COMBINED SCOURING AND BLEACHING PROCESS OF COTTON KNITTED FABRICS WITHOUT USE OF CHEMICALS

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ABSTRACT

The current work endeavored to avoid chemicals during scouring and bleaching of cotton knit fabric in order to introduce a green method. Single jersey singl knit fabrics were treated in water at 100 °C, 105 °C, and 110 °C for 45 min at reduced process stage. Fourier transform infrared data revealed the weakening and shifting of typical bands of wax and pectin-based cotton impurities in the region of 1,740–1,200 cm^{-1} for the pretreated samples at 130 °C for 20 min. Color difference (Color Measurement Committee ΔE) was found within the acceptable range for 1.5% and 1% dyed samples when treated at 105 °C for 20 min, while 0.5% dyed samples required 130 °C for 20 min to achieve the desired range. The ratings for color fastness to washing, perspiration, and rubbing were 4–5 for all the chemical-free pretreated samples. The proposed process yielded better strength and dimensional stability compared to the conventionally pretreated samples.

Keyword: Chemical free, Scouring & Bleaching, Whiteness Index, Colour Fastness

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1.Introduction:

Cotton fabric has several impurities such as fats and waxes, pectinous substances, proteinous matter, ash etc. Presence of fats and waxes in cotton fabric imparts poor water absorbency. Efficient removal of these impurities during grey preparation is essential to guarantee proper dyeing, printing and finishing processes. Till today, the most commonly accepted sequence of operations for cotton grey preparation is acid or enzyme desizing. alkali scouring and hypochlorite or hydrogen peroxide bleaching. This sequence of operations is time consuming and needs a large quantity of water, energy and a variety of chemicals. In order to remove these impurities, scouring of cotton fabric is normally carried out with strong alkali at high temperature and for longer duration. Although, this treatment gives very good results, one of the problems is high loss in weight of cellulosic material (Sorbe Biotechnology 2005). The total amount of impurities to be removed is less than 10 % (about 5 to <10%) of the total wt (Choudhury 2006). On the other hand, bleaching removes any unwanted colour from the fibres. This process also eliminates any traces of other impurities remaining from the previous preparation steps and improves the absorbency of the material for dyeing and printing (Broadbent 2001). During bleaching process it is unexpected to loss excessive wt. of fabric because; excessive weight loss in bleaching can reduce fabric strength, durability and dimension (Tailfer 1998). Again, in the enzymatic treatment, producers of textile enzymes recommend dosages of approximately 0.05 to 6% of cellulase preparation on garment weight depending on the desired result, the treatment method and the activity of the enzyme product (Heikinheimo 2002). Due to the un-optimized cellulase composition and high dosages, significant weight and strength losses can occur. Commercially a weight loss of 3-6% and strength loss of about 10% is considered acceptable (Choudhury 2006). A suitable bio-polishing effect without excessive loss of fabric strength is generally obtained with 3.5% weight loss of fabric (Heikinheimo 2002). Amount of raw material is reflected by the wt. or GSM (g/m2) of fabric, which must be maintained for garments. If the excessive wt. loss occurs in the pretreatment, then GSM will be reduced significantly, it will definitely affect the garment quality. In case of high concentration of H2O2 or enzyme in the pretreatment processes, chemical cost will be increased. Again, if the wt. loss is less than the standard mentioned, then impurities will remain in the substrate which will create absorbency problem during the combined process.

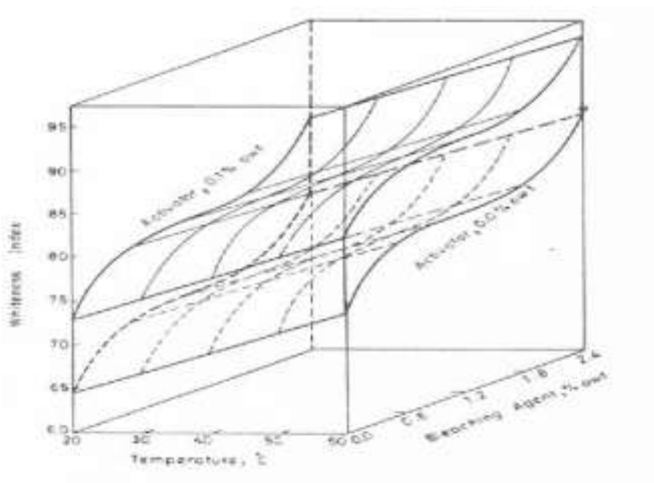
2.1 COMBINED SCOURING-BLEACHING OF COTTON

In the combined scouring-bleaching of cotton, the scouring process is accelerated in the presence of H2O2 and less time is generally required to achieve good absorbency of the material (Choudhury 2006). The advantages of this process are increased production with reduction of labour cost and reduced treatment time; the loss in wt. and strength of material is less (Choudhury 2006). H2O2 is a powerful oxidizing agent that rapidly destroys the natural colouring matters present in cotton without undue oxidative damage to the fibres (Broadbent 2001). Full use of the stabilizing properties of natural cotton impurities minimizes peroxide consumption during bleaching. High alkalinity at elevated temperatures produces efficient scouring action. Bleaching and leveling residual waxes are also affected in this process. Hence a combined scouring bleaching process for cotton using peroxide in winch and package has gained commercial success (Shenai 1995).

2.2 ENZYMATIC TREATMENT OF COTTON

Bio-polishing with Cellulase Enzyme Cellulase is a complex natural mixture of different components, which work synergistically to degrade cellulose to glucose (Enzyme Technology 2002). Knitted fabric in circular form is very difficult to singeing. But the surface of the fabric can easily be cleaned by bio-polishing process. The main advantage of bio-polishing is the prevention of pilling (Olsen 2004). The surface modification of cellulosic fabrics confers cooler and softer feel, brighter luminous color using cellulases (Choudhury 2006). Bio-polishing is getting tremendous popularity due to its effectiveness and process simplicity.

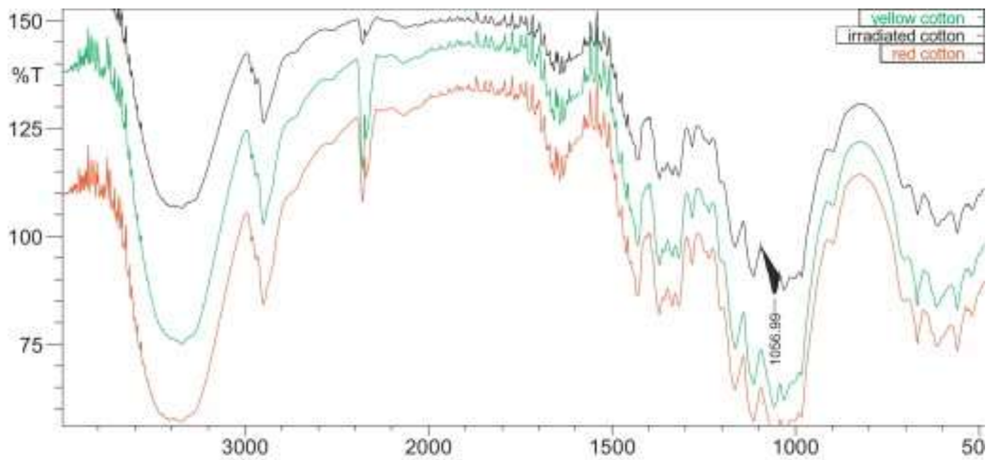
2.3 COMBINED SCOURING- BLEACHING OF POLYESTER COTTON BLEND



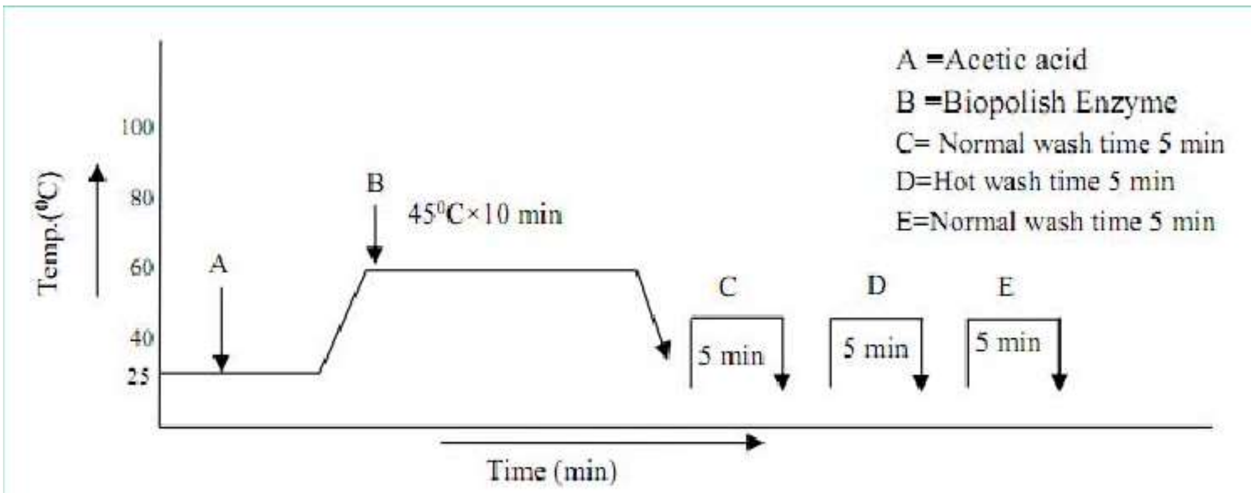
The scouring-bleaching formulation consisted of a scouring agent, a bleaching agent and an activator. A previously standardised 171 self-emulsifiable scouring agent at 2% by volume was used in the formulation; it had perchloroethylerw as solvent, emulsifier and pine oil as wetting agent in the ratio 1:45. Sodium chlorite (80%) suppliedby Fluka AG and triethanolamine hydrochloride (TEA. HCl), analaytical grade, were used as the bleaching agent and activator respectively. The bleaching agent and the activator were used in the ratio of 2: 1 by volume. The ratio was previously standardized.

2.4 COMBINED SCOURING- BLEACHING BY GAMMA RADIATION

Fabric used in this experiment includes cotton knitted single jersey structure of 160 gsm. The grey cotton knitted fabric was immersed in different (0 – 30 g/L) amount of hydrogen peroxide solution for 10 min. Subsequently, the samples were irradiated under Co-60 gamma radiation of absorbed dose (5–20 kGy) at a dose rate 5 kGy/h. Water absorbency, whiteness index (WI), weight loss, bursting strength, elongation at burst and dye uptake were taken as the measure of extent of scouring and bleaching performance of the intended fabric. The new technology yielded product with acceptable whiteness and water absorbency which is suitable for pale shade dyeing. The optimum results were achieved for the sample irradiated at a total dose 5 kGy treated with 10 g/L H_2O_2 solution. The water absorbency and WI value were 2.4 s and 39.43, respectively, as well as 82.2% dye exhaustion was obtained having the bursting strength 203.20 kPa for this option. But higher dose of radiation was found responsible for lowering the bursting strength of the fabric. However, the irradiated samples demonstrated the good dye-ability indicating the excellent level dyeing with Bezaktive Red S-3B and Novacron Yellow ST-3R reactive dyes.



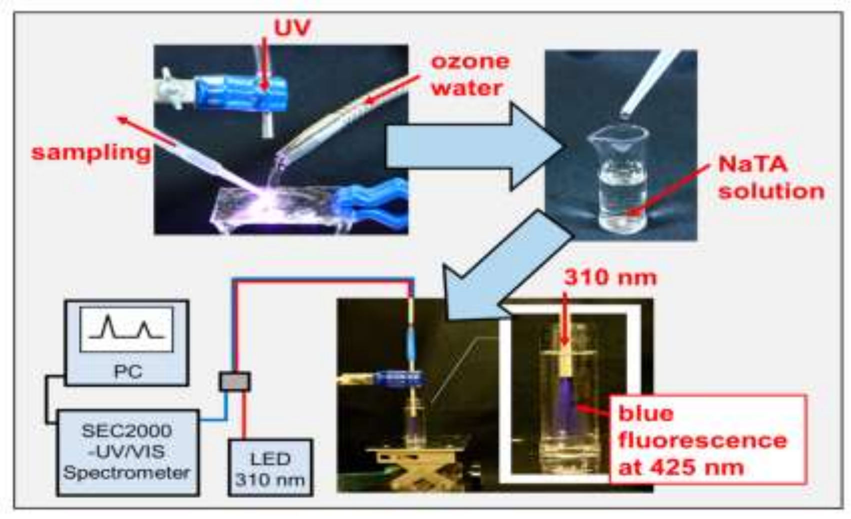
2.5 COMBINED SCOURING AND BLEACHING USING ENZYMES



Enzymes are biocatalysts obtained from living cells through biochemical reactions specifically metabolic process of the cells. Enzymes obtained from the natural source since ancient times in the production of food products, such as cheese, sourdough, beer, wine, vinegar and indigo formation.The development of fermentation processes has grown during the last century, specifically for the production of purified enzymes in a large scale. The use of recombinant gene technology has improved enzyme-manufacturing processes. Most industrial enzymes occurred hydrolysis for degrading the natural substances. Enzymes are used in not only food production but also pharmaceuticals, textiles, leather processing

2.6 COMBINED SCOURING AND BLEACHING USING AQUEOUS OZONE AND UV RADIATION

Chemicals for the scouring and bleaching of fabrics have a high environmental load. In addition, in recent years, the high consumption of these products has become a problem in the manufacture of natural fabric products. Therefore, environmentally friendly, low-waste processes for fabric treatment are required. In this paper, we discuss the bleaching of fabrics using advanced oxidation processes (AOP). These processes use electrochemically generated aqueous ozone and ultraviolet (UV) irradiation to achieve bleaching. However, colour reversion often occurs. In this study, we suppressed unwanted colour reversion by treatment with rongalite. After treatment, changes in fabric colour were determined by measuring the colour difference and reflectance spectra. The best bleaching effect was obtained when ozone and UV irradiation treatments were combined, achieving results similar to those of a conventional



bleaching method after 60 min of UV irradiation. In addition, the AOP treatment resulted in the simultaneous scouring of the fabric, as shown by the increased hydrophilicity of the fabric after AOP treatment. Thus, this AOP process represents a new fabric bleaching process that has an extremely low environmental impact.

4. CONCLUSION

It was possible to carry out scouring and bleaching of cotton knit samples without conventional sodium hydroxide and hydrogen peroxide, rather using only nonionic detergent and anionic wetting agent at 105°C as a precursor of 1% and 1.5% shade dyeing. The two parameters, namely CMC ΔE and fastness properties, are chief prerequisites for the acceptance of textile dyed fabric in global market. It was clarified in a justified manner that, combined CMC ΔE outcome exhibited accepted values for all the 1% and 1.5% dyed samples. Again, the color fastness properties were in line with the expectation level very sensibly. However, pretreatment effect was also critically reviewed through weight loss%, drop test, wax content analysis. In almost all cases, the treated samples kept consistency with the conventionally pretreated samples. It is obvious that the natural impurities and natural coloring agents were not removed as a whole like conventional pretreatment, where extreme level of alkali hydrolysis of the fatty substances or esters took place. But evidence of weakening of the characteristic bands of wax and pectin substances through FTIR investigation bears out the core indication that there is a scope of pretreatment with least chemicals for 1% and 1.5 shade dyeing. SEM analysis and strength test measurement were also involved to establish morphological likeness and strength retention of the treated samples during the work. In addition, 0.5% shade dyeing required high temperature application like 100°C, 105°C and 110°C where the duration was sometimes 45 min and even 60 min. Here, auto ionization of water gave a hand to the detergent and wetting agent chemistry for successful outcome. Because of this innovative scope, huge washing cycle could be reduced, peroxide killing, neutralization steps were possible to be eliminated, which confer to the protection of environment in essence, which inspires the validation of the present approach.

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