IDENTIFYING THE VALUES OF WHITENESS INDEX, STRENGTH AND WEIGHT OF COTTON SPANDEX WOVEN FABRIC IN PEROXIDE BLEACHING OF DIFFERENT CONCENTRATION

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Abstract: *The purpose of this research is to identify the values of whiteness index, strength and weight (g/m^2) of cotton spandex woven fabric in hydrogen peroxide (H_2O_2) bleaching of different concentration. Different concentration of H_2O_2 chemical during bleaching exhibits different values of the above stated properties. H_2O_2 in aqueous alkaline medium produced per hydroxyl ion that helped H_2O_2 to undergo homolytic fission to two hydroxyl radicals ($OH^•$), which formed oxycellulose that attacked the cellulose of fibers, yarns or fabrics. Oxycellulose injured the mechanical properties like tear, tensile and weight values of the fabrics containing cellulose. Besides, H_2O_2 with NaOH solution established good bleaching action that improved the optical properties like whiteness values of fabric. The operation was conducted at 100°C to 110°C temperature with the machine speed of 40 meter per minute where the pH was observed from 10.5 to 11.5. Powerful oxidizer like H_2O_2 was used in this research for bleaching the specimen in ˝Benninger Ben Bleach˝ machine at different concentrated H_2O_2 solution like 15%, 25% and 35% with different gram per liter ratio. Whiteness index, weight, tear strength and tensile strength of the specimen were carried out in accordance with the test method mentioned in this paper. This research is practice based, and the outcomes are advantageous to the personnel involved in textile industries, who are in charge of conducting the bleaching operations of cotton spandex woven fabrics and to controlling of their above mechanical and optical properties.*

Keywords: *Concentration, oxidizer, oxycellulose, whiteness index, mechanical properties, optical properties.*

1 INTRODUCTION

There is a great importance of this research in the textile wet processing zone since the task of controlling strength properties of the bleached samples were always challenging. Cotton fabrics were always wounded while bleaching in higher concentrated bleaching solution with the presence of strong alkali. Different scholars worked related to this experiment at different times where literature review exposed different results, some of which were similar and some were widely dissimilar. Due to the range of variables involved, if any parameters were changed while experiment, then another properties of the specimen were also changed.

Haque et al reported that chlorine bleaching is a powerful process with poisonous vapors those may tint on wood floorings and on matting. They proposed to work in a well-ventilated area where air circulation is more. Wearing rubber gloves with an apron is must to conduct these processes of bleaching. Direct contact to skin with bleaching substitute can cause chemical burning [1]. Kalantzi et al recommended to use dilute bleaching substitutes since strong bleaching substitutes can injury cloths and also ruining the next wash cycles. After washing treatment is very important as harmful chemicals substituents are removed by the process of after wash treatment [2]. Benefiel et al also reported that after dyeing is done, it is required to stop the chemical process of the chlorine by rinsing the fabric with clean water. It can be used bleaching stoppers to stop the process of bleaching. It suggested to not use vinegar or ammonia to neutralize bleaching reactions since mixture of these chemicals substituents with bleach can create poisonous gas [3]. Peng et al reported that bleaching substituents work best on cotton, linen, rayon and etc. Bleaching is also done at the blends of cotton with synthetics like polyester or other manmade fibers. Bleaching actions is good at higher temperatures. Less temperature bleaching is much less effective [4].

Yu et al also reported that concentration of different bleaching substituents is used based on the fiber compositor, weight and thickness of the cloths. If the thickness and weight of the cloths are more, higher bleaching substituents are applied [5].

Liu et al also reported that thin fabrics are cold bleach with lesser concentration as higher temperature bleach with higher concentration does severe damage to the cloths [6]. Luo et al also reported that for increasing the optical whiteness effect on the cloths, bleaching is done. For conducting the whitening treatment on cloths heavy bleach is mandatory. The more the bleaching is, the better the whiteness is and vice versa [7]. Xu et al also reported that small amount of bleaching substituents will lead the wool fibers and silk fibers to degrade. These fibers are natural but they are obtained from animals. These fibers are also hampered against bleaching reactions [8].

Halim et al reported that bleaching is the common name of any chemical substituents those are applied technologically and internally to whiten fabrics, to lighten hair color and to eliminate stains. It habitually states, specially, to a weak solution of sodium hypochlorite [9]. Ke et al reported that bleaching agents have wide range of bactericidal possessions, which make them useful to sanitize and disinfect and are applied in the sanitation of stagnant water to control bacterial attack, viruses movement and algae growth in many areas where disinfected conditions are needed [10]. Liu et al reported that bleaching agents are also used in many industrial places, notably in the bleaching of wood pulp and other natural animal fibers. Bleaching substituents also have other negligible applications in removing fungus, killing unwanted plant, and swelling the permanence of cut flowers [11]. Wang et al reported that bleaches work by responding with other dyed natural materials like organic dyes, and revolving them into colorless substituents. Majority of the bleaching agents are oxidizing agents which can eliminate electrons from other particles. Some of the bleaching agents are like reducing agents which can provide electrons in the solution [12]. Hossain et al reported that reducing agents are uses like as in sulphur dioxide for bleaching wool, either as gas or as liquid solutions with sodium dithionite. Bleaching basically acts with many other natural materials as well the proposed dyed pigments, so they may deteriorate or impairment the natural substituents like as fibers, yarns, fabrics, etc., and deliberately applied dyes like as the indigo on denim fabrics. At the same times, digestion of the goods, inhalation of the smokes, or interaction with skin or eyes may reason for health injury [13].

Edwards et al reported that initial procedure of bleaching comprises of spreading fabrics in a bleaching bath to whiten by the accomplishment of the sun and water. In the 15th century, there was a substantial fabric bleaching production unit was in Europe countries specially in the western Europe, by the use of irregular nonacidic baths and acidic baths like lactic acid from sour milk and later diluted sulfuric acid [14]. Eren et al reported that chlorine built bleaching agents those are shortened the process of bleaching from months to hours, were created in Europe in the 16th century [15]. Chattopadhyay et al discovered that sodium hypochlorite bleaching those were the first profitable bleach was available in Paris and they were spread out all through the country later on [16]. Bigambo et al reported that the sterilizing and refreshing capability of hypochlorite bleaching agents were significantly enhanced in medical applications, public health and also in sanitations at school, college, universities and in hospitals [17]. Han et al reported that the first manufactured hydrogen peroxide was in the year of 1816 by responding barium peroxide with nitric acid. Hydrogen peroxide was first applied for bleaching in 1864, but was not commercially vital till the year of 1932 [18]. Zhou et al reported that hydrogen peroxide was used as a washing bleach substituents in Europe as the initial 20th century, was not famous in the North America till the year of 1970 [19].

Altay et al reported that an oxidizing bleaching agent acts by contravention the chemical bonds that break up the chromophore. The changing of the molecule levels into a dissimilar material, which does not comprise any chromophore, or does not comprises a chromophore which does not engross visible light sources are based on chlorine but are of oxygen anions those respond through the early nucleophile attack [20]. Oliveira et al reported that broad spectrum efficiency of most bleach is because of their general chemical reactivity in contradiction of natural organic compounds. The discriminating toxic actions of antibiotics destroy many proteins, which makes them tremendously handy antiseptics. Nevertheless, hypochlorite bleaches of lesser concentration were seen to attack the bacteriological by interfering with heat tremor proteins on their walls [21].

Hareem et al reported that most industrial and household bleaching substituents are belonged to three broad classes like chlorine based bleaches, peroxide-based bleaches and sulphur dioxide based bleaches. Chlorine based bleaches, where energetic chemical constituent is chlorine, typically from the decay of several chlorine substituents such as hypochlorite or chloramine [22]. Hassan et al also reported that in peroxide based bleaching compounds; the active agent is oxygen, practically from the decomposition of a peroxide constituent like hydrogen peroxide [23]. Haque et al reported that sulphur dioxide based bleaching compounds, where active compound is sulphur dioxide, perhaps from the decay of several oxo sulphur anion [24].

Indi et al reported that sodium dithionite is recognized as sodium hydrosulphite that is a significant reductive bleaching compound. Sodium dithionite is a white crystal like powder with a feeble sulphurous scent. It is got by the reaction of sodium bisulphite with zinc [25]. Mojsov et al reported that this is usually used in industrial applications like dyeing, color fixation or other processing operations to remove surplus dye particles, remaining oxide and unintentional pigments. The reaction of sodium dithionite with formaldehyde creates rongalite that is applied in bleaching reactions [26].

Smriti et al conducted a risk assessment program that was completed by the European Union declared that the hypochlorite substances are not safe to the environment and they are daily destroying the ecological balance. Evaporation of hypochlorite is almost instant in the natural water background that reaches in a short time concentration [27]. Mojsov et al reported that the unstable chlorine compounds were pertinent in some indoor setups; which have insignificant influence in exposed environmental circumstances. Supplementary, the role of hypochlorite contamination in environment is expected as negligible in soils. Besides, breathing risk from chlorine and highly poisonous chlorinated spinoffs still exists [28]. Hannan et al reported that the sodium hypochlorite solution like 3% to 4% is characteristically weak for harmless use when sterilizing exteriors and when used as drinking water. A feeble solution like 2% bleach in heated water is distinctive for disinfecting plane surfaces previous to steeping of beer or wine. They conducted hypochlorite bleaching with the mechanism of disinfectant action for achieving good and harmless bleaching consequences [29].

Gedik et al reported that the color safe bleach is a chemical treatment that uses hydrogen peroxide as the active element for the purpose of removing stains from the cloths. They denied using hydrogen peroxide rather they used sodium hypochlorite or chlorine bleach because of smooth and harmless processing operations and consequences [30].

Tavares et al also reported that hydrogen peroxide bleaching has chemical constituents those can help to brighten colors. Whitening treatment can be done on cotton based compounds to get a good and even dyeing effect [31]. Udhayamarthandan et al reported that hydrogen peroxide is also applied for cleansing purposes and water purifications, but its antiseptic possibilities may be imperfect due to the concentration in the color safe bleach solution as associated with other applications [32]. Wang et al reported that the safety of bleaching substituents is dependent on the compounds present in the solution and also on their respective concentration percentages. The higher the concentration of peroxide bleaching solution is, the more the harmful activity is [33]. Kar et al reported that it is most often recommended to dilute the solution so that good bleaching action and even dyeing shade may be possible to obtain [34].

Xia et al also reported that if bleaching substituents are connected to the skin or to the eyes, it can cause severe annoyance problem, desiccating and even burns. Breathing of the bleach fumes can cause serious injuries to the interior parts of the body especially the lungs [35]. Wen et al reported that protective equipment such as hand gloves, masks, helmets and gown should always be used when using bleach substituents and chemical reactions [36]. Zhao et al also reported that bleaching chemicals should not be mixed with vinegar or such products those may contain ammonia. This incident can generate high poisonous chlorine gas which is very dangerous to the human body and mind. Chlorine gas is dangerous and can cause severe burns in the side and on the outside. In rare cases, bleaching substituents can be an addictive substance for definite individuals [37]. Hossain et al reported that sodium hypochlorite along with organic compound can act to produce chlorinated impulsive organic substances. Chlorinated substances are released while clear out function, few of them are poisonous and possible creature carcinogens [13].

Luo et al showed that interior air concentration considerably rise 10 to 50 periods for chloroform and 1 to 1200 times for carbon tetrachloride, correspondingly, over baseline amount in the household while using bleached substances [7]. It was explained that the raise of chlorinated unstable natural complex was low for plain bleach and high for heavy bleach. They also reported that use of such products may drastically raise cancer risk. The application of sodium hypochlorite reacting with natural compound is safer that all other bleaching process. Wang et al also reported that unstable chlorine substances can be applicable in interior setting since it has minor hamper on natural surroundings including air, water and soil. Industrial bleaching is rapidly destroying the situation of water so that plants and fish cannot grow in water. They do not get healthy environment [12].

Madhu et al experimented that the application of chlorine dioxide while bleaching has condensed the toxic compound production. This process may reduce the risk of respiration both for human and animals. Sodium hypochlorite ($NaClO$) named as liquid bleach is used in most of the household activities to clean the cloths. This process is easier to whiten that fabric quickly [38]. Islam et al also reported that the use of $NaClO$ is safer to take care of the water for drinking and also to maintain swimming pond free from all contagious diseases. Chlorinated compound like calcium hypochlorite ($CaClO$), calcium hydroxide ($CaOH$) and calcium chloride ($CaCl$) are available at market; those people are daily using to whitening the cloths. These products are easily available as white powder or as white tablets [39].

Islam et al reported that previously bleaching agents were only used to whiten the fabrics at household. But from 19th century bleaching was industrially started in Western Europe applying alkaline baths and acid baths. The elastic performances of cotton spandex woven fabric were controlled with proper heat setting temperature in stenter machine [40].

Islam et al experimented that optimum strength of the cotton spandex woven fabric was achieved with suitable heat setting temperature. A shrinkage property of cotton spandex woven fabric was controlled with appropriate heat setting temperature [41].

Korlu et al reported that fabrics containing cellulose fibers such as cotton are pretty sensitive to the alkaline or oxidative compounds and these fabrics are mostly destroyed while bleaching process. Metal ions like chromium, iron, manganese, copper, nickel, their oxides and salts affect the fabrics while H_2O_2 bleaching. Catalytic metal decomposition of H_2O_2 damaged the fabrics while bleaching [42].

The present research is conducted on cotton spandex stretched woven fabrics to study the impact of bleaching operation on the mechanical and optical properties of stretched fabrics.

2 EXPERIMENTAL PART

2.1 Materials used

Fabrics of different fiber content with different concentrated H_2O_2 solution were used in this research to do the required experiments. Fabric part and chemical part both are shown in Table 1 and Table 2 separately.

97% cotton and 3% spandex woven fabric was used in this research as mentioned in Table 1. The width and weight of the sample was 53" and 323 g/m^2. The weave of the fabric was 3/1 left hand twill.

In Table 1, for the given construction in serial no. A, 20x(10+70D)/125x58 shows a construction of a cotton spandex woven fabric. Cotton percentage is 97%. Along with this 3% spandex is inserted in weft way to provide elasticity. Here, warp yarn count is 20 Ne which is a non-stretched yarn made up of cotton fibers, but weft yarn count is (10+70D) that means, spandex of 70 denier is used with the core of 10 Ne yarn in weft way to make it stretched. Thread density in ends per inch is 125 and picks per inch is 58. The weight of the fabric is 323 g/m^2 and width is 53".

Table 1 Cotton poly spandex woven fabrics of different composition

S.N	A
Construction	20×(10+70D)/125×58
Composition	97% cotton / 3% spandex
Weave	3/1 left hand twill
Width	53
Weight (g/m^2)	323

Various chemical compounds as mentioned in Table 2 were used in this research while bleaching the specimen. pH medium and ration of the chemicals compounds were also mentioned in Table 2. Trade names along with chemical formula were mentioned in this table.

Table 2 Chemicals and auxiliaries used in this research

S.N	Trade/Chemical name	Chemical formula	Medium	Ratio [g/l]
1	Sodium metasilicate	Na_2SiO_3	Alkaline	5-7
2	Sodium hydroxide	NaOH	Alkaline	5-6
3	Hydrogen peroxide	H_2O_2	Acidic	4-7
4	Wetting agent	$C_{20}H_{37}NaO_7S$	Alkaline	2-3
5	Sequestering agent	$C_{14}H_{23}N_3O_{10}$	Acidic	1-2

2.2 Methods used

Different ASTM and AATCC test methods were used to identify the different parameters of fabrics as stated below.

Whiteness index of the specimen was measured in agreement with the test method AATCC 183. Weight of the specimen was measured in the unit of g/m^2 in accordance with ASTM test method D3776. Tear strength of the specimen was measured in agreement with ASTM test method D2261. Tensile strength of the specimen was measured in accordance with the ASTM test method D5034.

Spectrophotometer was used to measure the whiteness index of the specimen. Strength tester was used to measure the strength of the specimen. GSM cutter and electric balance were used to measure the weight of the specimen.

Testex spectrophotometer TF131 was used in this research for measuring the whiteness index of the specimen. This instrument was invented in China in the year of 2002. Double beam is used to measure the whiteness index of the specimen with an integrated sphere. The specimen is scanned over the section of the spectrum and emitted rays are competently gathered by the detector within the incorporated range. Color difference values and whiteness index can be measured with this instrument.

Tensile strength of the specimen was conducted with Titan 10 Universal Strength Tester of James Heal of UK in accordance with the ASTM D5034 standard. This equipment is computer connected to a data analyzing system software to process and displays the results in the required standard. This machine is equipped with a high quality load cell system that can ensure the maximum accuracy to the limit.

Tearing strength of the specimen was conducted with Titan 10 Universal Strength Tester of James Heal of UK in agreement with ASTM D2261 Standard.

Testex circular sample cutter TF513A/C/D was used to cut the specimen to measure the weight of fabric.

Testex electric balance TF120 was used to measure the weight of the specimen in g/m^2 unit.

Counting glass was used to measure the (EPI) ends per inch and (PPI) pick per inch of the fabric. Herovo counting glass was used in this research to count the EPI and PPI of a fabric.

Fiber composition was tested with TESTEX Fiber Content Analysis Tester TB300 in accordance with AATCC20 standard in an independent laboratory to confirm the composition as mentioned in Table 1.

Projection microscope Projectina DMM 2000 was used to check the length section of the yarn before and after bleaching. The Digital Measuring Microscope DMM-2000 with Macro and Micro optics option has an enhanced technique with outstanding image quality to check the yarn surface. It impresses especially by its modular and compact design and by its very easy handling. This instrument use PIA-7000 software for ımage processing, comparison and measuring in combination with digital cameras.

Benninger bleaching machine Ben Bleach was used in this research. The working width of the machine was 220 cm. It had water tank, boiler, padder, vapor box, etc, for conducting the operations. The entire length of the machine was 32 meter. The speed of the machine was kept 40 meter per minute at 100°C to 110°C with the bath pH of 12 while bleaching the specimen [43].

2.3 Bleaching

Bleaching is a process by which the natural colors of the textile materials are removed to obtain an optimum level of whiteness values. It is an oxidation process by which the natural colors of the fabrics are damaged. With a view to applying the optical brightening agent, optical whitening agent or optical fluorescent agent good bleaching is the prerequisite. For achieving the dull shade bleaching process may not be necessarily required but for achieving brilliant shade bleaching processing is mandatory. Usually, bleaching chemicals generate some adverse influence on the cellulosic part of the cotton fabrics that's why the bleaching process should be continued cautiously. In general, 2% to 3% weight loss is occurred from the cotton fabrics due to the destruction of the cellulosic part of the fabrics. When the cellulosic parts are destroyed, the strength like tear and tensile are also reduced. Due to the attack on the cellulosic part of the cotton fabrics, the fibers, the yarns and the fabrics become weak which have direct influence on the strength properties on fabrics.

Bleaching reaction in different concentrated H_2O_2 solution

For removing the natural color and for increasing the whitening effect of cotton fabric bleaching was done with the chemical mentioned in Table 3. Different concentration like 15, 25 and 35% of H_2O_2 solution were used to bleach the cotton blended fabrics as mentioned in Table 3. Ratio of H_2O_2 was 4.5, 5.5 and 6.5 gram per liter in each concentration. Bleaching treatment was carried out in ″Benninger Ben Bleach″ machine that was a continuous bleaching process for woven fabrics. Temperature of the bleaching was 100°C to 110°C at the machine speed of 40 meter per minute with the pH of 10.8 on the scale of 0 to 14.

Table 3 Concentration and ratio of H_2O_2 in bleaching treatment

S.N	H_2O_2 concentration [%]	Amount of H_2O_2 [g/l]		
1	15	5	6	6.5
2	25	5	6	6.5
3	35	5	6	6.5

H_2O_2 was a stable chemical compound at acidic medium therefore it was required to add alkali for reaction. pH above 10, H_2O_2 was absolutely unstable when it disintegrated by water and oxygen. The free oxygen has no bleaching action and the catalysts were the reason of decline of bleaching power. H_2O_2 released hydrogen ion and per hydroxyl ion in the below way as mentioned in equation 1:

$$H_2O_2 \rightarrow H^+ + HO_2^-$$

H_2O_2 released per hydroxyl ion (HO^2-) in aqueous medium and chemically acted as a feeble dibasic acid. HO^2- ion was extremely unstable in the existence of oxidizable ingredient. It was disintegrated therefore bleaching action happened. NaOH triggered H_2O_2 since H+ ion was counter balanced with alkali that was advantageous for the discharge of O_2. Equation 2 shows the disintegration of per hydroxyl ions (HO^2-):

$$HO^{2-} \rightarrow HO^- + [O]$$

For happening bleaching action, the stabilized H_2O_2 required to be activated with alkalis. In alkaline medium H_2O_2 decomposed as like as the succeeding reaction. Equation 3 shows the decomposition of H_2O_2 solution:

$$H_2O_2 + OH^- \rightarrow OOH^- + H_2O$$

Conversely, at higher pH (exceeding 10.7) the discharge of per hydroxyl (HO^{2-}) ion was so speedy that it became unstable with the creation of oxygen gas which had no bleaching action. If the degree of decomposition was high, the unutilized HO^{2-} injured the fabrics. A harmless pH for the cotton fabric bleaching was between 10.5 - 10.8. Here the rate of evolution of per hydroxyl (HO^{2-}) ion was equal to the rate of the consumption for bleaching. At higher pH, H_2O_2 was not stable and therefore a stabilizer was often added in the bleaching action.

Sodium metasilicate (Na_2SiO_3) was a stabilizer that was used in H_2O_2 bleaching to help stabilization by formation of a complex with per hydroxyl ions

(HO^{2-}) which became free gradually at higher temperature. The silicate provided buffering action and its solution was colloidal in nature.

The presence of alkalis in H_2O_2 solution formed perhydroxyl ion. The presence of UV light helped H_2O_2 to undergo homolytic fission to two hydroxyl radicals ($OH^{\bullet}$). The metal actions had a catalytic consequence on the decomposition of H_2O_2. The decomposition rate was higher, it formed oxycellulose and attacked the cellulose. The produced oxycellulose hampered the strength and other mechanical properties of fibers or fabrics containing cellulose because of severe localized action. For reducing harmful effect of metal action, sequestering agent like di-ethylene tri-amine penta acetic acid was used in the research that was shown in Figure 1.

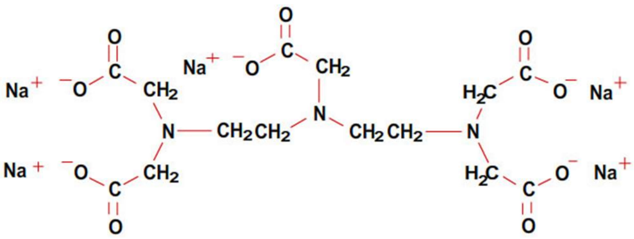

Figure 1 Di-ethylene tri-amine penta acetic acid (DTPA)

Di-ethylene tri-amine penta acetic acid stops the metal ions from catalytically disintegrating peroxide solutions by chelating them. This complex shaped a 3D structure as shown in Figure 2, which comprises of water of salvation molecules and this was composed by sequestering agent molecules.

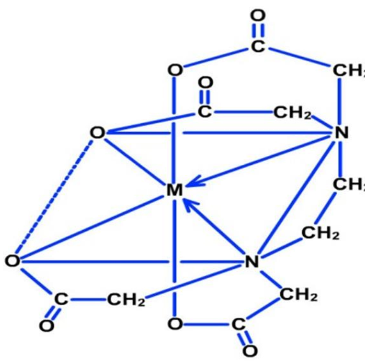

Figure 2 3D representation of Di-ethylene tri-amine penta acetic acid metal complex

Experiment for whiteness index, strength and weight of the samples were carried out after getting the bleached fabric in accordance with the standard provided by ASTM and AATCC standard.

2.4 Whiteness index test

Whiteness index of the bleached samples were measured by the Testex spectrophotometer TF131 in agreement with the test method provided by AATCC 183. Sample of size 4×4 cm was cut and prepared for the measurement of whiteness index. This instrument ejected double beam to measure the whiteness index of the specimen. Light rays are expelled through the samples and spectrums reading are collected by the sensor within the integrated assortment. Whiteness index of the samples were measured with the facilities of this instrument after bleaching the samples as mentioned in Table 3 and results were shown in Figure 3.

2.5 Tear strength test

Tearing strength of the bleached sample was measured by the Titan 10 Universal Strength Tester in agreement with the standard provided by ASTM D2261 test method. Sample size like 75×200 mm was cut from the bleached fabrics and placed in the Titan 10 Universal Strength Tester to measure the tear strength of the fabrics in both warp and weft way. Tear strength was measured for the treated fabrics with different concentrated H_2O_2 solution of different amount and shown the consequences in Figures 4 and 5.

2.6 Tensile strength test

Tensile strength of the bleached sample was measured by the Titan 10 Universal Strength Tester in agreement with the standard provided by ASTM D5034 Standard. Sample of size 100×150 mm in both warp and weft way were cut and placed in Titan 10 Universal Strength Tester to measure the tensile strength of the fabric from each type. Tensile strength was measured for the treated fabrics with different concentrated H_2O_2 solution of different amount and shown the consequences in Figures 6 and 7.

2.7 Weight test

Circular sample cutter Testex TF513A/C/D was used to cut the fabric and Testex Electric Balance TF120 was used to measure the weight of the samples in g/m^2 unit in accordance with ASTM test method D3776. Fabric should be conditioned in room temperature for 4 hours before taking the weight. Weight values can be taken by cutting 10×10 cm square area of the fabrics or 11.28 cm round cutting by the circular sample cutter. Weight was measured for the treated fabrics with different concentrated H_2O_2 solution of different amount and shown in Figure 8.

2.8 *Microscopic test*

Bleached fabrics were collected and yarns were unplugged from fabric to place in Projection Microscope Projectina DMM 2000 with glycerine for assessment. Yarns of before bleaching and after bleaching was taken from fabric and microscopic evaluation were taken to assess the performance as shown in Figures 9 and 10.

3 RESULTS AND DISCUSSION

3.1 Results of whiteness index

Bleached samples were placed in the spectro-photometer instrument and light beams were ejected through the samples to get the desired whiteness index values. In acidic medium H_2O_2 was stable, therefore few bleaching action occurred. But in strong alkaline medium with the presence of NaOH solution, good bleaching action occurred that had a direct impact on the whiteness values of fabric. Result of whiteness index are shown in the Figure 3. It was seen that lower whiteness values were obtained for the fabrics of lower concentrated hydrogen peroxide solution and vice versa. It was also seen that lower whiteness values were obtained for the fabrics of lower amount of hydrogen peroxide solution and vice versa.

3.2 Results of tear strength

Bleached samples were placed in the Titan 10 Universal Strength Tester to get the desired tear strength values. Presence of NaOH in H_2O_2 solution creates per hydroxyl ion that helped H_2O_2 to undergo homolytic fission to two hydroxyl radicals ($OH^{\bullet}$), which formed oxycellulose and it attacked the cellulose of fibers, yarns or fabrics. Oxycellulose injured the strength properties of fabrics containing cellulose. Result of warp tear strength and weft tear strength was shown in the Figures 4 and 5. It was seen that higher strength values were obtained for the fabrics of lower concentrated hydrogen peroxide solution and vice versa. It was also seen that lower strength values were obtained for the fabrics of higher amount of hydrogen peroxide solution and vice versa.

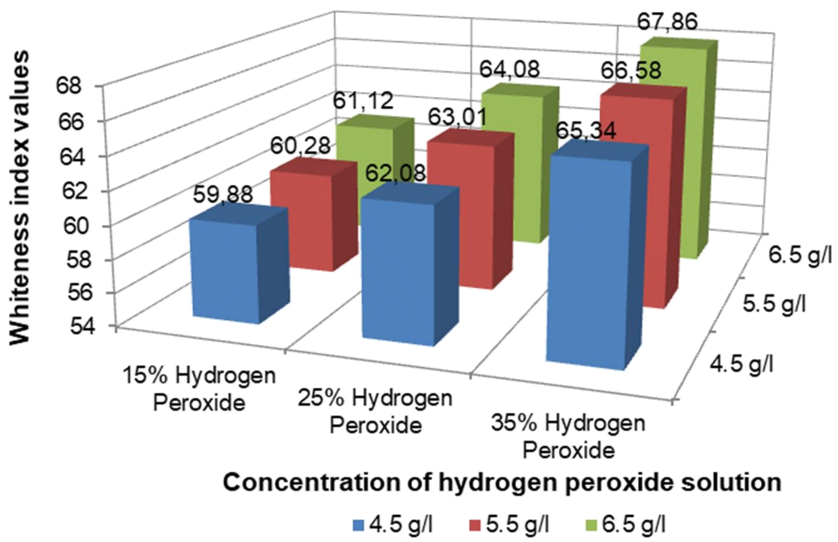

Figure 3 Whiteness index values of different concentrated hydrogen peroxide solution of different amount

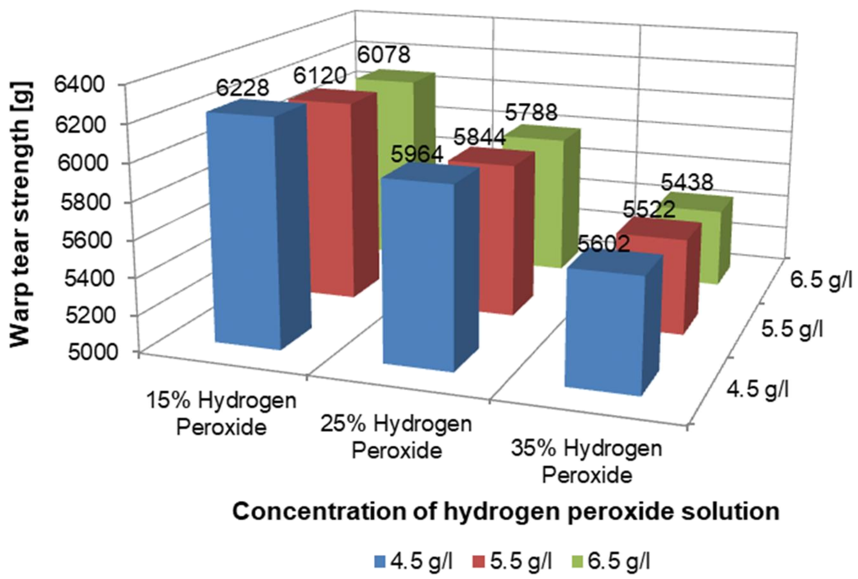

Figure 4 Warp tear strength of different concentrated hydrogen peroxide solution of different amount

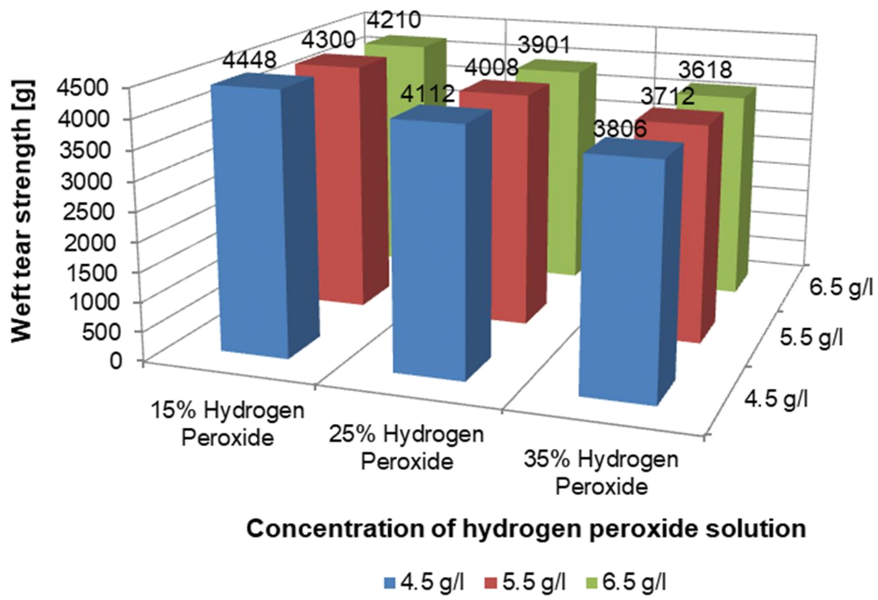

Figure 5 Weft tear strength of different concentrated hydrogen peroxide solution of different amount

3.3 Results of tensile strength

Bleached samples were placed in the Titan 10 Universal Strength Tester to get the desired tensile strength values. As from the previous experimentation it was clear that bleaching action produces oxycellulose that injured the cellulose of fabrics and reduced the tensile strength. Result of warp tensile strength and weft tensile strength was shown in the Figures 6 and 7. It was seen that higher strength values were obtained for the fabrics of lower concentrated hydrogen peroxide solution and vice versa. It was also seen that lower strength values were obtained for the fabrics of higher amount of hydrogen peroxide solution and vice versa.

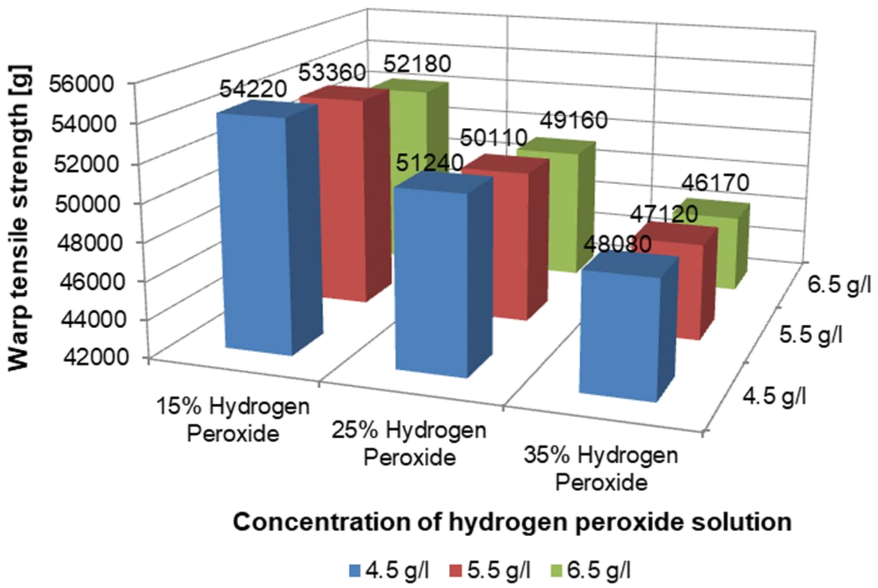

Figure 6 Warp tensile strength of different concentrated hydrogen peroxide solution of different amount

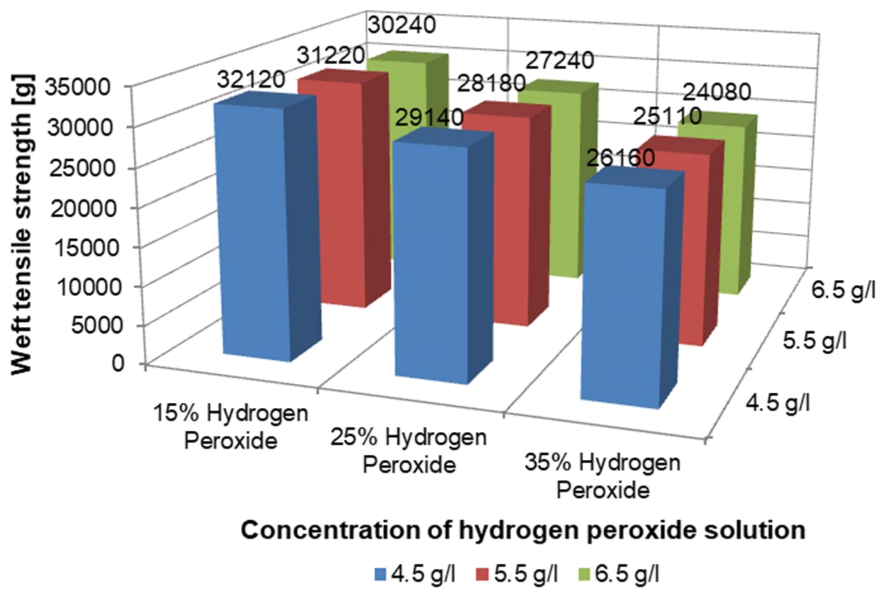

Figure 7 Weft tensile strength of different concentrated hydrogen peroxide solution of different amount

3.4 Results of weight

Bleached samples were conditioned and prepared for getting the weight values. While bleaching the cellulose of fabrics were injured and it helped to lose some fibers from yarns, which reduced the weight of the fabrics. Weight values were shown in the Figure 8. It was seen that higher weight values were obtained for the fabrics of lower concentrated hydrogen peroxide solution and vice versa. It was also seen that lower weight values were obtained for the fabrics of higher amount of hydrogen peroxide solution and vice versa.

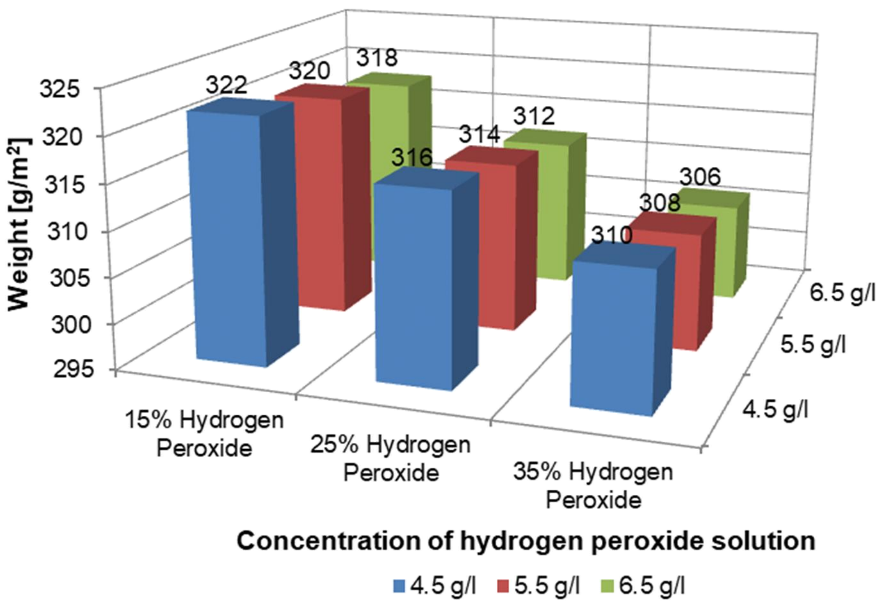

Figure 8 Sample weight of different concentrated hydrogen peroxide solution of different amount

3.5 *Microscopic observation*

Before bleaching the yarns have more hairiness, but after bleaching the yarns have less hairiness. H_2O_2 bleaching made the fiber loss of the yarns, which had direct consequences with the strength and weight loss of the yarns. More concentrated H_2O_2 solution removed more fibers from yarns, hence the strength loss and weight loss was more. Figure 9 shows the yarn of before bleaching and Figure 10 shows the yarn of after bleaching.

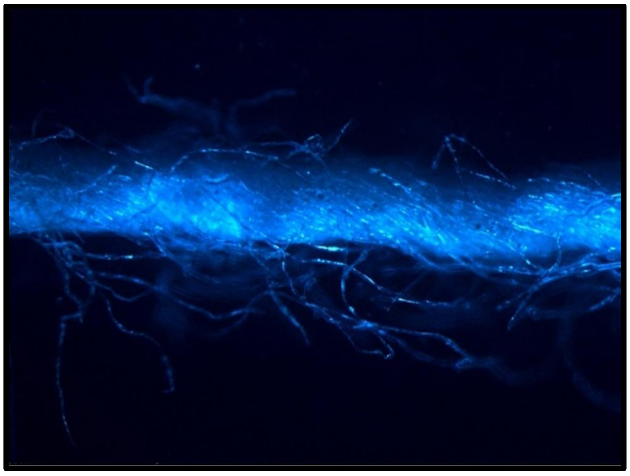

Figure 9 Microscopic view of a yarn of before bleaching

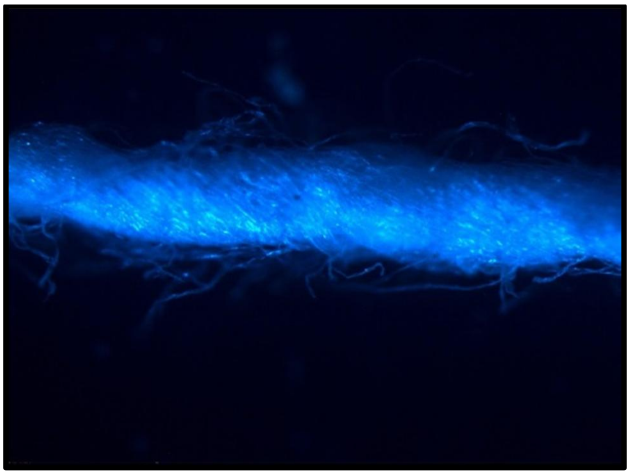

Figure 10 Microscopic view of a yarn of after bleaching

4 CONCLUSION

It was seen throughout the research that bleaching with higher concentrated H_2O_2 gave higher values for whiteness index, lower values of weight, tear and tensile strength of fabrics. Bleaching operation wounded the mechanical and optical properties of fabrics. Higher concentrated H_2O_2 damaged more cellulosic fibers of the fabric as a result less values of strength was achieved. Besides, more cotton fibers were lost while bleaching with higher concentrated H_2O_2 therefore, less values of weight was obtained. Different concentrated H_2O_2 with different volume exhibited different values of pH of the bath. Bleaching played a vital role in the textile wet processing zone to control the important physical properties of the fabrics. So, expertise knowledge of processing operation is essential to be successful at every batch by batch operation in industries. This research is beneficial to the personnel involved in textile industries who are responsible for bleaching operations of woven fabrics and it exposed potential ways for the scholars to further study in this field.

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