Effect of Dyeing Parameters on Color Strength of Viscose Rayon and Polyester Blended Fabric

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Abstract **- Color strength is dominating fact which determine the quality of dyed fabrics and it depends on different dyeing parameters like as temperature, salt, alkali, dye %. Effect of dyeing process parameters on color strength of rayon polyester blended fabric was studied in this research. By varying temperature, pH, dispersing agent, salt and soda the color strength of dyed fabric were investigated. Solid dyeing effect was developed by dyeing both part of blended fabric. Dyeing of polyester part was recommended with temperature 130°C depending on color strength value. Highest color strength value was observed for dyeing with reactive dyes at temperature 70-80°C using salt 60-80 g/l and soda 15-25 g/l. Different types of soda and alkali were used for dyeing of rayon part and measure their effect on color strength.**

Keywords **- Color strength, dyeing, viscose rayon, polyester, blendingand dyeing parameter.**

I. INTRODUCTION

Basically colorant is such type of material that can be applied on a substrate for coloring purpose. But all colorant are not considered as dye. To be a dye the colorant material should be soluble in an application medium such as water. From water, precipitation of dye inside the fibre is called coloration or dyeing [1]. Different types of dye are using in dyeing industry. Among them reactive and disperse dye are most common. Reactive dyes are commonly used for dyeing of cotton, wool, and nylon due to brilliancy, hue variety, high wet fastness, easy to use and easy process of application [2,3]. Polyester, nylon, polytrimethylene terephthalate (PTT), acrylic fabrics are commonly dyed with disperse dye due to good chemical bonding and color fastness properties [4,5].

Combining two or more different type of fiber together is termed as blending and it is done to attain a unique properties to the blended fiber. Now a days different types of fiber are available. Each and every fiber has particular properties and apply in specific area. Normally to attain required properties in the fiber blending is done. The use of blended fiber increased dramatically even in Bangladesh.

Viscose Rayon and Polyester are an ideal combination for blending. Viscose Rayon is one of the oldest commercial man-made fiber [6].The properties of viscose fiber is more similar to cellulosic natural fiber like as linen, cotton than synthetic fiber like as nylon or polyester [7]. The viscose solution of cellulose xanthate is generally used to spin viscose rayon fiber [8].Commonly viscose rayon fiber dyed with reactive dye [9].

Polyester fabrics are prominently used in the textile sector due to low cost and excellent physical and chemical properties [10]. Polyester fibers are hydrophobic in nature and highly compact and it is dyed with disperse dye at high temperature, as well as at high pressure [11].Maintain the accurate dyeing parameters are not only important but also very difficult. The parameters are segmented as internal and external factors like as pH value, concentration of dye, temperature, salt concentration, material to liquor ratio, time. The quality of final products depends on these parameters. When viscose rayon and polyester blended fabric dyed with the combination of reactive and disperse dye, the color strength prominently depend on concentration of dye, salt and alkali [12]. This color strength is the basic requirements of consumer. Due to inaccurate color strength value the order is commonly cancelled.

Many researchers conducted research on color strength [13-15]. In case of cotton-elastane (CE) and lyocell-elastane (LE) fabrics dyeing LE showed higher color strength than CE as well as LE influenced more than CE with respect to temperature [16]. An investigation was carried out with bamboo/cotton, viscose/cotton and modal/cotton. The bamboo/cotton fabrics showed the highest color strength value and modal/cotton showed the lowest color strength value [17]. Experiment was also carried out withTaguchi method for determining the standard value of color strength and proposed that with the setting of dye concentration 9%, temperature 75 °C, salt concentration 50 g/l, alkali concentration14 g/l, time 60 min and liquor ratio 1:8 showed the better result [18].50% polyester and 50% cotton (PES/CO) was treated with chitosan and poly (diallyldimethylammonium) chloride (PDDACl) and showed the best result of color strength [19].An investigation was also conducted for wool/nylon blend fabric dyeing with natural dye extracted from camphor tree (*Eucalyptus Citriodora*)by using different mordant and found the color strength value from 2.5 to 12 by varying different dyeing parameters [20].

II. MATERIALS AND METHOD

A. Sample Preparation

Fabric was cut into small pieces and measured. Exactly 10 gram (±5%) was taken for dyeing in laboratory dyeing machine (LABORTEX Sample Dyeing machine).

B. Scouring and Bleaching

As the fabric was derived from polyester-rayonblended yarn where polyester was synthetic and rayon was re-generated man-made fiber, so scouring was not necessary but mild scouring was done for yellowish appeared from heat setting. The process was carried out at 85°C for 40 minutes. The material to liquor ratio was 1:8. The recipe was used stated below:

TABLE I

MILD SCOURINGAND BLEACHINGRECIPE

Ingredient	Quantity
Detergent	0.60 g/l
Anticreasing agent	2.00 g/l
Sequestering agent	0.35 g/l
Stabilizer	0.20 g/l
H_2O_2	1.60 g/l
Soda ash	2.00 g/l

C. Auxiliaries and Dyes

For polyester part dyeing required auxiliaries and dyes are dispersing agent 1 g/l, acid buffer 1.5 g/l, disperse dyes (Megaperse Yellow 6GHXF 0.48%, Megaperse Navy NNA 0.53%, Megaperse Turquise Biue HXF 0.53%). Material to liquor ratio 1:10.

For rayon part dyeing required auxiliaries are salt 70 g/l, soda ash 20 g/l and dyes (Dchufix Yellow 3RXF 1.48%, Dychufix Navy Blue FBXN 1.86%, Rema Turquise Blue G 1.96%).

D. Dyeing of Polyester Part with Temperature Variation

Polyester part was first dyed at different temperature. Same shade % was maintained, pH 5, dispersing agent 1 g/l, acid buffer 1.5 g/l.The dyeing time was 50 minutes and the temperature was 50, 60, 70, 80, 90, 100, 110, 120, 130, 140°C. Then rayon part was dyed by keeping all parameter same.

E. Dyeing of Polyester Part with pH Variation

First polyester part was dyed with different pH keeping same shade % and using temperature 130°C, dispersing agent 1 g/l for 50 minutes. The pH was 3, 5, 7, 9, 11and 13. After that the rayon part was dyed with same parameter.

F. Dyeing of Polyester Part with Dispersing Agent Variation

Polyester part was dyed with same shade % by varying dispersing agent at 130°C, pH 5 for 50 minutes. Dyeing was done with dispersing agent amount of 0.00 g/l, 0.30 g/l, 0.60 g/l, 0.9 g/l, 1.20 g/l, 1.50 g/l, 1.80 g/l and 2.10 g/l. After that rayon part was dyed with same parameter.

G. Dyeing of Rayon Part with Temperature Variation

Polyester part was dyed first by keeping all parameter same. Then Rayon part was dyed with different temperature keeping same shade % and using salt 70 g/l, soda ash 20 g/l for 60 minutes. Dyeing was carried out at temperature 30, 40, 50, 60, 70, 80, 90, 100, 110, 120°C.

H. Dyeing of Rayon Part with Amount of Salt Variation

Polyester part was first dyed by keeping all parameter same. Then Rayon part was dyed with different amount of salt keeping same shade % and using soda ash 20 g/l for 60 minutes at temperature 80°C. Dyeing was carried out with salt 10, 20, 30, 40, 50, 60, 70, 80, 90, 100 g/l.

I. Dyeing of Rayon Part with Amount of Soda Variation

Polyester part was first dyed by keeping all parameter same. Then rayon part was dyed with different amount of soda ash keeping same shade % and using glaubar salt 70 g/l for 60 minutes at temperature 80°C. Dyeing was carried out with soda ash 5, 10, 15, 20, 25, 30, 35, 40 g/l.

J. Dyeing of Rayon Part with Different Types of Salt

Polyester part was first dyed by keeping all parameter same. Then rayon part was dyed with different amount of salt keeping same shade % and using 70 g/l, soda ash 20 g/l for 60 minutes at temperature 80°C. Dyeing was carried out with Ammonium Sulphate, Calcium Chloride, Calcium Sulphate, Magnesium Sulphate, Potassium Chloride, Potassium Sulphate, Sodium Chloride and Sodium Sulphate.

K. Dyeing of Rayon Part with Different Types of Alkali

Polyester part was first dyed by keeping all parameter same. Then rayon part was dyed with different amount of salt keeping same shade % and using salt 70 g/l and alkali 20 g/l for 60 minutes at temperature 80°C. Dyeing was carried out with Calcium Carbonate, Calcium Hydroxide, Magnesium Carbonate, Potassium Carbonate, Potassium Hydroxide, Sodium Carbonate, Sodium Hydroxide and Sodium Bi-Carbonate.

L. Color Strength Measurement

Data-color Spectroflash SF 650X machine was used for measurement of color strength of dyed fabric with setting of illuminant D65, large area view (LUV), specular included and CIE 1964 supple-mental standard observer (10° observer).

III. RESULTS AND DISCUSSION

A. *Effect of Temperature Variation*

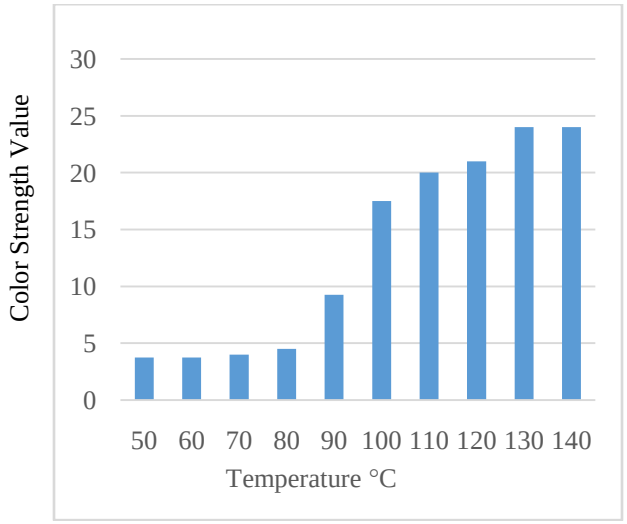

Fig. 1 Effect of temperature variation on color strength

The above graph showed the color strength value at different temperature. For 6.80% dye concentration with same auxiliaries but varying the temperature from 50-140°C the color strength obtained from 3.75 to 24. Higher value obtained at temperature 130-140°C. This one is suitable temperature perspective to color strength.

B. *Effect of pH Variation*

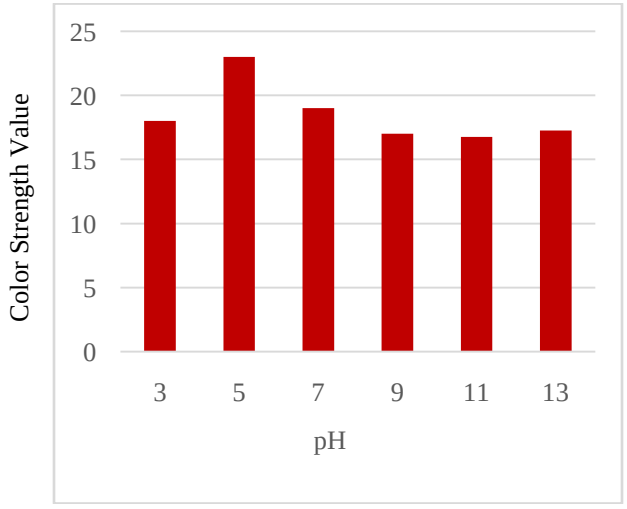

Fig. 2 Effect of pH variation on color strength

The graph showed the color strength value at different pH level at dye bath. The dye percentage was 6.80%. The maximum color strength 23 was showed at pH level 5 as well as minimum color strength 17 was showed at pH level 9. The pH level 5 is better for obtaining higher value of color strength.

C. *Effect of Dispersing Agent Variation*

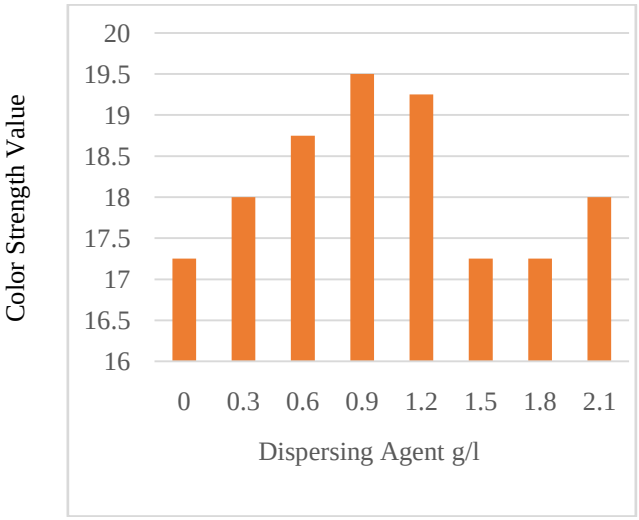

Fig. 3 Effect of dispersing agent variation on color strength

The above graph showed the color strength value at different amount of dispersing agent at dyeing medium. Atdye percentage was 6.80% and dispersing agent 0.90 g/l showed higher color strength value 19.50. So 19.50 g/l is the best dispersing agent amount for obtaining higher value of color strength.

D. *Effect of Salt Amount Variation*

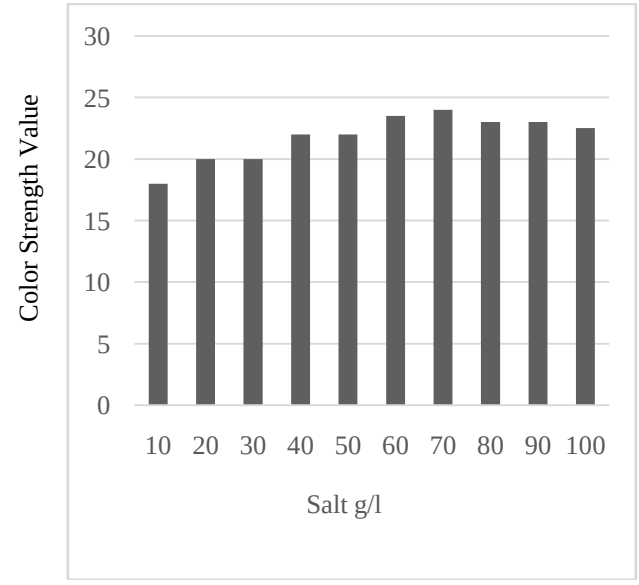

Fig. 4 Effect of salt amount variation on color strength

The above graph showed the color strength value at different amount of salt at dyeing medium. For 6.80% dye concentration higher value of color strength 24 was found for 70 g/l salt dosing. Then color strength 23.5 at 60 g/l dosing. So, it be said that 60-70 g/l is suitable for obtaining higher value of color strength.

E. Effect of Soda Amount variation

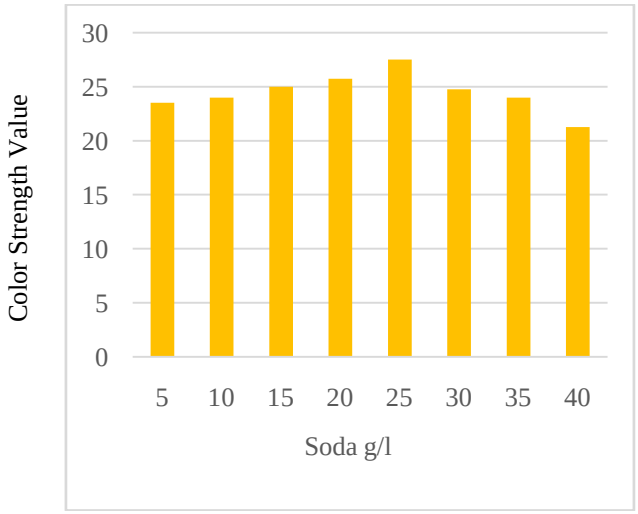

Fig. 5 Effect of soda amount variation on color strength

The above graph showed the color strength value at different soda dosing level. For 6.80% dye concentration highest value was found 27.5 at 25 g/l dosing and 25 was obtained at 15 g/l. Lower value 21.15 was found at 40 g/l dosing.

F. Effect of Different Types of Salt

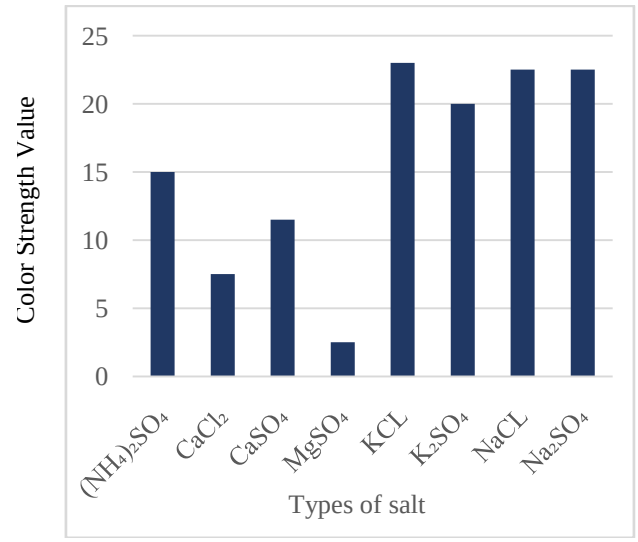

Fig. 6 Effect of different types of salt on color strength

The above graph showed the color strength value for different types of salt used during rayon dyeing. At 6.80% dye concentration highest value of color strength 22.5 was obtained for NaCl, Na_2SO_4 and lowest value 2.5 was obtained for $MgSO_4$. It is suggested to use NaCl or $Na_2SO_4$for obtaining higher value of color strength.

G. Effect of Different Types of Alkali

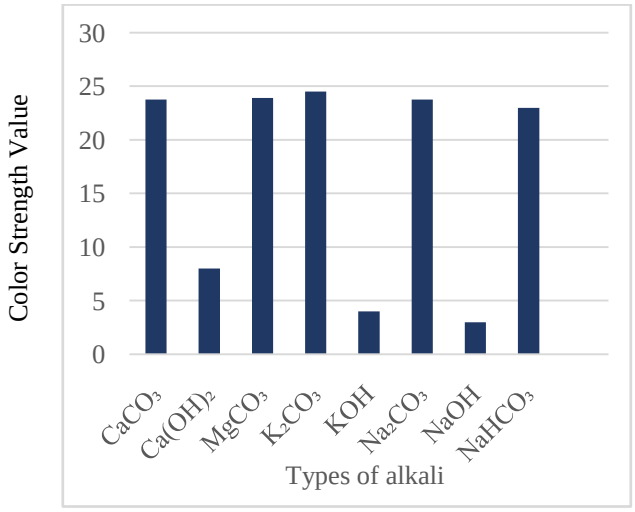

Fig. 7 Effect of different types of alkali on color strength

The above graph showed the color strength value for dyeing of rayon part of fabric by using different types of alkali. At 6.80% dye concentration highest value of color strength 24.5 was obtained for K_2CO_3 and above 23.5 for $CaCO_3$, $MgCO_3$,Na_2CO_3 and $NaHCO_3$ as well a slowest value 3 was obtained for $NaHCO_3$.

IV. CONCLUSIONS

In this study, the proper dyeing parameters has been developed for dyeing of viscose rayon and polyester blended fabric to maintain higher color strength. The dyeing parameters refers to temperature, pH, dispersing agent, salt, soda and alkali. From the above study it is suggested to maintain dyeing temperature 130-140°C, pH value 5, dispersing agent amount 0.90 g/l, salt amount 70 g/l, soda amount 25g/l, NaCl or Na_2SO_4 salt are very helpful to obtain higher value of color strength.

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