagnetic wave has a frequency f, a speed *v* and a wavelengthλ, which are related by the equation $v=f\lambda$. In vacuum or in air, the speed v = c (speed of light: 3×10^8m/s) so the relationship would be $c=f\lambda$ [6]

Color difference (ΔE): In CIE L*,a*, b* space, the color difference between a standard and a trial sample is expressed numerically ΔE [7]

$$\Delta E = \left(\Delta L^{*2} + \Delta a^{*2} + \Delta b^{*2}\right)^{\frac{1}{2}}$$

$$\text{where, } \Delta L^* = L_T^* - L_S^*$$

$$\Delta a^* = a_T^* - a_S^*$$

$$\Delta b^* = b_T^* - b_S^*$$

Where, the subscripts T and S denote trial and standard samples respectively. The color difference can also be specified in terms of co-ordinates L*, C* and H*where C* represents Chroma and H* represents hue angle

Date of submission : 30.05.2013 Date of acceptance : 03.12.2013

C*= the distance between the sample and L-axis

H*= the angle made by the chroma line and a* axis.

The total color difference (in CIELCH system)[8]

$$\Delta E=\left(\Delta C^{*2}+\Delta H^{*2}+L^{*2}\right)^{\frac{1}{2}}$$

CIE recommended the CIE L*a*b* system. The system is intended to be a uniform color space with the following properties [9][10]

(i)A rectangular, three dimensional color space (L*a*b*) in which all surface colors can be represented.

(ii) The distance between the points representing the colors of two samples is proportional to the visual color difference between them.

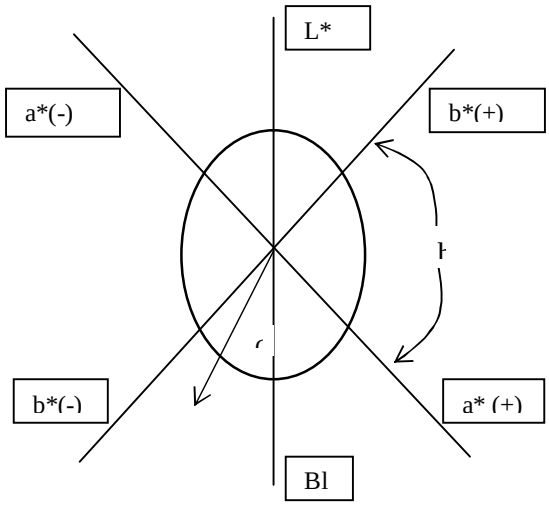
(iii) The axes are scaled sothat color difference is represented by unit distance.

(iv) The L*a*b* values can be easily interpreted in terms of the hue, lightness and depth of shade.

L* is the vertical axis and represents lightness. 0 being a perfect black and 100 a perfect white.

a* an axis in the plane normal to L which represents the redness/greenness quality of the colour, positive values denote redness and negative values denote greenness

b* an axis normal to both **L** and a which represents the yellowness/blueness quality of the colour, positive values denote yellowness and negative value denote blueness**.**



2. Experimental work

Recipe of Scouring and Bleaching

Chemicals	Conc.	Conc.	Conc.	Conc.
	Sample 1	Sample 2	Sample 3	Sample 4
Wetting agent (CK)*	0.5 g/l	0.5 g/l	0.5 g/l	0.5 g/l
Sequesting agent, (Tex-D-900)*	0.5 g/l	0.5 g/l	0.5 g/l	0.5 g/l
Antifoaming agent, (FFC)*	0.5 g/l	0.5 g/l	0.5 g/l	0.5 g/l
Scouring chemical Caustic	2.5.0 g/l	3.0 g/l	3.5.0 g/l	4.0 g/l
Bleaching agent, H_2O_2	4g/l	4g/l	4g/l	4g/l
Stabilizer (CentableachSOF)*	0.5g/l	0.5g/l	0.5g/l	0.5g/l
Per oxide killer (Crocks)*	0.5g/l	0.5g/l	0.5g/l	0.5g/l
Acetic Acid	0.5g/l	0.5g/l	0.5g/l	0.5g/l
Temperature	95c	95c	95c	95c
Time	60 min	60 min	60 min	60 min
L:R	1:8	1:8	1:8	1:8

*Commercial Name

2.1. Procedure of scouring

(i) Wetting agent, sequestering agent and antifoaming agent were put in the dyeing bath at room temperature

(ii) Then peroxide and stabilizer were added in the dye bath at 40° C.

(iii) Then alkali was added in the dye bath and the temperature was raised to 98°C from room temp @ 2.5°C/min.

(iv) The dyeing bath was run for 60 minutes at 98°C.

(v) Then bath temperature was lowered down to 70-80°C from 98° C. (vi)Then rinsing was done in hot water twice (around 70°C) and washing was done in cold water. Then temperature was raised to 80° C and at that temperature crocks was applied for removing residual H2O2.

(vii) At last acetic acid was applied for neutralizing the dyeing bath.

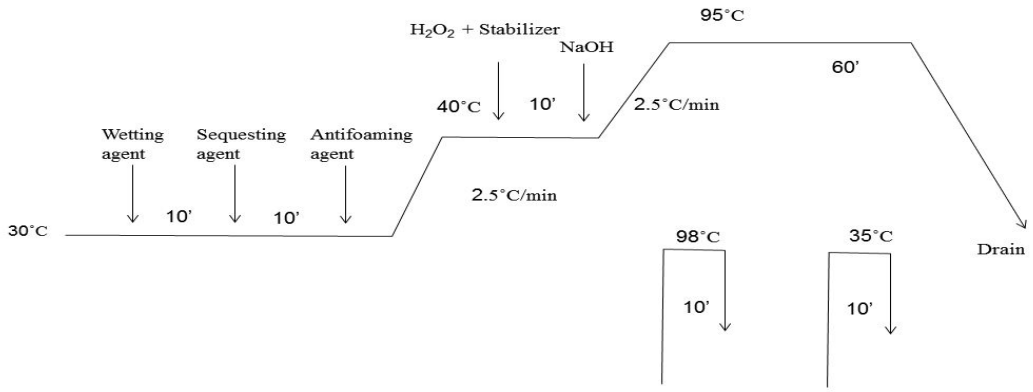


Figure 1 : Curve of scouring and bleaching of cotton fabric

3. Dyeing

Dyeing was carried out in the same bath after scouring and bleaching.

3.1 Recipe of dyeing

Chemicals	**Amount**
Reactive dye (Sumifix Yellow 3RS)*	2%
Levelling agent(200BF)*	1g/l
Salt Soda	10g/l
	10g/l
L: R	1:8
Temperature	60°c
Time	60 min

*Commercial name

3.2 Procedure of dyeing

(i) Leveling agent was applied in the dyeing bath at room temperature.

(ii) The dyeing bath was continued for 10 min at room temperature.

(iii) The temperature was raised to 40° C and salt was applied at that temperature.

(iv) Then the dyeing bath was run for 10 min at 40° C.

(v) After 10 min soda ash was added at 40° C and the bath was running for 10 min.

(vi) Then the temperature was raised to 60° C and sumifix dye was added at that temperature.

(vii) The whole bath was kept for 60 min at 60° C for dyeing,

(viii) The temperature was dropped to30°C from 60° C for cooling the bath.

(ix) Then rinsing was done in hot water twice (around 70°C) and washing was done in cold water.

(x) At last acetic acid was applied for neutralizing the dyeing bath.

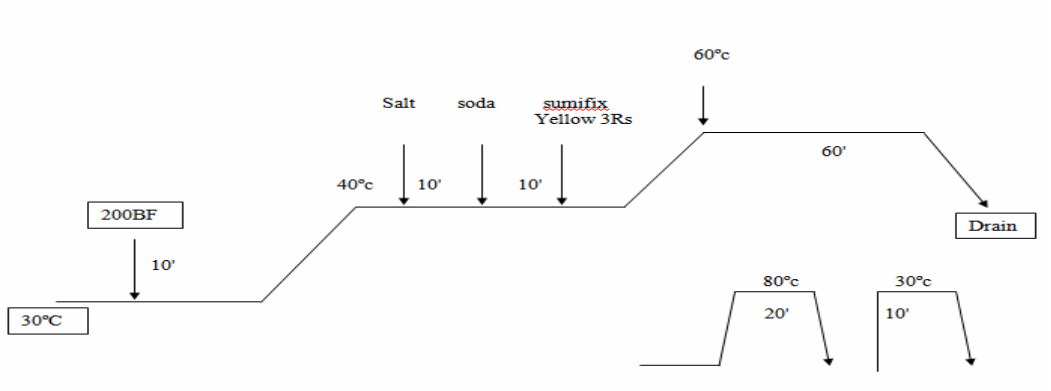


Figure 2 : Curve of cotton fabric dyeing with reactive dye

4 Drying

Then the fabric were dried with the help of iron

5. Testing

After drying all the four classes of samples were tested to evalute their performances. In this regard the following tests was carried out color difference(ΔE)

6. Measurement the color difference

The differences of color among the four different samples were tested by using a CCMS color measuring instrument. The test were carried out in Fakir Apprels Ltd .Further details are given below

6.1 Procedure

(i) First calibration was done

(ii) Then the 1st fabric was clamped in the spectrophotometer and was taken it as a standard.

(iii) Then 1st fabric was taken off.

(iv) Then 2nd fabric was clamped and was taken the readings.

(v) After that the 2nd fabric was taken off and the 3rd sample was clamped.

(vi) Then reading was taken for 3rd sample.

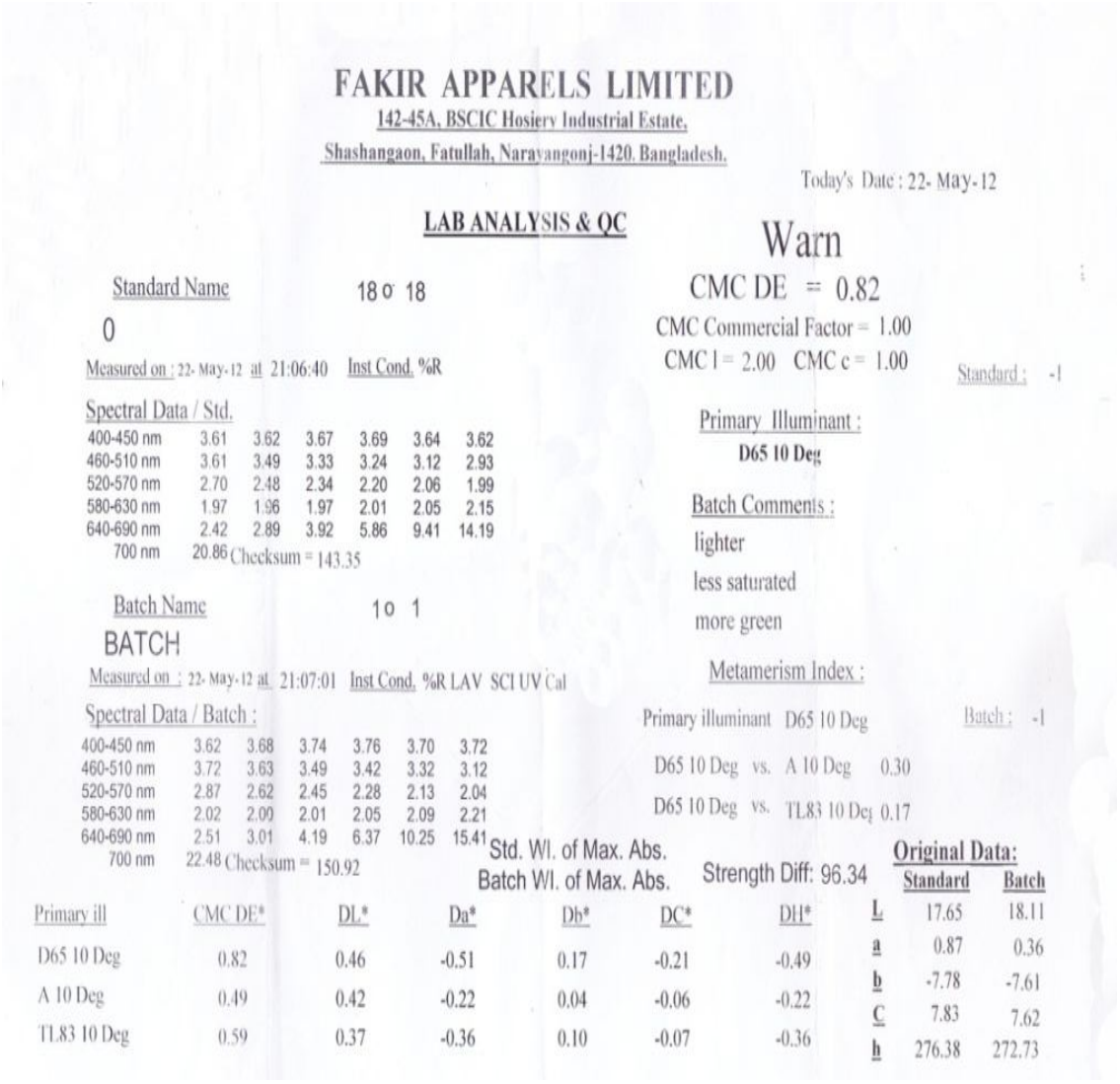
(vii) Then the 3rd fabric was taken off.

(viii) And the 4th fabric was clamped and the readings was taken for 4th fabric.

And all measurement is done with the standard of 1st sample.

Result

Table 1 CCMS data of sample 2



FAKIR APPARELS LIMITED

142-45A, BSCIC Hosiery Industrial Estate,

Shashangaon, Fatullah, Narayangonj-1420. Bangladesh.

Today's Date : 22- May- 12

LAB ANALYSIS & QC

Warn

Standard Name 18 o 18

0

CMC DE = 0.82

CMC Commercial Factor = 1.00

CMC l = 2.00 CMC c = 1.00

Measured on : 22- May- 12 at 21:06:40 Inst Cond. %R

Standard : -1

Spectral Data / Std.

400-450 nm	3.61	3.62	3.67	3.69	3.64	3.62
460-510 nm	3.61	3.49	3.33	3.24	3.12	2.93
520-570 nm	2.70	2.48	2.34	2.20	2.06	1.99
580-630 nm	1.97	1.96	1.97	2.01	2.05	2.15
640-690 nm	2.42	2.89	3.92	5.86	9.41	14.19
700 nm	20.86	Checksum = 143.35				

Primary Illuminant :

D65 10 Deg

Batch Name 1 o 1

BATCH

Batch Comments :

lighter

less saturated

more green

Measured on : 22- May- 12 at 21:07:01 Inst Cond. %R LAV SCI UV Cal

Metamerism Index :

Primary illuminant D65 10 Deg

Batch : -1

Spectral Data / Batch :

400-450 nm	3.62	3.68	3.74	3.76	3.70	3.72
460-510 nm	3.72	3.63	3.49	3.42	3.32	3.12
520-570 nm	2.87	2.62	2.45	2.28	2.13	2.04
580-630 nm	2.02	2.00	2.01	2.05	2.09	2.21
640-690 nm	2.51	3.01	4.19	6.37	10.25	15.41
700 nm	22.48	Checksum = 150.92				

D65 10 Deg vs. A 10 Deg 0.30

D65 10 Deg vs. TL83 10 Deg 0.17

Std. Wl. of Max. Abs.

Batch Wl. of Max. Abs.

Strength Diff: 96.34

Primary ill	CMC DE*	DL*	Da*	Db*	DC*	DH*
D65 10 Deg	0.82	0.46	-0.51	0.17	-0.21	-0.49
A 10 Deg	0.49	0.42	-0.22	0.04	-0.06	-0.22
TL83 10 Deg	0.59	0.37	-0.36	0.10	-0.07	-0.36

Original Data:

	Standard	Batch
L	17.65	18.11
a	0.87	0.36
b	-7.78	-7.61
C	7.83	7.62
h	276.38	272.73

Table 2 CCMS data of sample 3

FAKIR APPARELS LIMITED

142-45A, BSCIC Hosiery Industrial Estate,
Shashangaon, Fatullah, Naravangonj-1420. Bangladesh.

Today's Date : 22- May-12

LAB ANALYSIS & QC

Pass

Standard Name 18 o 18

0

Measured on : 22- May-12 at 21:06:40 Inst Cond. %R

Spectral Data / Std.

400-450 nm	3.61	3.62	3.67	3.69	3.64	3.62
460-510 nm	3.61	3.49	3.33	3.24	3.12	2.93
520-570 nm	2.70	2.48	2.34	2.20	2.06	1.99
580-630 nm	1.97	1.96	1.97	2.01	2.05	2.15
640-690 nm	2.42	2.89	3.92	5.86	9.41	14.19
700 nm	20.86	Checksum = 143.35				

Batch Name 1 o 1

BATCH

Measured on : 22- May-12 at 21:07:01 Inst Cond. %R LAV SCI UV Cal

Spectral Data / Batch :

400-450 nm	3.62	3.68	3.74	3.76	3.70	3.72
460-510 nm	3.72	3.63	3.49	3.42	3.32	3.12
520-570 nm	2.87	2.62	2.45	2.28	2.13	2.04
580-630 nm	2.02	2.00	2.01	2.05	2.09	2.21
640-690 nm	2.51	3.01	4.19	6.37	10.25	15.41
700 nm	22.48	Checksum = 150.92				

CMC DE = 0.72

CMC Commercial Factor = 1.00

CMC l = 2.00 CMC c = 1.00

Standard : -1

Primary Illuminant :

D65 10 Deg

Batch Comments :

lighter

less saturated

more green

Metamerism Index :

Primary illuminant D65 10 Deg

Batch : -1

D65 10 Deg vs. A 10 Deg 0.30

D65 10 Deg vs. TL83 10 Deg 0.17

Std. Wl. of Max. Abs.

Batch Wl. of Max. Abs.

Strength Diff: 96.34

Primary ill	CMC DE*	DL*	Da*	Db*	DC*	DH*
D65 10 Deg	0.72	0.36	-0.31	0.17	-0.11	-0.29
A 10 Deg	1.49	0.32	-0.22	0.04	-0.06	-0.22
TL83 10 Deg	0.92	0.37	-0.36	0.10	-0.07	-0.36

Original Data:

	Standard	Batch
L	17.65	18.11
a	0.87	0.36
b	-7.78	-7.61
C	7.83	7.62
h	276.38	272.73

Table 3 CCMS data of sample 4

FAKIR APPARELS LIMITED

142-45A, BSCIC Hosiery Industrial Estate,
Shashangaon, Fatullah, Naravangonj-1420. Bangladesh.

Today's Date : 22- May-12

LAB ANALYSIS & QC

Pass

Standard Name 18 o 18

0

CMC DE = 0.52
CMC Commercial Factor = 1.00
CMC l = 2.00 CMC c = 1.00

Standard : -1

Measured on : 22- May-12 at 21:06:40 Inst Cond. %R

Spectral Data / Std.

400-450 nm	3.61	3.62	3.67	3.69	3.64	3.62
460-510 nm	3.61	3.49	3.33	3.24	3.12	2.93
520-570 nm	2.70	2.48	2.34	2.20	2.06	1.99
580-630 nm	1.97	1.96	1.97	2.01	2.05	2.15
640-690 nm	2.42	2.89	3.92	5.86	9.41	14.19
700 nm	20.86	Checksum = 143.35				

Primary Illuminant :
D65 10 Deg

Batch Comments :
lighter
less saturated
more green

Batch Name 1 o 1

BATCH

Measured on : 22- May-12 at 21:07:01 Inst Cond. %R LAV SCI UV Cal

Spectral Data / Batch :

400-450 nm	3.62	3.68	3.74	3.76	3.70	3.72
460-510 nm	3.72	3.63	3.49	3.42	3.32	3.12
520-570 nm	2.87	2.62	2.45	2.28	2.13	2.04
580-630 nm	2.02	2.00	2.01	2.05	2.09	2.21
640-690 nm	2.51	3.01	4.19	6.37	10.25	15.41
700 nm	22.48	Checksum = 150.92				

Metamerism Index :

Primary illuminant D65 10 Deg Batch : -1

D65 10 Deg vs. A 10 Deg 0.30

D65 10 Deg vs. TL83 10 Deg 0.17

Std. Wl. of Max. Abs.
Batch Wl. of Max. Abs.
Strength Diff: 96.34

Primary ill	CMC DE*	DL*	Da*	Db*	DC*	DH*
D65 10 Deg	0.52	0.36	-0.11	0.07	-0.11	-0.29
A 10 Deg	0.59	0.32	-0.12	0.04	-0.06	-0.22
TL83 10 Deg	0.49	0.37	-0.16	0.01	-0.07	-0.36

Original Data:

	Standard	Batch
L	17.65	18.11
a	0.87	0.36
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C	7.83	7.62
h	276.38	272.73

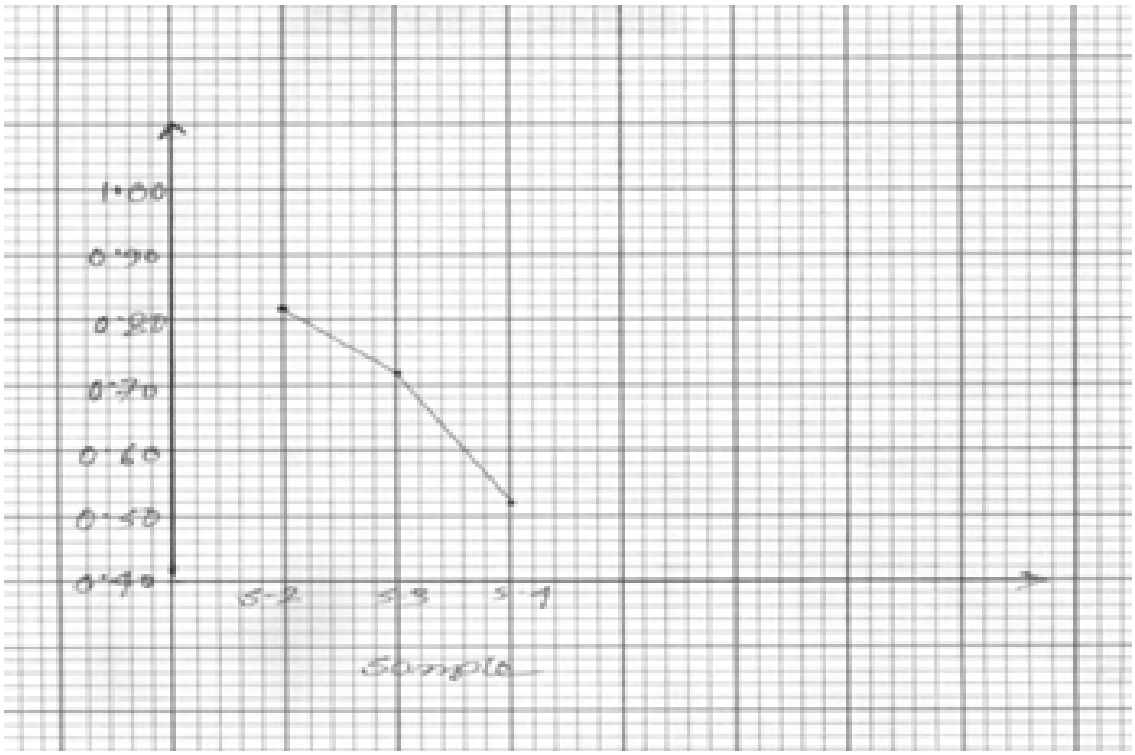

Figure **3 :** Comperison the ΔE value with standard sample 1 (Graphical representation)

Sample	dE	Result
Sample 2	0.82	Warn
Sample 3	0.72	Pass
Sample 4	0.52	Pass

Table-4 Comparison the ΔE value with Standard Sample-1(Obtained from tables 1,2&3)

10. Conclusions

Here caustic soda plays an important role on colordifference (ΔE).Color difference gradually minimized when concentration ofNaOH was changed from 3.0g/l to 4 g/l as 2.5 g/l was taken as a standard. But fabric losses its strength very fast as breakdown of cellulose unit. From all aspect better performance was obtained from 3g/l to 3.5 g/l.

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