EFFECT OF SCOURING AND BLEACHING TREATMENT ON KNITTED COTTON FABRICS FOR ECONOMIC STUDY

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Abstract

Cotton is the leading fibre in Textile Industry. Cotton is still the "King" of fibers because most of the world's apparel is made of Cotton. Apart from its fairly good strength, it is considered to provide comfort due to good moisture absorption and wicking properties. It is estimated that approx. 20 million tons of Cotton is processed worldwide yearly. Unlike man made cellulosic fibers such as Rayon and Lyocell, Cotton must be properly prepared for Dyeing, printing and finishing. To prepare the cotton fabric ready for Dyeing, printing and finishing scouring & bleaching is the fundamental step. Scouring of cotton textiles is an essential treatment in textile wet processing in order to obtain a sufficiently hydrophilic fabric. During scouring, waxes and other hydrophobic materials are removed from the cotton fibers. cotton fibres are off-white in color due to having colour bodies with it and the process of destruction these colour bodies from fibres is known as bleaching. The problems involved in normal scouring & bleaching using H_2O_2 is requirement of higher amount of alkali that will result higher cost in Effluent Treatment Plant to remove the alkalinity, use of wetting agent, sequestering agent, detergent & stabilizer and also require acetic acid to neutral the fabric. The aim of our work is to reduce the amount of alkali that is used in scouring , no use of acetic acid after scouring for neutralization and use of single chemical in place of that is cost effective. To fulfill our aim we use Imerol Blue Liquid in place of wetting agent, sequestering agent, detergent & stabilizer that is supplied by Clairiant and

compare the Imerol Blue process with classical scouring & bleaching process using stabilizer.

Keywords: Knitted, Economic, Scouring

INTRODUCTION:

Amount of water consumed depends to a large extent (refer Table A), on machine design and complexity of process (refer Table B, C). Different machines have their own characteristic features that set lower limits to the amount of water required e.g. machines such as winch or hank dyeing machine work at material to liquor ratio of at least 1:10-15while jigger works at 1:3.Many detailed surveys reveal remarkably wide variations in quantities of water used, i.e. from 5 - 5000 lit/kg of fabric processed. Average consumption in the scouring and bleaching of cotton fabrics was found to be in the range of 10 - 80 lit/kg and 10-130 lit/kg respectively depending on the machine and process employed. In case of dyeing carried out in jigger, the consumption of water is 10 - 60 lit/kg, while that carried out in a winch, it is around 100 -450 lit/kg. In another survey carried out at wool processing mills the average consumption of water for various unit processes showed marked variation and the average consumption appeared to be higher than necessary for efficient scouring, milling and dyeing. In case of consumption of water by various types of washing machine, some information has been published. The cost determining factors in this case are water hardness, level control, spray devices, water pressure and washing temperature.

Purpose	Percent water Use	
	Cotton textile	Synthetic textile
Steam generation	5.3	8.2
Cooling water	6.4	-
Demineralized or RO water for specific purpose	7.8	30.2
Process water	72.3	28.3
Sanitary use	7.6	4.9
Miscellaneous and fire fighting	0.6	28.0

Table A. Water usage in Textile Mills (%)

Process	Percent water consumed
Bleaching	38%
Dyeing	16%
Printing	8%
Boiler	14%
Other uses	24%

Table B. Total Water Consumed during Wet Processing

Process	Requirements in litres/ kg of product
Sizing	0.5-8.2
De-sizing	2.5-21
Scouring	20-45
Bleaching	2.5-25
Mercerizing	17-32
Dyeing	10-300
Printing	8-16

Table C. Water requirements for Cotton Textile Wet Finishing Operations

The Textile Industry is aware of the decrease in water sources and is developing new technology and new chemical alternatives, but the challenge will lay in converting the technology in current textile facilities into the new technology that uses less water. Another challenge will lie in changing the mindset of the current generations in the textile industry to use new chemical alternatives instead of the chemicals they have used in the past decades. This will be a slow process, but one that will need to happen in order for the textile industry to maintain current production and grow in the future.

Materials Used

1. **Fabric Specification:**
   Fabric type: S/J plain knit fabric (100%cotton)
   Fabric state: Grey
   GSM: 135
2. **Chemicals & Auxiliaries used:**
   - Wetting agent
   - Hydrogen peroxide (35%)

- Sodium Hydroxide
- Stabiliser
- Imerol blue liquid(*)
- Acetic acid

3.*Imerol Blue Liquid

A new all-in-one bleaching auxiliary for discontinuous alkaline peroxide bleaching of cotton and its blends with other fibers. Based on the exclusive Blue Magic bleaching technology, Imerol BLUE liquid is the key to a highly efficient bleaching process that is much faster and more economical than a classical discontinuous bleaching. Imerol BLUE liquid is a mixture of carboxylic acid salts and ethoxylated fatty alcohols. It allows:

- An excellent absorbency of the material, much better than a bleaching process using a classical peroxide stabilizer
- A high degree of whiteness
- No rinsing needed after bleaching, resulting in savings of water and time
- No or little neutralization with acid needed after bleaching. A simple pH correction is requested before a reactive dyeing
- A reduction of the process time resulting in increased machine output
- Reduced effluent loads and effluent volumes
- Is biodegradable, free from APEO and phosphorus

Machines used

- Sample dyeing m/c
- Spectrophotometer
- GSM cutter
- Electric Balance
- Bursting Strength Tester.

Methods

Scouring& Bleaching:

Scouring &Bleaching of 100% S/j grey fabric is carried out in sample dyeing m/c at two temperature(i.e. 100^0C & 110^0C), three M:L ratio(1:6,1:8 &1:10) using following recipes. Time is kept for temp. 100^0C is 30 min &for temp. 110^0C is 20 min.

Chemical	Recipe-1	Recipe-2	Recipe-3	Recipe-4	Recipe-5	Recipe-6	Recipe-7	Recipe-8
Imerol Blue	0.5g/l	0.5g/l	0.5g/l	0.5g/l	1g/l	1g/l	1g/l	1g/l
NaOH	1g/l	1.5g/l	2g/l	2.5g/l	1g/l	1.5g/l	2g/l	2.5g/l
H_2O_2	2.5g/l	2.5g/l	2.5g/l	2.5g/l	2.5g/l	2.5g/l	2.5g/l	2.5g/l

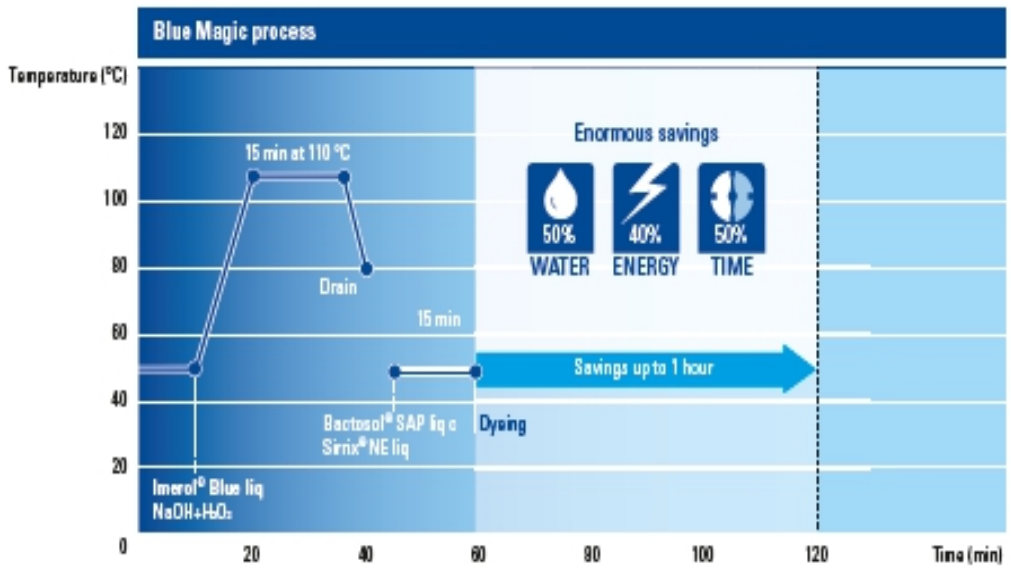
Table 1: Recipe for scouring & bleaching (single stage) using Imerol blue

Chemical	Concentration
Wetting agent	1g/l
Detergent	1g/l
Stabiliser	1g/l
H_2O_2	2.5g/l
NaOH	3g/l
M:L Ratio	1:8
Time	40 min
Temperature	100^0C

Table 2: Recipe for normal scouring& bleaching

As three M: L ratio & two temp. are used total no. of recipe using Imerol Blue is 8*3*2=48 and one for normal scouring & bleaching, so total no. of recipe i.e samples is 49.

Scouring & Bleaching Curve



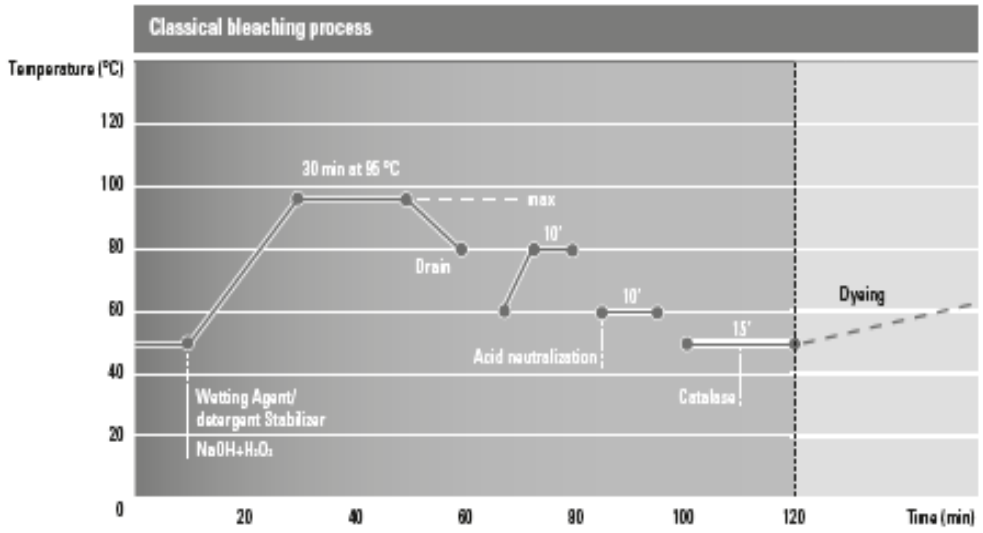


Figure 2: Normal scouring &bleaching

Aftertreatment

After scouring & bleaching, hot wash is carried out at 90^0C temp. For 15 min. In case of normal scoured & bleached fabric acid wash is done. After that drying is carried out at each sample in sample drying m/c.

Measurement of Scouring & Bleaching Effect

Whiteness of the bleached fabric of each sample is determined with the reflectance value using spectrophotometer(Datacolor400) and 10^0 observer &D65 illuminant is used to determine whiteness index. The scouring effect can be estimated by carrying out one for the following tests-

- Determination of weight loss.
- Absorbency test-

(i)Immersion test (ii) drop test or spot test. (iii)Wicking/column test

- Measurement of protein content.
- Measurement of wax content.
- Measurement of Methylene blue absorption.
- Measurement of Copper number.

This project work we determined the scouring effect by Immersion test.

Immersion test

Test: - Sample of 1cm x 1cm size is cut and it is left on water surface. With the help of stop watch, the time of the fabric for immersing is recorded.

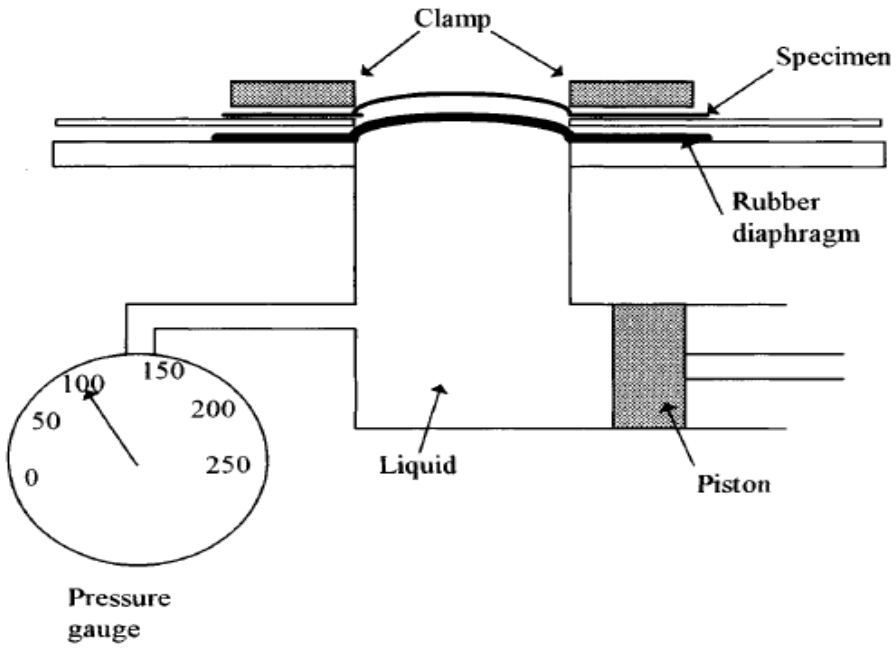
Result: - The standard time of immersing is 5sec.

Detemination of bursting strength

Bursting strength is carried out by Diaphragm bursting tester as follows:

Diaphragm bursting tester

This test in which the fabric to be tested is clamped over a rubber diaphragm by means of an annular clamping ring



And an increasing fluid pressure is applied to the underside of the diaphragm until the specimen bursts. The operating fluid may be a liquid or ages. Two sizes of specimen are in use, the area of the specimen under stress being either 30mm diameter or 113mm in diameter. The specimen's with the larger diameter fail at lower pressures (approximately one-fifth of the30mm diameter value). However, there is no direct comparison of the results obtained from the different sizes. The standard requires ten specimens to be tested. In the test the fabric sample is clamped over the rubber diaphragm and the pressure in the fluid increased at such a rate that the specimen bursts within 20 ± 3 s.

Determination of gram per square meter (GSM)

GSM is measured of each sample by GSM cutter.

Result and Discussion

Values of L, whiteness index, GSM & Bursting Strength for scoured & bleached sample at M: L ratio 1:6 and temp. 100^0C.

Table: 3

Conc. of	A=0.5g/l	A=0.5g/l	A=0.5g/l	A=0.5g/l	A=1.0g/l	A=1.0g/l	A=1.0g/l	A=1.0g/l
Imerol Blue(A)	B=1.0g/l	B=1.5g/l	B=2.0g/l	B=2.5g/l	B=1.0g/l	B=1.5g/l	B=2.0g/l	B=2.5g/l
NaOH(B)&H_2O_2(C)	C=2.5g/l	C=2.5g/l	C=2.5g/l	C=2.5g/l	C=2.5g/l	C=2.5g/l	C=2.5g/l	C=2.5g/l
Value of Lightness(L)	91.16	91.3	91.12	91.28	90.76	90.18	91.39	91.74
Whiteness Index	52.22	57.11	52.13	54.07	46.38	45.07	51.94	56.71
Bursting Strength	113	115	120	116	120	115	117	119
GSM	146	144	146	142	144	144	146	144

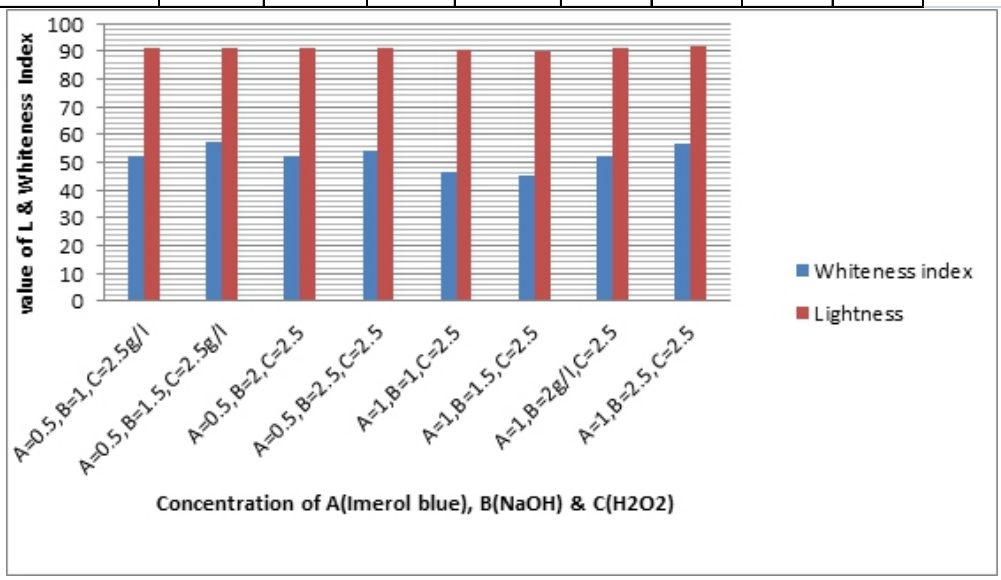


Figure: 3

Here (Table 3 & Figure 3) we see that maximum bleaching effect is at conc. A=0.5,B=1.5,C=2.5 as whiteness index is maximum here i.e 57.11 and maximum bursting strength is realized at conc. A=0.5,B=2,C=2.5 is 120 lb/in^2

Values of L, whiteness index, GSM & Bursting Strength for scoured &bleached sample at M:L ratio 1:8 and temp. 100^0C.

Conc. of Imerol Blue(A) NaOH(B)&H_2O_2(C)	A=0.5g/l B=1.0g/l C=2.5g/l	A=0.5g/l B=1.5g/l C=2.5g/l	A=0.5g/l B=2.0g/l C=2.5g/l	A=0.5g/l B=2.5g/l C=2.5g/l	A=1.0g/l B=1.0g/l C=2.5g/l	A=1.0g/l B=1.5g/l C=2.5g/l	A=1.0g/l B=2.0g/l C=2.5g/l	A=1.0g/l B=2.5g/l C=2.5g/l
Value of Lightness(L)	90.1	91.04	90.97	90.91	90.57	91.11	90.92	89.63
Whiteness Index	44.34	45.75	49.82	50.47	46.28	49.92	50.29	45.7
Bursting Strength	115	114	114	115	110	120	109	115
GSM	143	144	136	141	143	144	146	141
Immersion Time	17	16	16	12s	10	8	4	2s

Table:4

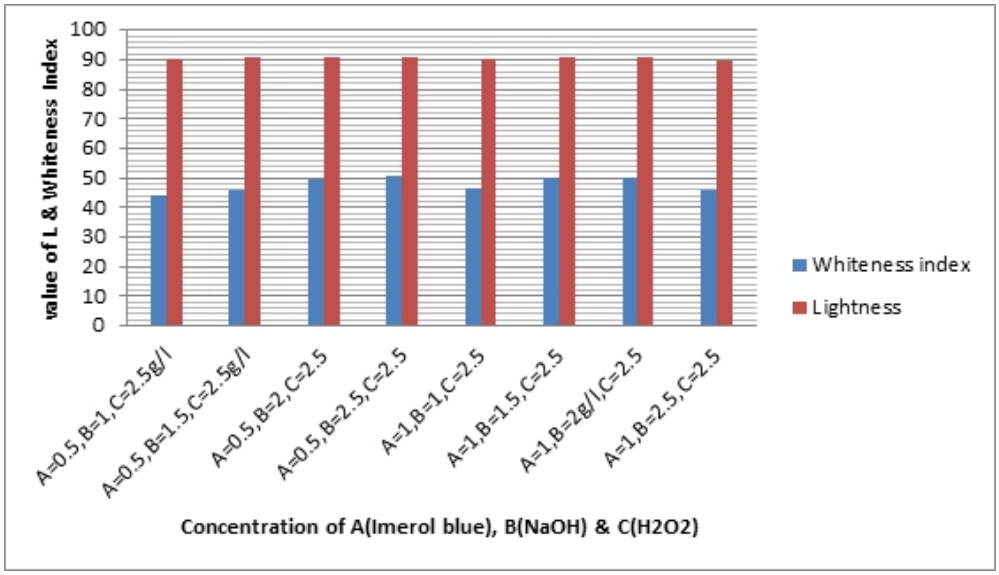


Figure: 4

Here (Table 4 & Figure 4) we see that maximum bleaching effect is at conc. A=0.5,B=2.5,C=2.5 as whiteness index is maximum here i.e 50.47 and maximum bursting strength is realized at conc. A=1,B=2.5,C=2.5 is 115 lb/in^2

Values of L, whiteness index, GSM & Bursting Strength for scoured &bleached sample at M:L ratio 1:10 and temp. 100^0C.

Table:5

Conc. of	A=0.5g/l	A=0.5g/l	A=0.5g/l	A=0.5g/l	A=1.0g/l	A=1.0g/l	A=1.0g/l	A=1.0g/l
Imerol Blue(A)	B=1.0g/l	B=1.5g/l	B=2.0g/l	B=2.5g/l	B=1.0g/l	B=1.5g/l	B=2.0g/l	B=2.5g/l
NaOH(B)&H_2O_2(C)	C=2.5g/l	C=2.5g/l	C=2.5g/l	C=2.5g/l	C=2.5g/l	C=2.5g/l	C=2.5g/l	C=2.5g/l
Value of Lightness(L)	91.06	91.49	91.18	91.4	92.28	90.64	90.69	91.06
Whiteness Index	46.86	54.73	50.11	55.56	59.83	47.54	44.29	48.76
Bursting Strength	122	118	108	110	105	117	119	110

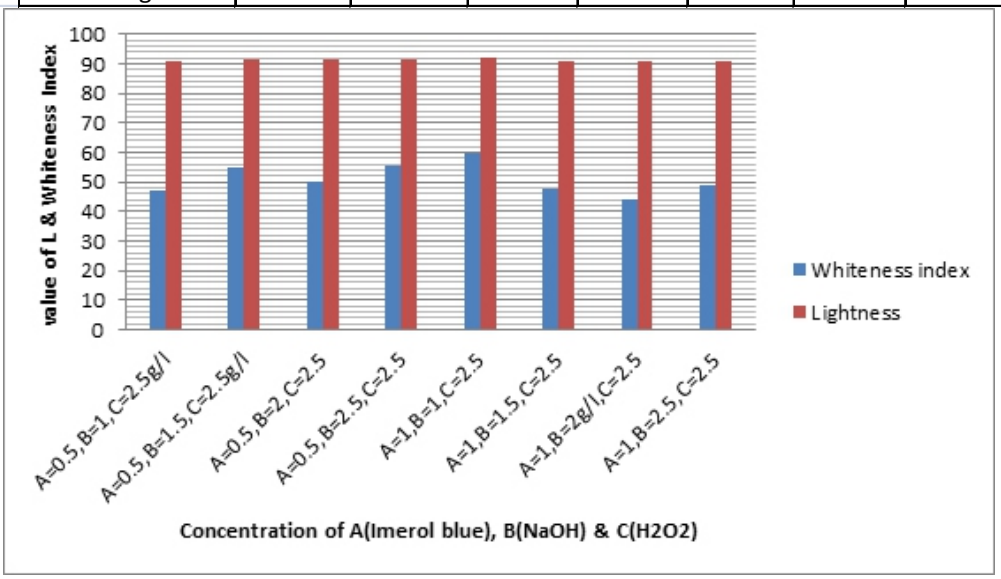


Figure:5

Here (Table 5 & Figure 5) we see that maximum bleaching effect is at conc. A=1,B=1,C=2.5 as whiteness index is maximum here i.e 59.83 and maximum bursting strength is realized at conc. A=0.5,B=1.0,C=2.5 is 122 lb/in^2

Values of L, whiteness index, GSM & Bursting Strength for scoured & bleached sample at M:L ratio 1:6 and temp. 110^0C.

Table:6

Conc. of Imerol Blue(A) NaOH(B)&H_2O_2(C)	A=0.5g/l B=1.0g/l C=2.5g/l	A=0.5g/l B=1.5g/l C=2.5g/l	A=0.5g/l B=2.0g/l C=2.5g/l	A=0.5g/l B=2.5g/l C=2.5g/l	A=1.0g/l B=1.0g/l C=2.5g/l	A=1.0g/l B=1.5g/l C=2.5g/l	A=1.0g/l B=2.0g/l C=2.5g/l	A=1.0g/l B=2.5g/l C=2.5g/l
Value of Lightness(L)	90.77	90.9	90.91	90.43	90.47	89.79	89.9	90.25
Whiteness Index	47.59	53.84	46.65	38.46	34.92	37.91	35.78	36.13
Bursting Strength	117	118	117	122	112	118	120	118
GSM	139	142	142	133	140	142	140	140
Immersion Time	35	30s	20	18	15	11	10	10s

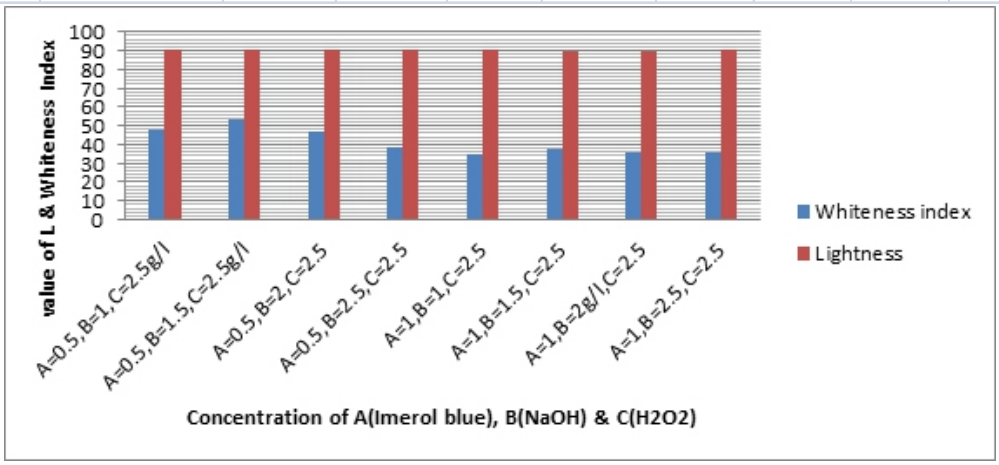


Figure:6

Here (Table 6 & Figure 6) we see that maximum bleaching effect is at conc. A=0.5,B=1.5,C=2.5 as whiteness index is maximum here i.e 53.84 and maximum bursting strength is realized at conc. A=0.5,B=2.5,C=2.5 is 122 lb/in^2

Values of L, whiteness index, GSM & Bursting Strength for scoured & bleached sample at M:L ratio 1:8 and temp. 110^{0}C.

Table:7

Conc. of Imerol Blue(A) NaOH(B)&H_2O_2(C)	A=0.5g/l B=1.0g/l C=2.5g/l	A=0.5g/l B=1.5g/l C=2.5g/l	A=0.5g/l B=2.0g/l C=2.5g/l	A=0.5g/l B=2.5g/l C=2.5g/l	A=1.0g/l B=1.0g/l C=2.5g/l	A=1.0g/l B=1.5g/l C=2.5g/l	A=1.0g/l B=2.0g/l C=2.5g/l	A=1.0g/l B=2.5g/l C=2.5g/l
Value of Lightness(L)	90.72	91.03	91.29	91.45	91.97	90.68	90.11	90.07
Whiteness Index	41.47	46.9	48.42	50.22	53.94	42.63	38.99	54.41
Bursting Strength	115	107	112	117	118	118	117	115
GSM	144	141	137	143	143	141	138	139
Immersion Time	10	7	8	7	6	6	5	4s

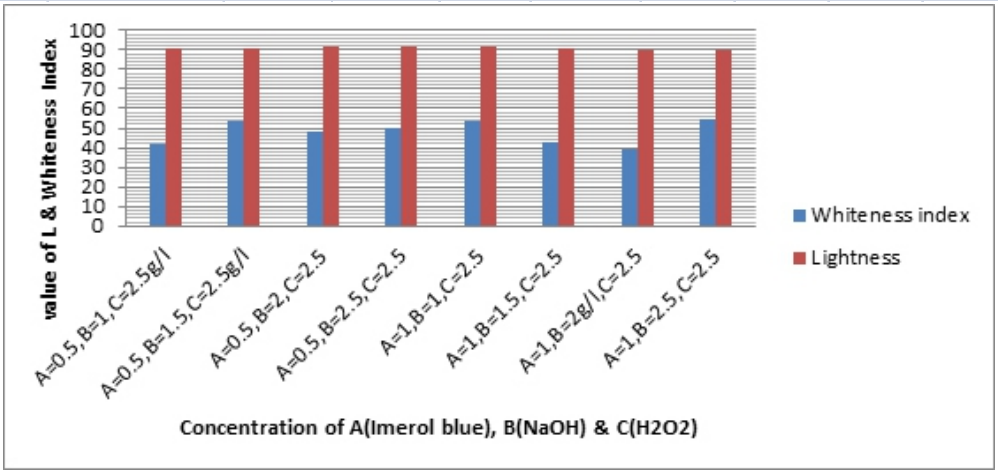


Figure:7

Here (Table 7 & Figure 7) we see that maximum bleaching effect is at conc. A=1.0,B=2.5,C=2.5 as whiteness index is maximum here i.e 54.41 and maximum bursting strength is realized at conc. A=1.0,B=1.5,C=2.5 is 118 lb/in^2

Values of L, whiteness index, GSM & Bursting Strength for scoured & bleached sample at M:L ratio 1:10 and temp. 110^{0}C.

Table: 8

Conc. of Imerol Blue(A) NaOH(B)&H_2O_2(C)	A=0.5g/l B=1.0g/l C=2.5g/l	A=0.5g/l B=1.5g/l C=2.5g/l	A=0.5g/l B=2.0g/l C=2.5g/l	A=0.5g/l B=2.5g/l C=2.5g/l	A=1.0g/l B=1.0g/l C=2.5g/l	A=1.0g/l B=1.5g/l C=2.5g/l	A=1.0g/l B=2.0g/l C=2.5g/l	A=1.0g/l B=2.5g/l C=2.5g/l
Value of Lightness(L)	91.72	90.9	92.11	91.04	92.49	90.02	91.39	91.15
Whiteness Index	57.93	48.95	58.57	46.12	60.99	57.73	50.95	49.3
Bursting Strength	112	115	115	110	114	116	113	117
GSM	141	145	141	145	141	143	141	143
Immersion Time	15	12	10	8	7s	8	9	4s

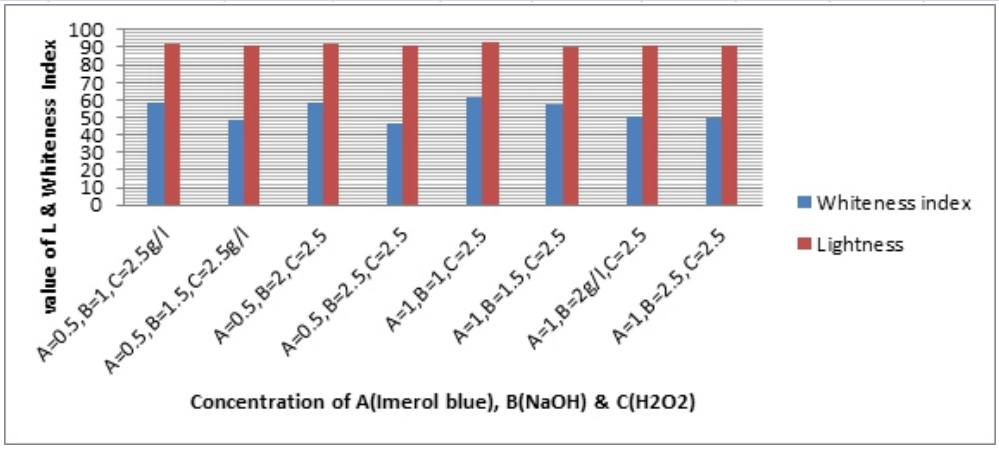


Figure: 8

Here (Table 8 & Figure 8) we see that maximum bleaching effect is at conc. A=1.0,B=1.0,C=2.5 as whiteness index is maximum here i.e 60.99 and maximum bursting strength is realized at conc. A=1.0,B=2.5,C=2.5 is 117 lb/in^2

In case of Normal Scouring & Bleaching (using stabilize, Wetting agent & Detergent) (Table:9)

Table:9

Conc. of	Wetting agent=1g/l	NaOH=2.5g/l	M:L=1:10
Chemical &	detergent=1g/l	H2O2=2.5g/l	Time=40min
Parameter	Stabiliser=1g/l		temperature=100^0C
Value of Lightness(L)	91.72		
Whiteness Index	47.93		
Bursting Strength	112		
GSM	141		
Immersion Time	2 sec		

FINDING

- For M:L ratio 1:6 & temperature 100^0C maximum bleaching effect is found at conc. A=0.5,B=1.5,C=2.5 as whiteness index is maximum here i.e 57.11 and maximum bursting strength is realized at conc. A=0.5,B=2,C=2.5 is 120 lb/in^2
- For M:L ratio 1:6 & temperature 110^0C maximum bleaching effect is found at conc. A=0.5,B=1.5,C=2.5 as whiteness index is maximum here i.e 53.84 and maximum bursting strength is realized at conc. A=0.5,B=2.5,C=2.5 is 122 lb/in^2
- For M:L ratio 1:8 & temperature 100^0C maximum bleaching effect is found at conc. A=0.5,B=2.5,C=2.5 as whiteness index is maximum here i.e 50.47 and maximum bursting strength is realized at conc. A=1,B=2.5,C=2.5 is 115 lb/in^2
- For M:L ratio 1:8 & temperature 110^0C maximum bleaching effect is at conc. A=1.0,B=2.5,C=2.5 as whiteness index is maximum here i.e 54.41 and maximum bursting strength is realized at conc. A=1.0,B=1.5,C=2.5 is 118 lb/in^2
- For M:L ratio 1:10 & temperature 100^0C maximum bleaching effect is found at conc. A=1,B=1,C=2.5 as whiteness index is maximum here i.e 59.83 and maximum bursting strength is realized at conc. A=0.5,B=1.0,C=2.5 is 122 lb/in^2
- For M:L ratio 1:10 & temperature 110^0C that maximum bleaching effect is at conc. A=1.0,B=1.0,C=2.5 as whiteness index is maximum here i.e 60.99 and maximum bursting strength is realized at conc. A=1.0,B=2.5,C=2.5 is 117 lb/in^2

Suggested Recipe for Scouring & Bleaching using Imerol Blue Liquid:

From the above discussion the recipe we suggest for scouring & Bleaching using Imerol Blue Liquid is as follows:

Imerol Blue Liquid	1 g/l
NaOH	2 g/l
H2O2	2.5g/l
M:L ratio	1:8
Time	30min
Temperature	100^0C

COSTING

It is estimated that the costing for scouring & bleaching to process 1 Kg fabric is 13 taka but for Imerol Blue process using above recipe it requires only 4 taka. That is to say it saves 9 taka per

LIMITATIONS

It is suggested in Imerol Blue process that the temperature should be raised quickly after adding chemicals. But as our sample dyeing m/c is conventional, so we could not maintain that. For this may be we could not get accurate result.

CONCLUSION

This project work was confined to scouring & bleaching with one kind of multifunctional chemical i.e Imerol Blue Liquid. Here bleaching shows good result than normal process but scouring shows a little bit lower absorbency than normal process. Investigations with other multifunctional chemicals are necessary before making any generalized statements. As scouring & bleaching plays key roles in re dyeing, detailed knowledge of their chemical composition is also essential to understand and explain all the facts. Similarly chemical constitution of multifunctional chemical should also be known to comprehend their effects. However, it may be suggested that further study be undertaken with other multifunctional chemicals having complete technical data and using testing equipment in proper order.

Refferences

Broadbent A D (2001). Basic principles of textile coloration, Cambridge, Woodhead Publishing.

E.R. Trotman (1991). Dyeing & Chemical Technology of Textile Fibres , Hodder & Stoughton, Hachette UK.

Peter J. Hauser,(2011) Textile Dyeing . InTech, Chapters published, Croatia.