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Available online at: www.jrrset.com

ISSN (Print) : 2347-6729
ISSN (Online) : 2348-3105

JIR IF : 2.54
SJIF IF : 4.334
Cosmos: 5.395

Volume 9, Issue 7 - July 2021 - Pages 72-86

Effect of Pretreatment on Fastness Properties of Direct Dyed Goods

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ABSTRACT

Direct dyes are water soluble dye and direct dyes have direct affinity to cellulosic materials and also termed as substantive dyes .one of the popular because dye cost is less and easy method of application .To improve its fastness properties of direct dyed goods to overcome these drawback the direct dyed goods are undergone after treating with metallic salt and formaldehyde ,in our pretreatment study instead of after treatment of the goods to be dyed with direct dyed is pretreated with potassium aluminum sulphate to improve fastness property. In this project an effort is made on pretreatment of direct dyes on cotton fabric with the help of potassium aluminum sulphate to improve the fastness property. As on now potash alum act as pretreatment of a binder on pigment dyes to improve its binding property of this experiment here conducting the pretreatment of alum before applying direct dyes on fabric a pretreatment is given to the fabric to improve its binding property and mark its fastness property . It was found that direct dyes exhibit poor fastness property. Here we compare the fabric of pretreatment before applying direct dyes and direct dye without pretreatment and compare these fastness properties

INTRODUCTION

Cotton is a soft, fluffy staple fiber that grows in a ball, or protective case, around the seeds of the cotton plants of the genus Gossypium in the mallow family Malvaceae. The fiber is almost pure cellulose. Under natural conditions, the cotton bolls will increase the dispersal of the seeds.

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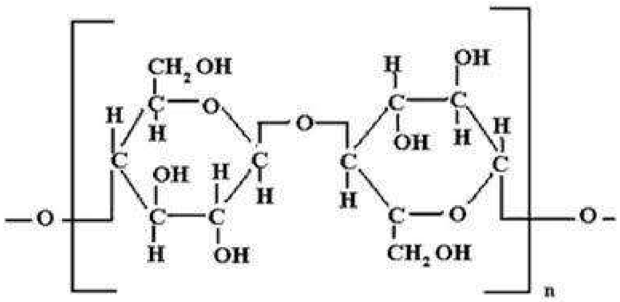
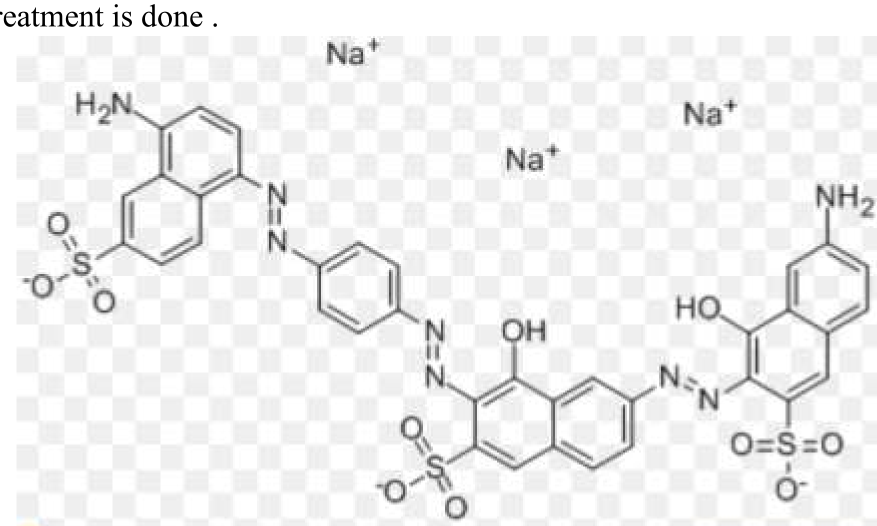


Manually decontaminating cotton before processing at an Indian spinning mill.
The plant is a shrub native to tropical and subtropical regions around the world, including the Americas, Africa, Egypt and India. The greatest diversity of wild cotton species is found in Mexico, followed by Australia and Africa. Cotton was independently domesticated in the Old and New Worlds.

The fiber is most often spun into yarn or thread and used to make a soft, breathable textile. The use of cotton for fabric is known to date to prehistoric times fragments of cotton fabric dated to the fifth millennium BC have been found in the Indus Valley Civilization, as well as fabric remnants dated back to 6000 BC in Peru. Although cultivated since antiquity, it was the invention of the cotton gin that lowered the cost of production that led to its widespread use, and it is the most widely used natural fiber cloth in clothing today.
India is the world's largest producer of cotton. The United States has been the largest exporter.

DIRECT DYES

Direct dyes are sodium salt of sulphonic acid and most of them contain an AZO group as the main chromo pore. Direct dye dyeing is carried out alkaline condition .This dyeing process is done comparatively in low temperature after observing dyes it tends to bleeding of dyes which produce unevenness of shade ,to resist these different types of after treatment is done .



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Direct dyes are anionic dyes substantive to cellulosic fibers when applied from a aqueous bath containing electrolyte .many of them also dye protein fibers direct dyes are very easy to apply and available in the market

*Direct dyes are water soluble dyes

*It is anionic in nature

*It needs electrolyte for exhaust

*Dyeing process is carried out in alkaline condition .

* Generally applied for cellulosic as well as protein fibres .

* Fastness properties are average specially wet fastness .

* Fastness properties are improved by after treatment.

*It is not widely used as compared with reactive dyes

*Comparatively cheap in price .

* Direct dyes are used for cheap goods for local market

It is not suitable to dye cellulosic fibre with direct dyes for this reason most of the cases reactive dyes , basic dyes and azoic colour is used ,the use of direct dyes is very limited.

POTASSIUM ALUMINUM SULPHATE

Aluminum-based alums have a number of common chemical properties. They are soluble in water, have a sweetish taste, react acid to litmus, and crystallize in regular octahedral. In alums each metal ion is surrounded by six water molecules. When heated, they liquefy, and if the heating is continued, the water of crystallization is driven off, the salt froths and swells, and at last an amorphous powder remains. They are astringent and acidic.

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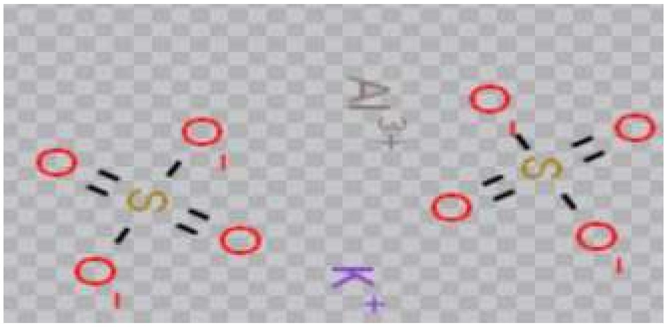

Aluminum-based alums have been used since antiquity, and are still important in many industrial processes. The most widely used alum is potassium alum. It has been used since antiquity as a flocculent to clarify turbid liquids, as a mordant in dyeing, and in tanning. It is still widely used in the treatment of water, in medicine, for cosmetics (in deodorant), in food preparation (in baking powder and pickling), and to fire-proof paper and cloth.

Alum is also used as a styptic, in styptic pencils available from pharmacists, or as an alum block, available from barber shops and gentlemen's outfitters, to stem bleeding from shaving nicks and as an astringent. An alum block can be used directly as a perfume-free deodorant (antiperspirant), and unprocessed mineral alum is sold in Indian bazaars for just that purpose. Throughout Island Southeast Asia, potassium alum is most widely known as tawas and has numerous uses. It is used as a traditional antiperspirant and deodorant, and in traditional medicine for open wounds and sores. The crystals are usually ground into a fine powder before using.

Alum is used as a mordant in traditional textiles and in Indonesia and the Philippines, solutions of tawas, salt, borax, and organic pigments were used to change the color of gold ornaments. In the Philippines, alum crystals were also burned and allowed to drip into a basin of water by babaylan (shamans) for divination. It is also used in other rituals in the animistic anito religions of the islands.

In traditional Japanese art, alum and animal glue were dissolved in water, forming a liquid known as dousa, and used as an undercoat for paper sizing.

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FASTNESS PROPERTIES

Term used in the dyeing of textile materials that characterizes a material's colour's resistance to fading or running. Colour fastness is the property of dyes and it is directly proportional to the binding force between photo chromic dye and the fiber.

1 light fastness

2 colour fastness

3 rubbing

1.4.1 LIGHT FASTNESS

Light fastness is a property of a colourant such as dye or pigment that describes how resistant to fading it is when exposed to light. Dyes and pigments are used for example for dyeing of fabrics, plastics or other materials and manufacturing paints or printing inks.

Light encountering a painted surface can either alter or break the chemical bonds of the pigment, causing the colors to bleach or change in a process known as photo degradation. Materials that resist this effect are said to be lightfast. The electromagnetic spectrum of the sun contains wavelengths from gamma waves to radio waves. The high energy of ultraviolet radiation in particular accelerates the fading of the dye.

Light fastness is measured by exposing a sample to a light source for a predefined period of time and then comparing it to an unexposed sample Light fastness, wash fastness, and rub fastness are the main forms of colour fastness that are standardized. The light fastness of textile dye is categorized from one to eight and the wash fastness from one to five, with a higher the number indicating better fastness Clay earth pigments such as burnt sienna often have a high lightfastness

COLOUR FASTNESS

Colorfastness property is one of the most important properties of them. It is a property of a colorant which allows it to retain its different characteristics despite degradation conditions such as exposure to light and dry cleaning.

Colour fastness is a term used in the dyeing of textile materials that characterizes a material's colour’s resistance to fading or running. Colour fastness is the property of dyes and it is directly proportional to the binding force between photo chromic dye and the fiber. The colour fastness may also be affected by processing techniques and choice of chemicals and axillaries.

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Colour is an influential element of fashion and aesthetics of clothing, it has great value for both the user and the brand. Colour is one of the most significant features in attracting customers and inclines to buy a product/garment. Retaining the original colour is one of the important quality parameter of coloured textiles. Colour fastness is rated poor if it does not comply with the tests by exposing to laundry, light, rubbing and other agencies such as perspiration.

Fading, change in colour, staining to adjacent textiles material were common complaint of poor textile quality materials. Standardized testing for colour fastness and other parameters were established in 20th century by leading industrialized countries such as US, UK, Europe and Japan. AATCC, International Organization for Standardization and Society of Dyers and Colorists played vital role in establishing the test methods.

RUBBING FASTNESS

Rubbing color fastness refers to the ability to sustain original color of dyed fabrics when rubbing. Dry rubbing color fastness refers to the situation of fading and staining of dyed fabric when rubbed with a standard white cloth. Wet rubbing color fastness refers to the situation of fading and staining of dyed fabric when rubbed with a standard white cloth which water content is 95% to 105%. The evaluation of Rubbing color fastness depends on the degree of staining of white cloth. After testing, the white cloth is compared to staining sample cards to measure staining fastness. Rubbing color fastness, same as washing color fastness, divide into 5 grades and 9 files, among which grade 5 is the best and grade 1 is the worst. The friction fading of fabric is to make dye fall off caused by friction. Wet rubbing is influenced by both external force and water, so it is about one level lower than dry rubbing.

Rubbing color fastness refers to the ability to sustain original color of dyed fabrics when rubbing. Dry rubbing color fastness refers to the situation of fading and staining of dyed fabric when rubbed with a standard white cloth.

Objectives of the Study

- To study the behavior of direct dyeing cotton pretreated with potassium aluminum sulphate

- To study the effect of cat ion as agent on wash fastness, light fastness , and rubbing fastness of direct dyed

- To investigate the interference of cationic agent on dye fibre covalent bond formation

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• Pretreatment of cotton fabric by using potassium aluminum sulphate and dyed with direct dye on cotton fabric

• Without pretreatment, the control sample is dyed with dye

• Comparative study of pretreated fabric and controlled sample on its fastness property

MATERIALS AND METHODOLOGY

100% cotton' fabric is a natural product only consisting of cellulosic fibers. It is biodegradable and can withstand as many hot washes in its lifetime as it needs to. Cotton is the most popular fabric used to make home furnishings, and for a good reason.

world Cotton fabric is one of the most commonly used types of fabrics in the. This textile is chemically organic, which means that it does not contain any synthetic compounds. Cotton fabric is derived from the fibers surrounding the seeds of cotton plants, which emerge in a round, fluffy formation once the seeds are mature.

For instance, most T-shirts contain at least some amount of cotton, and true blue jeans are 100 percent cotton. This fabric is used to make bathrobes, bathmats, and towels, and it is also used to make bed sheets, blankets, and duvets. Manufacturers may even use cotton to make curtains, wall-hangings, and other types of home decorations.

Since cotton is highly breathable and absorbent, it is commonly used to make warm-weather clothing. Its softness makes it a good option for formal and business wear, and its notable draping abilities make it an ideal fabric for dresses.

Manufacturers use cotton to make medical supplies, and this fabric is also used to make industrial thread and tarps. In summation, cotton can be used to make practically any type

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of textile for consumer or industrial use. Cotton production is inherently non-impactful on the environment. Since this type of textile is a natural fiber, it is biodegradable, and it doesn't fill up waterways or contribute to other forms of pollution

Specimen parameter :

1 100% Pure cotton – Bleached and mercerized
2 EPI - 200
3 PPI-150
4 Warp & weft – 100% cotton
5 Weave – Plain weave
6 Count – 120s count

Testing Methodology:

FABRIC PROCUREMENT
↓
PRETREATMENT
↓
DYEING
↓
TESTING

COLOR FASTNESS TO CROCKING TEST (WET AND DRY RUBBING)

"Crocking" is an industrial term referring to a transfer of a colorant through rubbing. The crocking test determines the resistance of textile colors to rubbing off and staining other materials. A fabric with poor color fastness could rub colorants off on consumers, furniture, other textiles or miscellaneous items.
ISO 105 X12 and AATCC 8 are the primarily standards for measuring color fastness to crocking. The standards are partly equivalent and largely similar in their test methods.

ISO 105 X12 and AATCC 8 procedures

In both the ISO 105 X12 and AATCC 8 test methods, the test samples are rubbed with a dry rubbing cloth and then a wet cloth.

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The ISO 105 X12 and AATCC 8 test methods both use a machine known as a "crockmeter" to rub the fabric. The crockmeter has a "rubbing finger" which the lab technician rubs across the fabric by turning a mechanical lever. The crockmeter applies a stronger force for a longer period than an inspector can manually apply when performing inspection at the supplier's facility.

The rubbing fingers vary in size for pile fabrics and other textiles. The rubbing direction can also vary based on the type and design of the fabric. But the crockmeter typically rubs the fabric in the warp and weft directions separately. The direction is particularly important for striped or pattern fabrics for which results can vary.

The staining of the rubbing cloth is then assessed using the Grey Scale for Staining. Many textile importers will accept a grade 4 rating for dry rubbing and grade 3 rating for wet. Color fastness to wet rubbing is typically lower than for dry rubbing for most fabrics.

ISO 105 X12 and AATCC 8 vary mostly in the amount of water used to wet the cloth rubbed on the test specimen. The amount of water is calculated as "wet pick up", or the amount of fluid by percent weight picked up by the fabric. ISO 105 X12 requires the cloth be wetter than that following the AATCC 8 standard

COLOR FASTNESS TO LIGHT TEST(LIGHT FASTNESS)

The color fastness to light test determines the effect of natural sunlight on textile colors.

All textile colorants are susceptible to some fading in sunlight, as colorants by nature absorb certain wavelengths. But you don't want your colored fabric to fade too quickly over the course of its life.

Color fastness to light testing might be particularly important to importers of clothing worn predominately outdoors. But even retail display lighting can cause fading. So all textile importers should consider this test for their products.

ISO 105 B02 and AATCC 16 are the most common international standards for color fastness to light. Both standards test fabrics under a Xenon Arc lamp that closely resembles natural sunlight. But the standards vary significantly in their assessment methods.

ISO 105 B02

ISO 105 B02 has four different exposure cycles with different humidity and temperature levels, including A1, A2, A3 and B. Many importers use A2 because it mimics extreme low humidity conditions.

ISO 105 B02 varies from AATCC 16 in that a blue wool reference material with a known reaction to light is simultaneously exposed to light during the test. The fading of the test sample is then rated in comparison to the fading of the blue wool reference. The Blue Wool Scale ranges from 1 (very low color fastness to light) to 8 (very high color fastness to light).

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In ISO 105 B02 A2, the lamp can also have either a black panel (un-insulated) or black standard (insulated) sensor to control the temperature.

AATCC 16

AATCC 16 includes five different testing options. Option 3 is the most commonly used because it simulates extreme low humidity conditions and is most equivalent to the ISO 105 BO2 A2 cycle.

The Option 3 procedure subjects the fabric to continuous light, while some other AATCC 16 options subject the fabric to alternating light and dark conditions. Option 3 uses a Xenon lamp with a black panel sensor, while Option 4 and 5 use black standard sensors.

AATCC 16 differs from ISO 105 B02 in that light exposure in the former case is measured using a specialized unit of irradiance known as "AATCC Fading Unit" (AFU). Most apparel units are exposed to 20 AFU and rarely need to be exposed to more than 40 AFU. Upholstery should be exposed to 40 AFU and draperies to 60 AFU. The greatest exposure time is 80 hours on this scale.

The color change of the fabric is measured using the Grey Scale for Color Change, as in other AATCC color fastness test standards. Importers will typically accept a grade 4 rating for this test.

COLOR FASTNESS TO WATER TEST(WASHING FASTNESS)

Color fastness to water determines the resistance of textile colors to immersion in water.

You might think this test sounds like the washing test. But color fastness to water testing is specifically used to measure the migration of color to another fabric when wet and in close contact. The washing test also typically uses a basic PH solution due to the addition of detergent, while this test is conducted at neutral PH levels.

ISO 105 E01 and AATCC 107 are the most common standards for color fastness tests to water. The standards are technically equivalent, but the testing methods vary slightly between them.

ISO 105 E01 and AATCC 107 procedures

For this test, the lab technician attaches a strip of multifiber fabric specimen to measure staining, as with the perspiration test. The test specimen and multifiber fabric are immersed together in water under specific conditions of temperature and time.

After soaking, the fabric is then placed between glass or plastic plates and dried under specified time, pressure and temperature conditions.

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The multifiber fabric is then compared to the Grey Scale for Staining and the test specimen is compared to the Grey Scale for Color Change. Many importers will accept a grade 3 rating for staining and a grade 4 for color change.

ISO 105 E01 and AATCC 107 vary most in the heating time of the test specimen after immersion. AATCC 107 requires the specimen to be heated for longer than ISO 105 E01.

RUBBING FASTNESS

What is Color Fastness?

Colour fastness is defined as property of pigment or dye to retain its original hue, especially without fading, running, or changing when wetted, washed, cleaning, when exposed to light, heat, or other influences.

Colour Fastness Test:

Colour Fastness to Hot Press

Colour Fastness to Water

Colour Fastness to Washing

Colour Fastness to Rubbing

Colour Fastness (SOLVENT)

FASTNESS TO HOT PRESS

Scope: This method covers the determination of the amount of fabric stretch.

Apparatus: Stretch testing instrument, measuring scale, 4 LB dead weight

Sample collection: 1.5 Mt fabric sample immediately after beam gaiting/loom starting

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Machine used: Washing machine, TMT, and sample dyeing machine (overflow)

Reagent used: Detergent

Testing Procedure:

Cut 10 cm x 4 cm testing sample, place an un dyed cotton cloth of approx. 14*4 cm on flat horizontal surface.

Place testing sample over it, place the heated iron 140 C TO 160 C on top and leave it for 15 sec.

After 15 second remove the iron and evaluate the change in colour of the testing sample and staining on un dyed cotton piece.

WASHING FASTNESS

Scope: This testing is used to determine the colour fastness of fabric to water.

Sample collection: Random sampling

Sample size: 40 cm full width fabric

Atmospheric condition: 70° to 90° F

Conditioning timing: Minimum 1 hour

Apparatus used: Perspirometer, Air oven, Aluminium container, Grey scale for assessment.

Testing Procedure:

Cut the specimen to the size of 10cm * 4 cm

Cut the standard covering fabric to the sample size.

Sandwich the specimen between the standard covering fabric and stitch all the four sides.

Take distilled water in 1:50 ratio and fully wet the sandwiched specimen for 30 min.

Now place the wetted sample between two plastic plates and place all plastic plates one above the other.

Now transfer the plates on bottom metal plate of the perspirometer.

Place the top metal plate and adjust the load with the help of thumb screws.

Then keep the loaded instrument in the air oven for 4 hours at a temperature of 38+- 1° C

After 4 hours remove the sample specimen from the instrument and remove the stitching

Compare the test specimen with the original sample for change in colour compare with scale also.

Compare the standard covering cloth with the fresh sample.

[10:20 PM, 8/2/2021] Aish: COLOUR FASTNESS TO WASHING

Scope: This testing is used to determine the colour fastness to washing.

Sample collection: Random sampling

Sample size: 40 cm full width fabric

Atmospheric condition: 70° to 90° F

Conditioning timing: Condition the fabric sample at least for 1 hour before testing.

Apparatus used: Laundrometer, measuring jar, balance.

Preparation of soap solution: Weight 5 gm of washing soap and dissolve in 1000 ml of water.

Preparation for Testing:

Cut the specimen to the size of 10 cm x 4 cm.

Cut the standard covering fabric to the sample size.

Stitch all the 4 sides by sandwiching the test specimen between the two standard covering fabric.

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Testing Procedure:

Take soap solution in the ratio of 1:50 (For 1 gm of material 50 ml of soap solution) in the pots of laundrometer

Set the laundrometer at 60°C

Then introduced the weighed previously prepared specimen in to the pots.4)

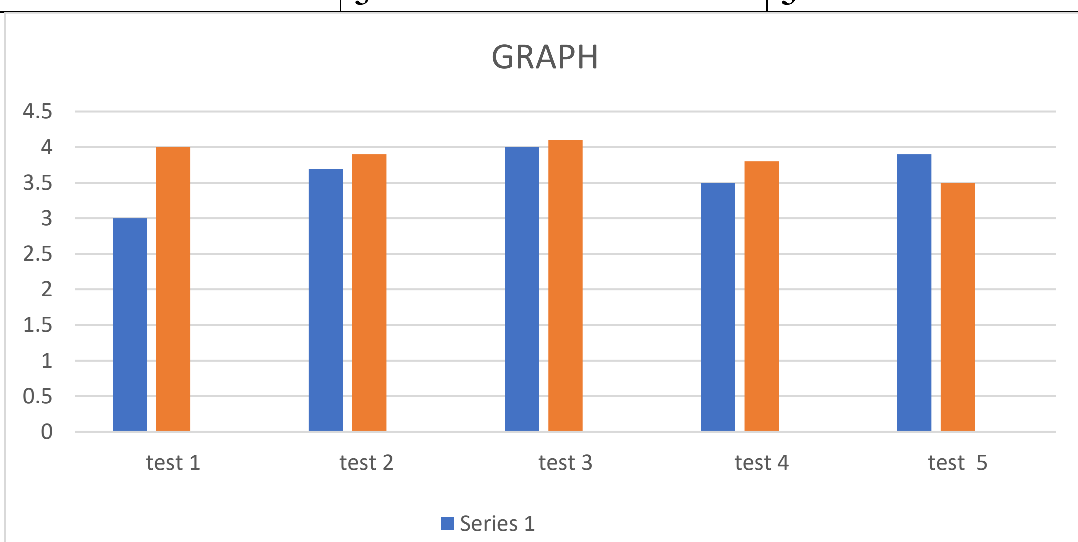
Start the machine and run it for 30 min.

After 30 min take out the specimen and wash with water., then dry in the air oven at temperature at 50 ° C.

RESULTS AND DISCUSSION

5.1 RUBBING FASTNESS

RESULTS	Untreated sample	Treated sample
1	3	4
2	3	3
3	4	4
4	3	3
5	3	3



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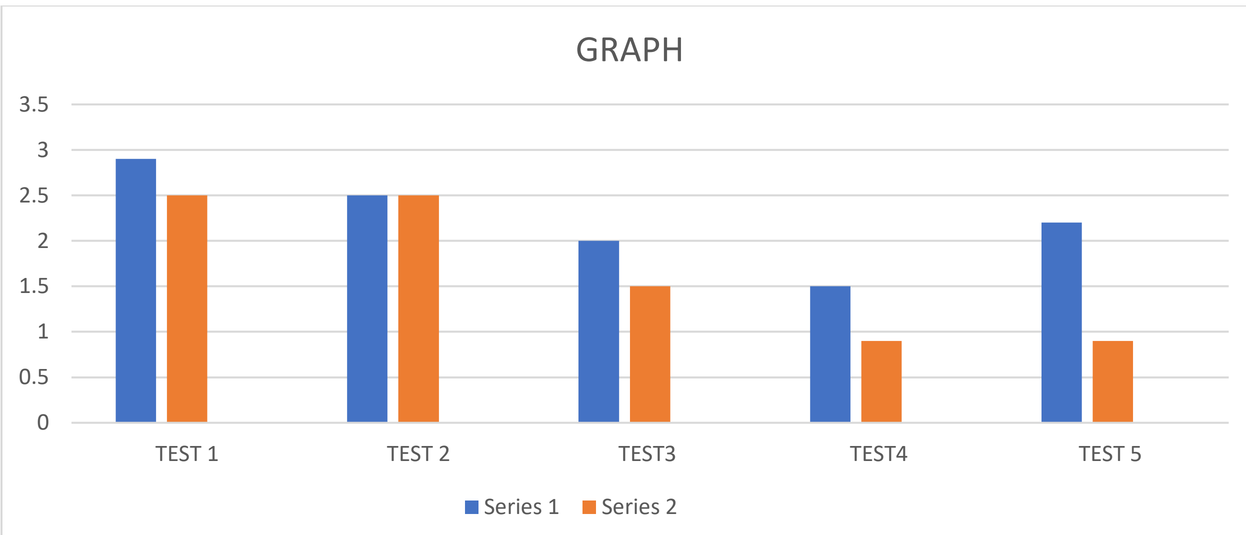
WASHING FASTNESS

RESULTS	Untreated sample	Treated sample
1	2	2
2	2	2
3	2	1
4	1	1
5	2	1



CONCLUSION

From this attempt in our project it's clear that improved rubbing fastness but poorness in washing fastness, also the reason for poorness is unfixed dye with increased migration, the penetration of dye is very low due to the pretreatment given.

Pigment dye is mainly used in printing thus an after treatment is given using potash alum which acts as a coating layer and doesn't allow other particles to penetrate which helps perfectly in all types of printing