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ESTIMATION OF SCOURING EFFECT ON COTTON BY VARYING CONCENTRATION OF CAUSTIC SODA

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ABSTRACT

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Apparel knit fabrics are normally prepared and dyed in exhaust equipment such as winch dyeing machine and jets. Scouring, prior to bleaching and dyeing is usually done in an alkaline process by boiling cotton in sodium hydroxide. Alkaline scouring at high temperatures for a long period of time followed by bleaching can abrade the fabrics and create an undesirable damage and change on the fabric surface. Scouring is practiced in the textile industry to remove the non-cellulosic hydrophobic cuticle constituents. This improves wet ability of the fibers, which facilitates uniform dyeing and finishing. Conventionally, scouring is performed by hot hydrolysis with NaOH, which involves large quantities of water and energy and requires special handling of the strong alkaline effluents. This project & thesis work has been devoted to study the scouring effect specially the minimum weight loss percentage (%) and obtaining maximum absorbency (Drop test, Immersion test) of textile material using minimum caustic soda.

Key words: *soda, quality, method, cotton, fabric*

INTRODUCTION

Most of the research done to develop an innovative alkaline scouring process was focused on the potentials of different caustic concentration. In this study a rational approach is adopted to design a new efficient caustic based cotton scouring process. The main aim is to find suitable caustic for the scouring purpose and to use it efficiently in the process. To do so, detailed knowledge of cotton fiber structure is required (Choudhury 2006). A question that needs to be answered for designing a new scouring process is, what to modify in cotton fibers to make them hydrophilic. Related questions are which specific components need to be removed and how to remove these unwanted components from the fiber. Apart from studying, each constituent in detail, the knowledge of how these unwanted cotton components are interconnected vital. Knowledge of the interactions between cotton fibers and caustic/chemicals/additives is essential for proper interpretation of the obtained results. All these issues are directly related to the fundamental knowledge about cotton fiber structure and morphology. A thorough literature review has been done on this issue, including the latest insights from plant science. That reveals structural information that directly and strongly influences the selection of caustic amount for developing a new scouring process. The gathered information about the cotton fiber is focused on those aspects that can affect the performance of a caustic scouring process. To complete the cotton fiber structure, some additional information on the secondary wall, coloring matters and the metal contents as well have been given.

MATERIALS AND METHODS

Scouring

Natural fibers contain oils, fats, waxes, minerals, leafy matter and motes as impurities that interfere with dyeing and finishing. Synthetic fibers contain producer spin finishes, coning oils and/or knitting oils. Mill grease used to lubricate processing equipment mill dirt, temporary fabric markings and the like may contaminate fabrics as they are being produced (Tomasino 2002). The process of removing these impurities is called Scouring. Even though these impurities are not soluble in water, they can be removed by Extraction, dissolving the impurities in organic solvents, Emulsification, forming stable suspensions of the impurities in water and Saponification, Converting the contaminates into water soluble components (Karmakar 1999).

i. Electronic Balance
ii. Pipette
iii. Measuring Cylinder
iv. IR Lab Dyeing Machine
v. Oven Dryer
vi. Beaker
vii. Glass rod

Cotton Scouring

The soda-ash boil

The type of alkali used for scouring of cotton depends on the quality of goods.

- For example, if colored yarns present in the fabric, sodium carbonate is ideally suited because of its low pH.
- Cotton yarns to be dyed in dark shade should be scoured with 1-2% sodium carbonate solution for 30 min in presence of wetting agent.

The mixture of caustic-soda and soda-ash boil

- 2 parts of caustic soda and 1 part of sodium carbonate,
- Single stage boiling,
- Soda-ash softens the water while interacting with Ca and Mg salts (if such are present),
- It creates an active reaction of the medium which is most favorable for the formation of stable emulsions and suspensions,
- Increases fiber swelling,
- Thus contributing to the release of impurities from the fiber,
- Neutralizes fatty acids contained in the fabric by soap formation,
- Reduces the adherence of detergents to wool in the alkaline medium conditions.

The soap/detergent- soda-ash boil

- This combination is comparably milder combination than that of caustic soda and hence ideally suitable for more delicate cloths and color woven goods compensating for the slower action of the milder alkali by the addition of a detergent.
- Anionic products like sodium alkyl sulphates and alkyl aromatic sulphonates and non-ionics like polyethoxylated compounds are used as detergent.
- Sometimes mixtures of anionic and non-ionic products are used.
- After scouring, washing is carried out by hot progressive rinsing while gradually decreasing the temperature in order to avoid break down of the emulsion and precipitation of the impurities onto the cotton.
- Washing is completed by treating the fabric in an acid solution to neutralize any alkali retained by the fabric.

Process description

Recipe

Caustic Soda (NaOH)	-X g/l
Soda Ash	-2g/l
Sequestering Agent	-1g/l
Wetting Agent	-1g/l
Detergent	-1g/l
Material Liquor Ratio	-1:20
Temperature	-105°C
Time	-40min

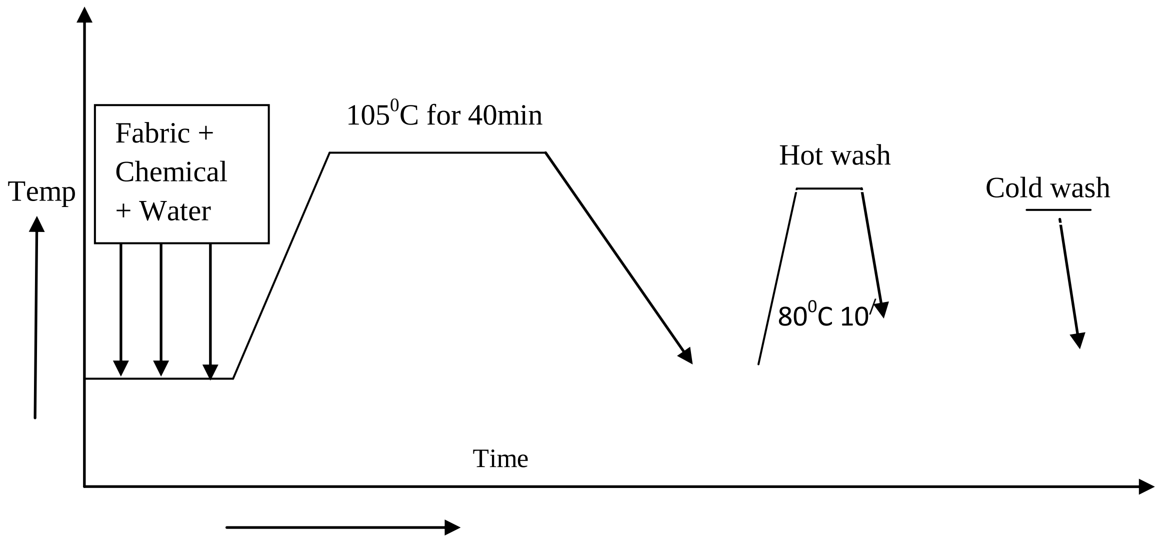

Fig. 1. Scouring Procedure Scheme

All the chemicals were taken according to recipe measuring by electronic balance. Stock solution of caustic soda of 2% & 4% and soda ash of 1% were prepared. Before putting the samples in scouring bath, the samples were kept in woven dryer at 105°C for 30 minutes to measure woven dry weight. After taking woven dry weight of each sample, those were put in a water bath. Then the chemicals and water were taken according to recipe and later on the samples were given in scouring bath. Completing all this, each pot was given in the machine. The program was set for 40min at 105°C. Unloading the samples hot wash was done with detergent for 10min at 80°C. Finally cold wash was done and again the samples were dried in woven dryer at 105°C for 30min and estimating the scouring effect were measured (Trotman 2005).

RESULTS AND DISCUSSION

The main changes which occur in cotton goods during scouring process are loss in weight (4-8%), loss in length due to shrinkage during boiling treatment, alteration in yarn count affected by both losses and changes in strength (Vilensky 1983). However, the most important characteristic of scoured fabric is increased wet ability, which is necessary for subsequent processing. Wettability must be obtained not only in the capillary spaces between fibers, but also inside the fiber themselves. While scouring is beneficial for wettability, when carried out in severe conditions, it includes fiber deterioration e.g. the creation of cavities in fibers or dissolution of the cuticle and primary wall (Rosen 1978).

Estimation of scouring effect

The scouring effect can be estimated by carrying out by the following tests

1. Determination of weight loss
2. Absorbency test-
    a) Immersion test
    b) (i) Drop test and
       (ii) Spot test

Determination of weight loss

The loss in weight of fabric during scouring shows that a considerable amount of impurities are removed. The weight of unsecured and scoured samples taken separately at the same moisture content and then the weight loss is measured in percentage.

$$\textit{Weight loss} = \frac{\textit{Weight (before scouring – after scouring)}}{\textit{Weight before scouring}} \times 100\%$$

Weight loss of Single Jersey (Plain) Fabric

Table 1. Weight Loss (%) of single jersey (plain) fabric

Sample No	Caustic soda(g/l)	Before Scoured Weight(gm)	After Scoured Weight(gm)	Weight Loss (%)
01	1	5.05	4.88	3.37
02	2	5.03	4.82	4.17
03	3	5.00	4.77	4.60
04	4	4.95	4.70	5.05
05	5	5.08	4.82	5.20
06	6	5.00	4.73	5.39
07	7	4.97	4.72	5.30
08	8	5.00	4.70	6.00
09	9	5.00	4.67	6.60
10	10	5.00	4.64	7.20
11	11	5.00	4.63	7.40
12	12	4.93	4.57	7.30

Weight loss of Single Jersey (Fleece) Fabric

Table 2. Weight Loss (%) of Single Jersey (Fleece) fabric

Sample No	Caustic soda(g/l)	Before Scoured Weight(gm)	After Scoured Weight(gm)	Weight Loss (%)
01	1	5.19	5.00	3.67
02	2	5.01	4.80	4.19
03	3	5.03	4.79	4.77
04	4	5.08	4.82	5.12
05	5	4.95	4.68	5.45
06	6	4.97	4.68	5.83
07	7	5.01	4.70	6.17
08	8	5.12	4.81	6.05
09	9	5.04	4.72	6.35
10	10	4.93	4.58	7.10
11	11	4.97	4.61	7.24
12	12	5.05	4.67	7.50

Weight Loss (%) of 1x1 Rib fabric

Table 3. Weight Loss (%) of double jersey (1x1 Rib) fabric

Sample No	Caustic soda(g/l)	Before Scoured Weight(gm)	After Scoured Weight(gm)	Weight Loss (%)
01	1	5.08	4.90	3.54
02	2	5.02	4.81	4.18
03	3	5.09	4.86	4.52
04	4	5.06	4.82	4.71
05	5	4.95	4.70	5.03
06	6	4.92	4.65	5.49
07	7	4.98	4.68	6.02
08	8	5.01	4.69	6.39
09	9	5.12	4.80	6.25
10	10	5.03	4.68	6.96
11	11	5.01	4.67	6.78
12	12	5.07	4.71	7.05

The weight loss(%) is increasing with respect to increasing of caustic soda upto a certain limit but later on if the caustic soda is increased the weight loss(%) is not so high. Minimum weight loss and maximum absorbency can be obtained up to 2-4 g/l of caustic soda for all fabric. Without wetting agent absorbency is not obtained prefect. As chemicals cannot penetrate to interior to the fabric and waxes are not removed well (Walton 1990). Fabric roughness will be increased by increasing higher amount of caustic soda in scouring bath. Final comment of standard recipe for different fabric with minimum caustic, minimum weight loss but maximum scouring effect is

Caustic soda	: 2—4 g/l for all type of fabric
Soda ash	: 1—2.5 g/l
Wetting agent	: 0.5—1 g/l
Sequestering agent	: 0.5—1 g/l
Anticreasing agent	: 0.5—1 g/l
Time	: 40 minutes
Temperature	: 105°C
pH	: 10.5—11.5

CONCLUSION

The major goal of any scouring process is to improve the water absorbency of natural fibers by removing the water-repellent components of the fiber cuticle which facilitates uniform dyeing and finishing. Since the cuticle is cross-linked to the primary cell wall by esterified pectic substances, efficient scouring correlates with a considerable removal of both waxy and pectic substances. Absorbency is quantitatively estimated by measuring the time required for a water drop to be absorbed or the distance traveled by a waterfront after a predetermined time. Although simple to perform, these techniques lack accuracy and cannot discern between highly efficient scouring techniques, especially when the fiber becomes rapidly wettable and insignificant times are being recorded. At the opposite extreme are staining techniques targeted to bind to the newly accessible hydrophilic components, such as congo red for cellulose, the exposed cellulose correlated with an increase in the fabric's hydrophilicity, from what a fabric's weight loss was observed as function of the severity of the scouring treatment applied, clearly indicating that the bound caustic increases proportionally with the amount of available binding sites.

Scouring is related to hydrophilicity and can be achieved by uncovering the pores that are already present in the fibers, by removing waxes and other non-cellulosic materials in the primary wall. The technical feasibility of caustic scouring has been recognized by many researchers over the last decade. However, continuous Caustic scouring process has been widely implemented by textile industries. The most important reason identified was the ability to remove cotton fiber waxes during caustic souring. The pre-rinsing in hot water above 90°C with a surfactant helps to reduce the wax impurity load and renders a better subsequent effect towards primary wall destabilization. With these results we have recommended the usual scouring temperature 105°C for NaOH.

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