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Research Article

Optimization of Time and Saving Water, Energy through Using Regulator with Hydrogen Peroxide in Exhaust Bleaching Process

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Abstract

On this investigation so as to optimize time, water and energy of exhaust bleaching procedure one test turned into accomplished by using modern bleaching regulator Imerol® Blue liquid (mixture of carboxylic acid salts and ethoxylated fatty alcohols) with caustic soda, H_2O_2 (50%), Bactosol AP (peroxide killer), Acetic acid whilst others become conducted the use of classical wetting agent Imerol (PCLF), sequestering agent (EDTA), stabilizer ($NaSi0_3$), caustic soda, H_2O_2 (35%). In this take a look at demonstrated that (a) Applied the bleaching regulator at 110°C decreased the bleaching time 15 min that accelerated productiveness in comparison to classical bleaching agent. (b) While Bleaching achieved with Imerol® Blue liquid absorbency of cotton knit material changed into stepped forward rather than classical bleaching process. (c) Modern bleaching method decreased weight loss percentage of cotton knit material as compared with classical method. (d) Whilst bleaching regulator Imerol® Blue liquid implemented on cotton knit cloth no rinsing became wished that's leads the minimization of bleaching time and water with in comparison to classical bleaching. For the outcome effluent volumes decreased that gives benefit on the surroundings and ecology. (e) Bleach regulator Imerol® Blue liquid allows to consume caustic soda at neutral pH in knit cloth as evaluation with classical bleaching. For the result neutralization with acid turned into prevented in modern bleaching technique. (f) For the bleach regulator, wetting, sequestering trait of imerol® Blue liquid no longer simplest leads the minimization of energy, alkaline quantity, degradation of cellulose in method but also advanced degree of whiteness, uniformity and improved dye-potential.

Keywords: Optimization time, water, energy; Cotton S/J knit fabric; Imerol® Blue liquid
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Introduction

While cotton fabric undergo scouring remedy coloring depend stay at the morphology of cotton material. Cotton containing impurities that play vital role for discoloration .Condition of climate, soil impact on degree of yellowness. When moisture are interacted to leaves will responsible for spot. Dust, dirt, bugs not handiest impart discoloration impact however additionally oils, greases from manufacturing device provide discoloration impact at the cotton.

Bleaching agent destroyed the coloring count of cotton observed with minimal loss that is the ambition of bleaching [1].Oxidation or minimization of coloring count achieved from bleaching treatment. For the consequence permanent whiteness was visible on the fabric. Optical brighteners made textile substrate chemically bleached. Duration of time was steadily minimized from day to hours in the period of modern era bleaching. For the consequence cost of manpower and finished product is decreased. On this take a look at efforts had been made to optimized time, water, strength, no rinsing, progressed whiteness, weight loss of substrate [2].

Ambition of analysis

1. Analyze Effects of the activator with hydrogen peroxide used in cotton knit (S/J) fabric during exhaust bleaching process.
2. Minimized the time of exhaust bleaching process.
3. Optimize the percentages of chemicals, water, energy are required for bleaching process.
4. Maximized whiteness and minimized the weight loss of bleaching process.
5. Enhanced the absorbency of cotton knit (S/J) fabric exhaust bleaching process.
6. Optimized the effluent load and effluent volume in exhaust bleaching process.
7. Minimized the alkaline amount exhaust bleaching process.

Mechanism of peroxide bleaching

Bleaching did no longer happen inside the alkaline medium of hydrogen peroxide, absent of alkali, temperature. In the presence of water hydrogen per oxide produce per hydroxyl ion (HOO-) that is weak acid. Inside the presence of water hydrogen per oxide produce in keeping with hydroxyl ion (HOO-) that is susceptible acid. In the influence of oxidizable component per hydroxyl ion decomposed that is the principle of bleaching. In the have an effect on of oxidizable component in step with hydroxyl ion decomposed that is the principle of bleaching. Autonomy of HOO- is due to neutralization of H+ ion in the effect of alkali.

$$H_2O_2 = H^+ + HOO^-$$

$$H^+ + OH^- = H_2O$$

When the pH range is above 10.8 faster acceleration of HOO- ion occurred which lead its unstable trait with oxygen formation. As a result bleaching result has disappeared. Another scenario is that higher decomposition inspire the HOO- to give worse effect on fabric. In the range of 10.5-10.8 pH bleaching performance safer and foremost due to equilibrium state of evolution rate and consumption rate. Unstable state created in hydrogen peroxide due to higher pH that is the reason for addition of stabilizer [3].

Experimental

Materials

100% cotton knit fabric (S/J), Imerol® Blue liquid acts as bleach regulator, wetting agent and sequestering agent, caustic soda, H_2O_2 (50%), Bactosol AP (peroxide killer), Acetic acid for modern bleaching process and for Classical bleaching wetting agent (Imerol PCLF), sequestering agent (EDTA), stabilizer ($NaSi0_3$), caustic soda, H_2O_2 (35%) was collected from Clari Chem Ltd. Dhaka.

Methods

Method of modern bleaching

At the beginning cotton knit S/J fabric became considered with Imerol® Blue liquid, H_2O_2 and caustic soda at room temperature in bleaching bath. Raised the room temperature to 110°C through maintaining the grade 5°C / min. whilst temperature reached at 110°C ran the bleaching tub for 15 min. After subsequent steps was cool downed the bath at 70°C and dropped the bath. Peroxide killer Bactosol AP turned into used 0.3 g/L to put off residual peroxide on cotton knit S/J cloth. After that for neutralization acetic acid became used at 0.5g/L on the cotton knit S/J cloth.

Classical bleaching process

All through set the bleaching tub at room temperature cotton knit material turned into taken together with wetting agent, sequestering agent, stabilizer, H_2O_2 and caustic soda. Raised the temperature to 90-95°C at grade 1-2°C/min. For classical bleaching ran the bathtub for 20-45 min. After that cool downed to 70°C and dropped the bath. Peroxide killing agent 0.3g/L changed into utilized to remove residual peroxide on cotton substrate. After that for neutralization acetic acid became used at 0.5g/L on the cotton knit S/J material.

Determination of weight loss (%) in modern and classical exhaust bleaching process

Weight loss (%) impose adverse effect and play vital role in bleaching process due to its importance. Bleaching process reduce the cotton knit fabric impurities (oil, fat, waxes). For the consequence cotton knit substrate became changed its state into light weight. Weight loss (%) was evaluated by subtracting un scoured and scoured substrate with respect to percentage in process [4].

$$\text{Weight loss (\%) of the sample} = \frac{\text{Sample weight before scouring} - \text{sample weight after scouring}}{\text{Sample weight before scouring}} \times 100$$

Evaluation of absorbency in modern and classical exhaust bleaching process

At some point of willpower of absorbency performance 0.1 % direct pink solution changed into taken. A pipette used to drop the dye solution and then implemented on cotton knit material. After applying absorption phenomena become visually evaluated.

Determination of whiteness index in modern and classical exhaust bleaching process

For the willpower of whiteness index of cotton knit material spectrophotometer 968(X-rite, USA) become used with setting D65 illuminant [5] and 10°C observer. Knit fabric was folded double to conduct the test of whiteness index. The following equation measured the whiteness index:

$$WI = Y + 3.448.Z - 3.904.$$

Evaluation of pH values in modern and classical exhaust bleaching process

A digital pH/Temperature meter was used with a mixture of glass electrode for assessment bleaching method in term of modern and classical method.

Results and discussion

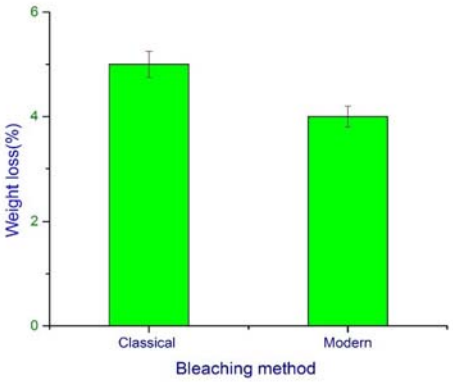
The reason of this investigation turned into not best to explore the technique of bleaching cotton knit material the usage of bleaching regulator Imerol® Blue liquid, H_2O_2, caustic soda but also utilizing classical wetting agent (Imerol PCLF), sequestering agent(EDTA), stabilizer($NaSi0_3$), H_2O_2 and caustic soda via preserving temperature, time at some point of investigation impact of weight reduction(%), pH, absorbency, whiteness index, energy, time, water turned into observed to optimize standard recipe that's become apparent in table 1**:**

Table 1 Comparison between classical and modern bleaching with respect to standard recipe

Bleaching process recipe	
Classical bleaching	Modern bleaching
Wetting agent (Imerol PCLF)= 1.0 g/L	Imerol® BLUE liq. = 1.0%
Sequestering agent (EDTA)= 1.0 g/L	Causic soda = 1.0 g/L
Stabilizer ($NaSi0_3$) = 1.0 g/L	H_2O_2 (50%) = 3.0 ml/L
Causic soda = 2.5 g/L	Initial pH = 10.5
H_2O_2 (50%) = 2.5 ml/L	After refill pH = 7.5
pH = 10.5	M : L = 1 : 8
M : L = 1 : 10	Temp. = 110°C
Temp. = 95°C	Time = 15 min
Time = 20 – 45 min	

Effect of weight loss (%) in classical and modern bleaching process

To analysis the effect of weight loss (%) of cotton knit bleached fabric, bleaching process was not only carried in modern way under the influence of 110°C,15 min, M:L =1:8 and but also conducted in classical way at 95°C, 20-45 min, M:L=1:10.



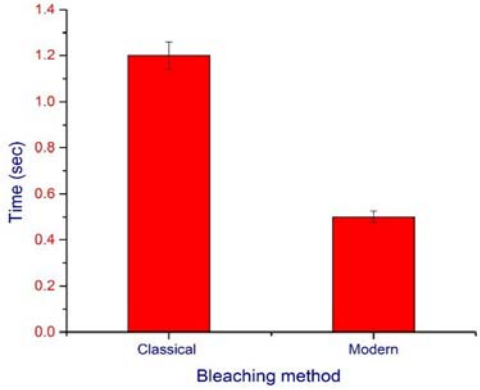


Figure 1 (left) Comparative analysis of weight loss (%) of bleached fabric in modern and classical method

Figure 2(right) Comparative analysis of absorbency of bleached fabric in modern and classical method

It was obvious from fig. 1 that weight loss (%) of cotton knit fabric was reduced due to application of regulator Imerol® Blue liquid, H_2O_2 and caustic soda rather than classical bleaching technique. Imerol® Blue liquid acts as an effective stabilizer during bleaching reaction by blocking atomic oxygen that tends to weaken cellulose.

Analysis of absorbency in classical and modern bleaching process

Modern bleaching method was proceeded at 110°C, 15 min, M: L =1:8 and classical bleaching method become carried at 95°C, 20-45 min, M: L=1:10. Via this two-step absorbency of bleached material was justified.

In accordance with fig. 2, it turned into visible that because of utility of regulator Imerol® Blue liquid, H_2O_2 and caustic soda on knit fabric confirmed even, whole speedy bleaching motion in preference to classical method. Imerol® Blue liquid had wetting and detergent traits that reduced the surface tension of water at most level and helped liquor to penetrate into knit material by using doing away with more impurities as compared to classical bleaching method.

Effect of whiteness in classical and modern bleaching process

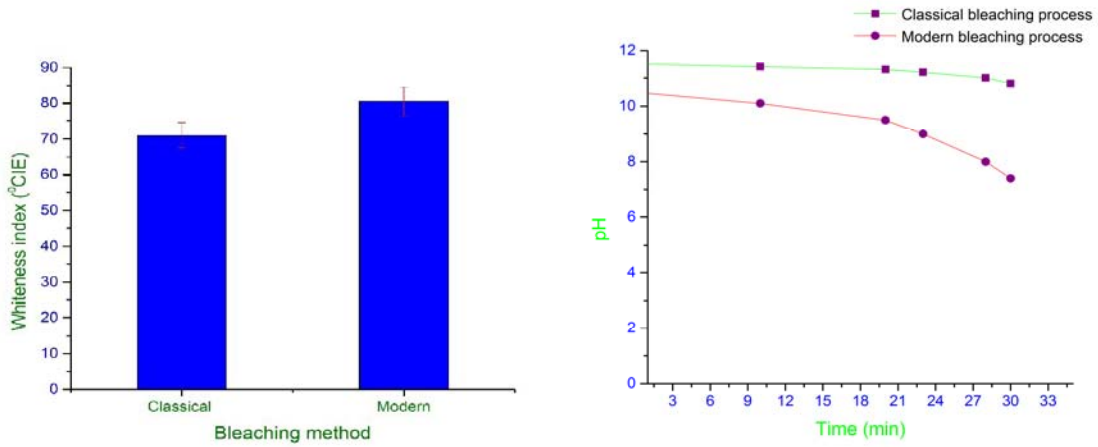


Figure 3 (left) Investigation of whiteness index value in classical and modern bleaching method

Figure 4 (right) Comparison between Classical & Modern bleaching process with respect to pH

To analysis the effect of whiteness index of cotton knit bleached material, bleaching procedure changed into not best carried in modern way underneath the effect of 110°C,15 min, M:L =1:8 and but also conducted in classical manner at 95°C ,20-45 min, M:L=1:10.

Via analysis of bleaching process from fig. 3**,** it turned into cleared that the whiteness of cotton knit cloth turned into advanced by the application of bleach regulator Imerol® Blue liquid, H_2O_2 and caustic soda while compared with classical bleaching technique. For the effective stabilizing trait of Imerol® Blue liquid enables to controls the peroxide response via limiting rate of oxidation in bleaching. For the outcome maximum diploma of whiteness without big decrease in degree of Polymerization was seen as compared to classical bleaching.

Analysis of pH values in classical and modern bleaching process

Modern bleaching method was proceeded at 110°C, 15 min, M: L =1:8 and classical bleaching method become carried at 95°C, 20-45 min, M: L=1:10. Via this two-step pH of bleached material was justified.

It was obvious from fig. 4 that caustic soda was consumed during the modern bleaching with

bleach regulator Imerol® Blue liquid, H_2O_2 leading to an 7.5 pH that appeared as neutral when compared with classical bleaching process that showed 10.5 pH that was alkaline. For the consequence neutralization of knit fabric through acid was neglected in the influence of bleach regulator. In classical bleaching 10.5 pH responsible faster acceleration of HOO^- ion which lead its unstable trait with oxygen formation. As a result good bleaching result has disappeared as compared to modern bleaching.

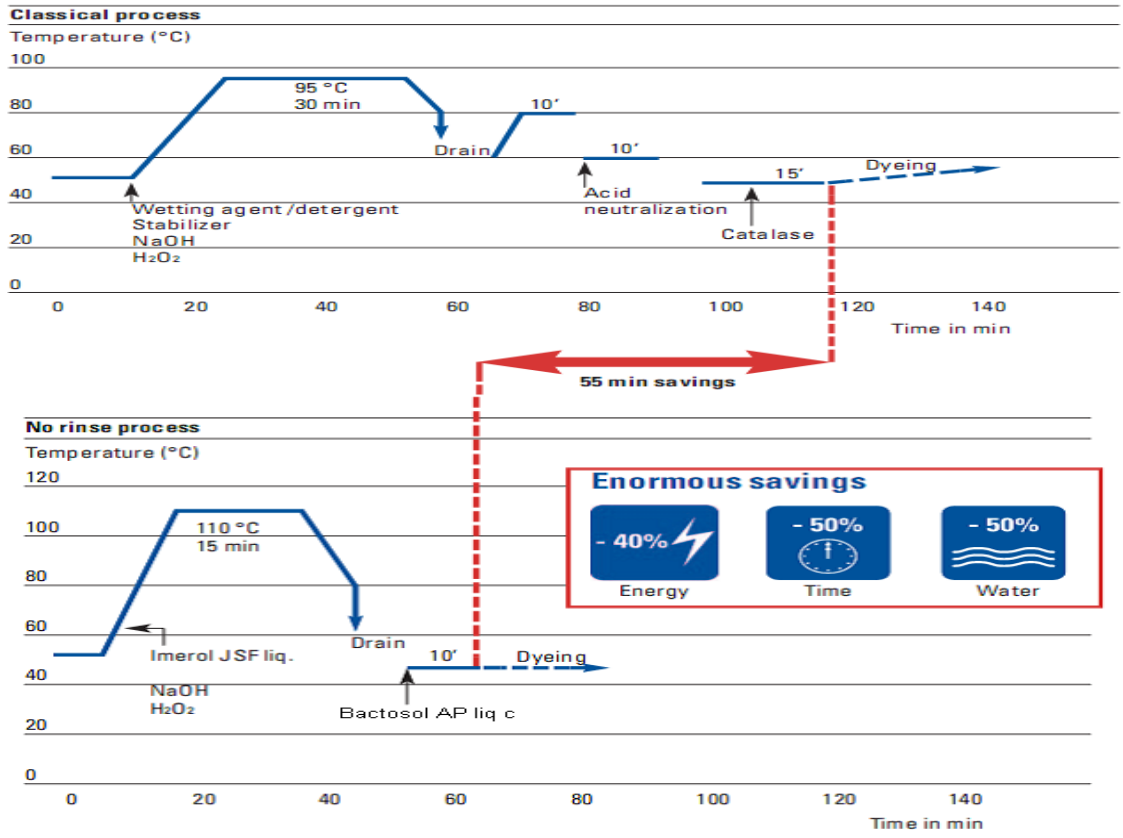


Figure 5 Comparative evaluation of process energy, water, time in respect with classical and modern bleaching method

Evaluation of process energy, water, time in respect with classical and modern bleaching method

Through evaluation from fig. 5, it was transparent that Imerol® Blue liquid acts as a bleach regulator, a wetting agent and a sequestering agent. The regulating function of Imerol® Blue liquid helped to regulate the temperature to 110°C that reduced time 15 min from 30 min for classical bleaching. Wetting and detergent traits of Imerol® Blue liquid reduced the surface tension of water at most level and helped liquor to penetrate into knit material by using doing away with more impurities as compared to classical bleaching method. Caustic soda was consumed during the modern bleaching with bleach regulator Imerol® Blue liquid, H_2O_2 leading to a 7.5 pH. However, classical bleaching process showed 10.5 pH that was alkaline. For the consequence neutralization of knit fabric through acid was neglected in the influence of bleach regulator rather than classical bleaching method. In contrast, it was cleared from fig. 5 that using Bactosol AP liq c not only eliminates the peroxide but also saves the time, water of rinsing and energy rather than classical bleaching method.

Analysis of process time in classical and modern bleaching method

Though analysis of table 2 with respect to process time it was demonstrated that when cotton fabric was bleached by the application of Imerol® Blue liquid, H_2O_2, caustic soda, bactosol AP liq c took less time, water as compared to classical bleaching method. For the consequence application bleach regulator minimized the bleaching time of about 135 min that reduced the effluent cost and make environment friendly nature.

Table 2 Comparative analysis of process time in classical and modern bleaching method

Step no	Bleaching process			
	Classical process		Modern process	
	Step name	Time (min)	Step name	Time (min)
1	Fill water	5	Fill water	2
2	Fabric Load	5	Fabric Load	4
3	Temp. raise to 60°C	5	Imerol Blue Injet	1
4	Scouring chemicals Dozing	3	Caustic dosing	10
5	Multi-functional che. Dozing	10	Temp. raise to 70°C	12
6	Run at 60°C	5	pH check (pH - 10.5)	1
7	Temp. raise to 70°C	3	H_2O_2 injet at 70°C	1
8	H_2O_2 dozing	2	Temp. raise to 110°C	13
9	Temp. raise to 110°C	13	Run at 110°C	20
10	Run at 110°C	60	Cooling to 70°C	15
11	Cooling to 80°C	15	Overflow rinse & Drain	10
12	Sample check	5	Neutralization at 40°C	10
13	Overflow rinse	13		
14	Drain	2		
15	Fill water	5		
16	Temp. raise to 90°C	5		
17	Run at 90°C	10		
18	Cooling to 80°C	5		
19	Drain	3		
20	Fill water	5		
21	H_2O_2 killer dozing	2		
22	Temp. raise to 90°C	5		
23	Run at 90°C	20		
24	Drain	3		
25	Fill water	5		
26	Temp. raise to 50°C	5		
27	Acetic acid Dozing	2		
28	Run at 50°C	10		
29	pH Check	5		
	Total time	236		99

Conclusion

Trough analysis of modern and classical bleaching method it become discovered that bleaching regulator at 110°C reduced the bleaching time 15 min that improved productivity in comparison to classical bleaching agent. Furthermore absorbency of cotton knit fabric turned into 0.5 sec for modern bleaching technique whereas classical bleaching confirmed absorbency 1.2 sec. Moreover 4 % weight loss showed by using contemporary bleaching procedure while barely higher weight loss percent became came about in classical bleaching method. Higher degree of whiteness (80.5°CIE) became given by using modern bleaching approach while opposite state of affairs (71°CIE) changed into befell in classical bleaching method. For the modern bleaching method caustic soda ate up at neutral media (7.5 pH) in which as alkaline media (10.5 pH) become utilized for caustic soda consumption in classical technique. For this phenomenon

neutralization with acid changed into avoided in modern bleaching approach. In awesome result turned into carried out when cotton fabric bleached with modern approach no need of rinsing that leads the minimization of method time and water intake as compared with classical bleaching technique.

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