Weaving Dyeing and Evaluating Cotton - Jute Union Fabrics

BY

Gayathri D. S.

A THESIS SUBMITTED TO THE AVINASHILINGAM INSTITUTE FOR HOME SCIENCE AND HIGHER EDUCATION FOR WOMEN (DEEMED UNIVERSITY) COIMBATORE - 641 043

IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF

MASTER OF SCIENCE IN TEXTILES AND CLOTHING

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Certified as Bonafide research work

Signature of the Head of the Department	Signature of the Dean of the Faculty	Signature of the Guide
10/5/95	10/5/95	10/5/95

Acknowledgement

ACKNOWLEDGEMENT

The investigator expresses her immense gratitude and thanks to **PADMASHRI DR.(TMT.) RAJAMMAL P. DEVADAS, M.A., M.Sc., Ph.D., (OHIO STATE), D.Sc., (MADRAS), Hon.DHL (OREGON STATE), CHANCELLOR,** Avinashilingam Institute for Home Science and Higher Education for Women, (Deemed University), Coimbatore, for providing the opportunity to conduct the study.

The investigator expresses her sincere thanks to **DR. (TMT.) LAKSHMI SANTA RAJAGOPAL, M.S. (TENNESE), Ph.D., (MADRAS), VICE CHANCELLOR,** and **DR. (TMT.) SAROJA PRABHAKARAN, M.A., Dip in Ed., (MADRAS), Ph.D., (MOTHER TERESSA), REGISTRAR** and to **DR.(TMT.) USHA CHANDRA SEKHAR, M.Sc., (MADRAS), Ph.D., (PURDUE), DEAN,** Faculty of Home Science, for providing the facilities to conduct the study.

The investigator wishes to express her sincere thanks and profound gratitude to **DR. (TMT.) G. KRISHNA BAI, M.Sc., M.Phil., Dip in Ed., (MADRAS), Ph.D., (MOTHER TERESSA),** Professor and Head of the Department of Textiles and Clothing for her valuable guidance, constant encouragement and keen interest shown throughout the entire course of the study.

Contents

CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF PLATES

LIST OF APPENDICES

APPENDIX

Introduction

I INTRODUCTION

Textile materials are of interest to everyone, for they play the most important part in civilized life. Through out past centuries, natural and major textile fibres like cotton, linen, wool and silk have been used mainly for clothing purposes. The use of cotton in India dates back to prehistoric times namely 800 B.C. India is the acknowledged birth place and the original home of cotton fabrics. Cotton is superior to many other textile fibres due to the combination of properties like comfort, low cost and easy washability, King (1985).

Mahapatico et-al (1991) state that cotton is still the most important raw material for textile fabric amounting to fifty one per cent of the world's fibre production.

However, with the progress of Science and Technology, innovations were made in the field of textiles, thus synthetic and man-made fibres came into existence. The introduction of synthetic fibres and man-made fibres have brought about a revolution in the consumption of textile materials. Even though the synthetic fibres have easy care properties, light in weight and durability, they have their own limitatioins. They also produce static electricity which affect the

skin of the wearer. The pollution caused by the synthetic fibre manufacturing firms are threatening the entire world.

Because of the drawbacks in using synthetic fibres, many people would like to revert back to natural fibres especially cotton. At the same time cotton is becoming a scarce fibre due to its less production and more demand. Due to increased population and deforestation the cultivable lands of cotton have reduced in area wise, which ultimately cutshort the raw cotton output. With increasing population it may not be possible to clothe the entire mass with cent per cent cotton alone. To overcome the shortage of cotton it was blended with other fibres.

According to the "Encyclopaedia of Textiles", cotton in its pure form and in blends is used as the principle clothing of five continents of the world. The production is one of the factors in world's prosperity and economic stability.

One of the possible blend is jute and cotton. Indra (1994) says that the importance of jute in our national economy can be realised from the fact, that 12 lakh hectares of land in our country is under jute cultivation, producing on an average of 90 lakhs bales

Both the fibres under consideration come under cellulosic fibres and hence possess certain similar characteristics. Certain qualities inherent in cotton are lacking in jute and vice versa. Hence the investigator assumed that combination of cotton and jute would yield a fabric of better quality.

Since 1991, green minded consumers have increasingly been able to find stylish clothing from raw materials and process that to match their concerns about the environment.

Hence in this study, the investigator has made an attempt to blend cotton fibres with jute fibres, which is not available in the open market. By using cotton-jute blended yarn, union fabric is produced. The specific objectives of the study are:

1. Weaving cotton yarns with cotton-jute blended yarns in two varied proportions.
2. Dyeing of the woven cotton-jute union fabrics.
3. Evaluating the woven and dyed fabric.

Review of Literature

II REVIEW OF LITERATURE

Literature pertaining to the study are reviewed under the following headings:

A. Cotton and its Properties

B. Jute and its Properties

C. Definition and General Objectives of Blending

D. Need for Blending Jute with Cotton

E. Importance of Weaving and Basic Weaves

F. Pretreatments for Cotton-jute Blends

G. Dyeing of Cotton-jute

H. Related Studies

A. Cotton and its Properties:

Cotton fibre is defined as a very fine, much elongated, single cell seed hair, which grows on the outside of a cotton seed Shenai (1984). King cotton, supreme amongst all natural fibres, plays an important role in the Indian Textile Industry, which is primarily cotton based. India produced the finest and most beautiful cotton in the world says King (1985).

Bukayev (1984) is of the opinion that cotton is the seed hair of the shrub plant which bears botanical name Gosspyium, a member of Mallow family,

cultivated as an annual plant. According to Textile Hand Book, cotton fibres grow in the ball or seed pod of cotton plant which are cultivated in warm climates.

Hollen et-al (1979) state that cotton when picked is about 94 per cent cellulose and in finished fabrics it is 99 per cent cellulose. Mishra and Keshavan (1985) point out that the cotton contains vegetable cell, the other contents are oil and wax, pectose and pectins, proteins and related nitrogen compounds, mineral matters and natural colouring matters.

Munro (1987) recalls that cotton has unique properties which is not yet been matched by synthetic substitutes hence it accounts for half the world market of textile fibres. Needles (1986) adds that cotton has satisfactory appearance but possess low lustre unless mercerised or resin finished.

Encyclopaedia of Textiles (1972) remarks that the tensile strength of cotton fibre is greater in wet condition than in dry condition, it has remarkable capacities of absorbing moisture, withstand dry heat upto 248°F, good resistance to alkalies and stands up well in abrasion test.

King (1985) says that the chemical properties of cotton makes cotton vulnerable to acids, yet tolerant

of mild alkalines. Gohl and Vilensky (1987) remark that cotton as a relatively easy fibre to dye and print. Teli (1993) remarks that cotton has low resiliency or wrinkle resistance.

Corbman (1987) states that cotton is resistant to moths, yet attacked by mildew. Miller (1984) says that when purified the cotton fibre is pure white, highly absorbent, tasteless and odourless, very smooth and soft, non irritant and cool to touch, further he adds that most cotton fabrics need no special care or attention and they are reasonably durable in wear.

Cotton fibres have good heat conductivity, high absorbency, washability at high temperature, good tensile strength, crease resistance and abrasion resistance - Textile Leader (1992). Andrews (1992) specifies that all fabrics made out of cotton have many good qualities such as comfort, breathability and dyeability and therefore have been in use for centuries.

B. Jute and its Properties:

Jute known as golden fibre is a ligno cellulosic, natural bast fibre says Pandey (1991). Jute is a bast fibre obtained from a plant chorchorus says Cook (1984). The jute fibre plant chorchourus is a herbaceous annual, it may grow to five metres (15 feets)

with stalk diameter of 20mm. Raw jute consists of 62 to 64 per cent of cellulose with a high lignin content about 12 to 14 per cent, gums, waxes and other materials that cement the fibre together states Stout (1970).

According to JIRL (1990) jute is the cheapest and most important of all the cellulosic textile fibre next to cotton. Gupta (1993) says that jute ranks second in the production of textile fibres and is produced mainly in India and Bangladesh.

Ranjan (1973) says jute is a woody fibre not much elastic in nature and it has an elongation break about 1.6 per cent but it is used for many union and combination fabrics. Shenai (1984) remarks that jute is a highly hydroscopic fibre.

According to Encyclopaedia of Textiles (1972) jute fibres are moderately strong and lustrous and yellowish brown in colour. It tends to disintegrate in water and has poor elasticity. Jute needs considerable care while bleaching and dyeing. Lyle (1976) says jute is composed of a modified form of cellulose called lignin cellulose (a compound of cellulose and lignin) Chaudhuri et-al (1991) say that the presence of huge amount of lignin in jute, make it harsh. Lignin can be eliminated from the fibre by chemical treatment (bleaching) but complete removal of lignin from jute

fibres loses its fibrous property. Corbman (1985) points out that jute is more easily damaged by acids. Cook (1985) explains that jute is more resistant to rot than either grey cotton or flax. If highly scoured, it can have excellent resistance owing to the protective effect of lignin. King(1985) says jute contains some tannin (a mordant which aids dyeing) contributing to its acceptance of dye. Lyle (1976) says jute is readily dyed by basic, direct and vat dyes.

Smith and Block (1982) say that heat, sunlight and abrasion resistance of jute are poor, while dimensional stability of jute is good. Stout (1988) says that jute fibre has been used for the commercial manufacture of heavy textile yarns and fabrics for over 150 years.

According to Gulrajani (1986) jute fibres are traditionally used for the manufacture of packaging materials. For a considerable period efforts are being made to diversify the use of jute fibres in other areas. The important characteristics of jute fibre are its silky lustre, high tensile strength, low extensibility, considerable heat and fire resistance - Chellamani et-al (1994).

C. Definition and Objectives of Blending:

According to Roy (1980) the blending of fibres, is an age old art which has lately gained importance as a science with the advent of the man made fibres. He also adds that a thorough study of blended and mixture fabric is urgently needed in India in view of the perplexing multiplicity of blends and mixtures. Although the term blends and mixtures are commonly interchanged, technically there is difference in their meaning.

Wingate (1976) defines blended yarn as the yarn obtained by combining two or more different fibres; combining their respective desirable features in the yarn making process. Wool may be blended with staple polyester in order to obtain the draping quality of wool and to approach the strength and abrasion resistance of the polyester.

'Blend' is mixing fibres before spinning says AHEA. According to Vaidya (1988) the blends and mixtures were developed to satisfy the increasing demands of fibres and they will satisfy the demands of comfort, aesthetic properties and ease of dyeability.

The differences in the physical, mechanical and morphological characteristics of the different types of fibres make the study of blend and their properties, interesting research activity in thesis field - SITRA (1981).

General objectives of blending:

The first objective of blending is economy, where in expensive fibre is diluted with a cheaper one, retaining as far as possible the quality of the expensive fibre Munro (1987). The second objective is to produce yarns of enhanced qualities that cannot be obtained by using one type of fibre alone. Use of blended yarn enhances the aesthetic characteristics of fabrics - SITRA (1981).

The third objective is to combine the desirable (properties of the different) fibres and to obtain a decorative and colourful effect point out Munro (1987).

D. Need for Blending Jute with Cotton Fibres:

With the wide variety of different types of fibres that we have today, the trend towards combining two or more fibres in one fabric is growing rapidly and demands increasing attention from the textile engineers, designers and consumers says Stout (1970).

Srinathan et-al (1977) say blending of different types of fibres has become an established practice in the textile industry to produce fabrics with a diversity of enduses. However blending of cotton with

jute fibres has been practically ignored till recent times mainly due to the extreme differences in the length and fineness of the two fibres and impracticability of processing jute as such on the cotton spinning machinery.

According to Saptharishi (1994) versatility of jute fibres is such that it can find its applications in blends with cotton and other textile items and also simultaneously this fibre could be utlized in the manufacture of composites, molded products and paper production.

Objectives of blending jute and cotton:

At present cotton yarn production in 8s to 10s counts accounts for about five per cent of the total cotton yarn production of 1.4 million tones per year. To begin with even if a quarter of the production in 8s to 10s counts is substituted by cotton-jute blended yarns. Cotton yarn price is increasing day-by-day more than proportionately to any possible rise in jute prices, use of jute fibres in counts 8s and 10s can be expected to give still better economic advantage in future - Indra (1994).

Blending of jute with cotton and other fibres are to improve the functional properties of yarn as well as fabric. To improve process performance of jute fibre

with man-made and other natural fibre which are finer and have definite length Chaudhuri et-al (1991).

E. Importance of Weaving and Basic Weaves:

Weaving is one of the oldest art known to man points out Joseph (1972). Weaving is the process by which two sets of threads of any substance are interlaced at right angles to form a continuous web. The web referred to the fabric that the weaver creates. The warp threads or ends are the length wise yarns, which are set up first on the loom. The weft yarns also called as pick, woof or fill - are the crosswise intersecting yarns, explains Held (1978). Weaving is accomplished with a machine which is known to the world over as a loom, says Hall (1975).

The weaving process consists of three basic operations which form a continuous cycle views Grosicki (1988).

Basic weaves:

Weaves are classified as basic and fancy weaves Wingate (1970). Alexander (1977) says that the basic weaves are the plain , twill and satin. All other weaves are based on one of these three weaves.

Plain weave:

Among the various weaves, plain weave produces simplest form of interlacing, but it is used to a greater extent than any other weave opines Grosicki (1988). Ponting (1982) says that plain weave is best for all fabrics where firmness of texture is sought.

Twill weave:

The distinct design in the form of diagonals is the characteristic feature of the second basic weave called the twill opines Corbman (1985).

F. Pretreatments for Cotton-jute:

According to Datye and Vaidya (1984) pretreatments are given to get yarns or fabrics with satisfactory absorbency for subsequent dyeing, printing and finishing.

Desizing:

According to Bukayev (1984) the aim of desizing is the elimination of the size from the fabric which is applied on the warp yarns at sizing.

Vaidya and Trivedi (1975) define desizing as the process of removing size from the cloth, can be done by using acids, alkalies, enzymes, hypochlorites and sodium bromite.

Scouring and bleaching:

Datye and Vaidya (1984) feel that scouring of blended fabric is the key to the future performance of the fabric. According to Wingate (1976) the purpose of scouring process is to remove any sizing, dirt, oils or other substances that adhered to fibre in the construction.

Bhagwat (1991) feels that the purpose of bleaching is to remove the natural colours. Pandey et-al (1992) says that hydrogen peroxide bleaching have superior whiteness, better absorbency and much safer than other bleaching. Pandey (1991) says that bleaching of jute fabric to produce creamy white shade is an important operation in the manufacture of jute decoratives.

G. Dyeing of Cotton - Jute:

Corbman (1985) strongly stress that when the fabric contains a blend of fibres or combination of different yarns, need special procedure, dyes that are each specific for the particular fibres used.

Dyeing may also be called a finishing process as it colours the fabrics and so adds to its beauty says Deulkar (1988). Miller (1984) states that the fibre types in the blends or mixture that differ in affinity

must be dyed separately and matched to produce the required solid colour.

Dyes suitable for cellulosic fibres:

Direct dyes:

Shenai (1984) says that the direct dyes are water soluble dyes, having affinity for cellulosic fibres. Achwal (1980) says that for cotton, new direct dyes gives good reserve of other fibre in blends. Rajendran and Cellamani (1992) stress that the dyers often employ direct dyes on colouring cellulose is because of their low cost and simplicity of application.

Vat dyes:

Shenai (1984) prefers vat dyes for dyeing and printing on cotton because they have excellent fastness to washing, light, perspiration, chlorine and rubbing. Hollen and Saddler (1979) explain that vat dyes are insoluble compounds which are converted by suitable reducing solutions to water soluble compound substantive to cellulose. Due to very good all round fastness properties, dyeing of cellulosic textiles with vat dyestuffs is carried out.

Sulphur dyes:

"Sulphur dyes are mostly used on cotton and sulphur black is the most popular dye of this group", says Arora (1983). According to Giles (1974) sulphur

dyes are applied to the fibre as substantive leuco compound as the vat dyes and converted into insoluble poly disulphides inside the fibre by exposing the dyeings to air.

Reactive dyes:

Datye and Vaidya (1984) state that reactive dyes contain sulphonic acid groups and behave like acid dyes on polyamide fibres. When both is made alkaline these dyes react with the cellulosic components. Shenai (1984) expresses that the extent of the reaction between the dye and fibre is further increased by using a short liquor ratio.

Cook (1984) strongly stresses, that dyes stuffs of various types as used for cotton may also be applied to jute. Jute fibres has affinity for basic dyes and acid dyes.

H. Related Studies:

SITRA (1991) conducted a study on "Rotor spinning of jute fibres". It reveals the followings:

a. It is possible to produce good quality rotor yarns from cotton/jute blends using a short staple spinning system.

b. Slack mercerisation improves the strength of jute-cotton blended yarn (50:50) by about 85.

c. Fastness properties of jute/cotton blended yarn matches with that of cotton.

d. Air permeability is superior to fabrics made out of jute-cotton blends.

Pandey et-al (1993) conducted a study on "Effects of after treatments on direct dyed jute fabrics". From the study it was observed that an aftertreatment with copper sulphate potassium dichromate improved the light fastness in jute fibre as, on the other hand dye-fixing agents treated improved colour strength in jute fabric.

IJIRA and SITRA jointly have come out with fine quality jute fibres whose linear density is found to lie between 8 and 9 denier. Use of these fibres help to spin jute/cotton blended yarns upto 16s in ring and rotor spinning systems. Commercial operations of cotton jute spinning and jute blended fabrics weaving were undertaken by UNDP and NTC Ltd., (Coimbatore and Pondicherry).

Experimental Procedure

III EXPERIMENTAL PROCEDURE

The experimental procedure adopted for this study comprised of the following steps.

A. Weaving

B. Dyeing

C. Evaluation

A. Weaving:

The various aspects in weaving are as follows.

1. Selection of Yarns
2. Selection of Counts
3. Selection of Weaves
4. Selection of Loom
5. Preparation of Yarn for Weaving
6. Weaving Procedure

1. Selection of Yarns:

In order to weave cotton-jute union fabrics, cotton yarns for warp and cotton-jute blended yarns for weft were selected. Cotton-jute blended yarns selected were of two different proportions namely 50:50 and 70:30.

The cheapness combined with the eco-friendly and bio-degradable characteristics of jute fibres enjoy over cotton fibres, (The Hindu 1994). Hence jute fibres were selected for blending.

2. Selection of Count:

Out of the available counts in cotton-jute blends 10s and 6s, 10s was selected for the weft side and used in both the combinations of blends namely 50:50 and 70:30. In order to match the 10s of the cotton-jute blended yarns, 2/17s of cotton yarns were selected for the warp side.

3. Selection of Weave:

Among the basic weaves, plain and twill weaves were selected for the study. Because these two weaves were most widely used both in apparels as well as for furnishings. Plain weave is least expensive weave to produce and simplest form of interlacing, but it is used to a greater extent.

Twill weave is more satisfactory weave for suitings and even for furnishings like draparies. Twill 2/2 weave is more frequently used among the various twills like 2/1, 3/1 and 3/3.

Based on these reasons, plain and twill 2/2 weaves were selected for the study.

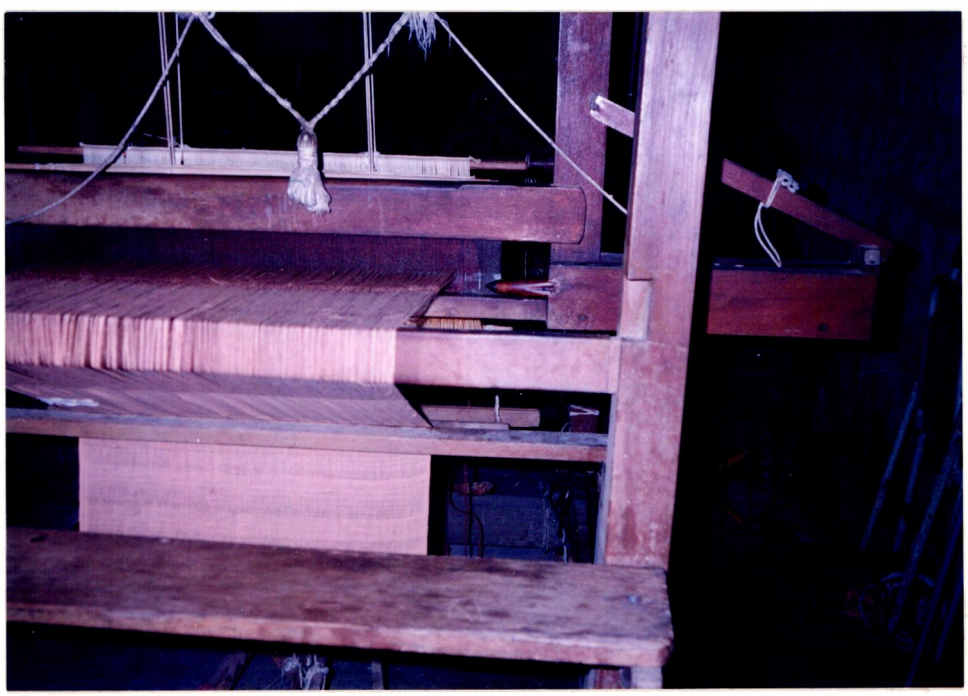


PLATE - I LOOM

4. Selection of Loom:

Loom is a machine, hand or power driven to weave cloth. A simple treadle loom with four harnesses was selected for the study. The selected loom is shown in Plate - I.

5. Preparation of Yarns for Weaving:

It is necessary to prepare the warp and weft yarns prior to weaving. Without proper preparation of yarns good weaving is not possible.

a. Preparation of warp yarns:

Held (1978) says that a warp yarn must be sturdy enough to withstand the tension of the loom and repeated movement of the reed. Hence sizing is an important stage in the preparation of warp yarns.

The warp yarns were sized with rice starch. After sizing, the warp yarns were wound on the warp beam. Sizing is mainly carried out to impart strength to warp yarns to withstand the strain during weaving.

According to Ishida (1978) warping is obtaining a definite number of threads, usually in a precisely designed order of given length and allowing the ends to wind over a cylinder called as beam in the warping process.

Drawing-in process followed by warping operation, where every warp ends were passed through heddles in the harness of the loom.

b. Preparation of weft yarn:

According to Bukayev (1984) weft yarn is slackly twisted and is not subjected to sizing. The weft yarns were would on bobbins from the cone using a winding wheel.

6. Steps in Weaving:

Weaving is a system of interlacing the treads of warp and filling each at right angles. After the preparation of warp and weft yarns, weaving operation is followed.

According to Corbman (1987) the following four operations are carried out in any type of weaving.

(i) Shedding: Specific warp yanrs raised by means of horness and shed was formed for the shuttle to pass through.

(ii) Picking: Shuttle with filling yarn was passed through the shed inserting the filling yarns. A passing of the shuttle from right to left through the shed is called a pick.

(iii) Beating up or Battening: After picking the weft yarn was pushed back and pressed against the previous filling by means of the reed.

(iv) Taking up and letting off: In this process, the warp yarns are released from the warp beam and the finished cloth was wound on cloth beam, which was located in the front of the loom.

About four metres of cloth in plain and 2/2 twill were produced in both the blend proportions namely 50:50 and 70:30. So totally 16 metres cloth were woven and one metre in each weave and blend proportions were kept as original sample. Remaining three metres in every categories were subjected to scouring and bleaching. One metre of the scoured and bleached sample in each variety was kept aside as control sample. Remaining two metre in each were cut into two equal pieces and dyed in vat and direct dyes of same shade.

Table I gives the nomenclature of the samples.

TABLE - I

NOMENCLATURE OF SAMPLES

Proportion of blends cotton-jute	Weaves	Original sample	Scoured and bleached	Dyed in	
				Vat	Direct
50:50	Plain	A	A 1	A 2	A 3
	Twill2/2	B	B 1	B 2	B 3
70:30	Plain	C	C 1	C 2	C 3
	Twill2/2	D	D 1	D 2	D 3

B Dyeing:

Dyeing includes the following steps:

1. Preparation of the Fabric for Dyeing
2. Selection of Dyes
3. Procedure for Dyeing
4. Aftertreatment of Dyed Samples

1. Preparation of the Fabric for Dyeing:

The cloth as soon as it comes from loom consists of natural dirts, fat and wax. The grey cloth may contain oils, grease and soil which might have occurred during weaving process. The foreign substances may hinder proper dye uptake while dyeing. So, the grey cloths were pretreated and prepared for dyeing. The preparation of the fabric for dyeing consists of the following steps.

a. Desizing
b. Scouring and bleaching

a. Desizing:

Desizing removes the sizing compounds applied to yarns to impart tensile strength - (Textile Wet Processing and Pollution Abatement Technology 1989). Iodine solution was used to find whether the grey sample contains sizing materials or not. Few drops of iodine

solution was poured on each sample. Since the colour of the solution showed little change as it changed from yellow to pale violet, the grey cloth contained traces of sizing material.

Hence desizing was carried out by the simple method called soap boiling. the samples were boiled in boiling water of 3 per cent soap solution for 3 ½ hours at boiling temperature. Then the materials were given thorough cold wash.

b. Scouring and bleaching:

Gupta et-al (1989) say that the purpose of scouring is to remove any sizing, dirt, oils and other substances that may have adhered to the fibre in the processing of the yarns in the manufacturing of the cloth.

Bleaching is essential to improve the whiteness of the fabrics. Taylor (1985) defines bleaching as the process of removing or destroying discolouring matter. According to Tortora (1982) fabrics are bleached or whitened to prepare them for dyeing or printing or to produce a fabric that is of a clear white colour. The procedure adopted for scouring and bleaching is given in Appendix III.

2. Selection of Dyes:

Direct and vat dyes were selected for dyeing. Pandey et-al (1993) feel that direct dyes can give better light fastness and colour strength properties on jute. BITRA reports that among the various dyes, vat dyes have all round colour fastness especially on cotton.

Since primary colours have been tried already in cotton-jute mixture fabric, and out the secondary colours, violet was yielding a correct shade in both the direct and vat dyes, the same was selected for the study.

3. Procedure for Dyeing:

a. Vat dyeing:

Recipe for vat dyeing:

Material liquor ratio	1 : 20
Vat dye (violet RR vat)	3.5 gms
Wetting agent	3.5 gms
Caustic soda	15 gms
Sodium hydro sulphite	15 gms
Water	1000 cc
Temperature	50 to 60°C

All the above chemicals were taken based on the weight of the material.

PLATE - II VAT DYEING

The dye powder was made into a thorough paste with the help of monopol soap. Boiling water was added to it. And the solution was stirred well. Caustic soda was added with constant stirring, so that the solution was full of lathers. This was followed by the addition of sodium hydro sulphite.

The sample to be dyed was immersed in water; excess water was removed; it was shaken well to remove wrinkles; and then dipped in the dye solution and allowed to boil for about 30 minutes. During dyeing, care was taken to keep the sample inside the solution to prevent oxidation. At the end, the sample was taken out and exposed well in the atmosphere to facilitate oxidation which resulted in the development of colour. Finally, the sample was rinsed thoroughly in three changes of soft water and dried. Plate-II shows dyeing of samples with vat dyes.

b. Direct dyeing:

Recipe used for dyeing with direct dye:

Material liquor ratio	:	1:15
Direct dye (violet Helio B)	:	20gms
Common salt	:	20 gms
Temperature		100°C

All the above chemicals were taken based on the weight of the material.

PLATE -III DIRECT DYEING

The dye stuff was made into fine paste by using little quantity of water and along with common salt. 1000cc water was poured into the vessel and brought to the boiling temperature. Then dye paste and common salt were added to the water. The material which was already wetted was put into the boiling dye bath without wrinkles. For 15 minutes, the samples were stirred well in the hot dye bath. Then they were taken out from the dye bath and rinsed in three changes of fresh cold water. Plate III shows dyeing of samples with direct dye.

4. Aftertreatment of Dyed Samples:

The vat and direct dyed samples were put into baths containing fixing oil. Two baths were prepared by adding 5ml of fixing oil in 5 liters of water separately. Vat and direct dyed samples were soaked in the two fixing baths separately. After 5 minutes, each of the dyed samples were washed in cold water separately and dried in shade.

C. Evaluation:

The woven and dyed samples were evaluated by the following methods:

1. Visual Inspection
2. Laboratory Tests
3. Statistical Analysis

1. Visual Inspection:

The woven and bleached samples were evaluated using the proforma (Appendix IV*a*) by a panel of 25 post graduate students specialising in the field of Textiles and Clothing at Avinashilingam Deemed University. The dyed samples too were evaluated by the same panel using another proforma (Appendix IV*b*).

2. Laboratory Tests:

The following laboratory tests were conducted for the original, scoured and bleached and dyed samples.

a. Fabric count
b. Fabric weight
c. Fabric thickness
d. Tensile strength
e. Bursting strength
f. Abrasion resistance
g. Drapability test
h. Drop test
i. Colour fastness to sunlight

a. Fabric count:

According to Booth (1982) fabric count is the number of ends and picks per square inch of the fabric.

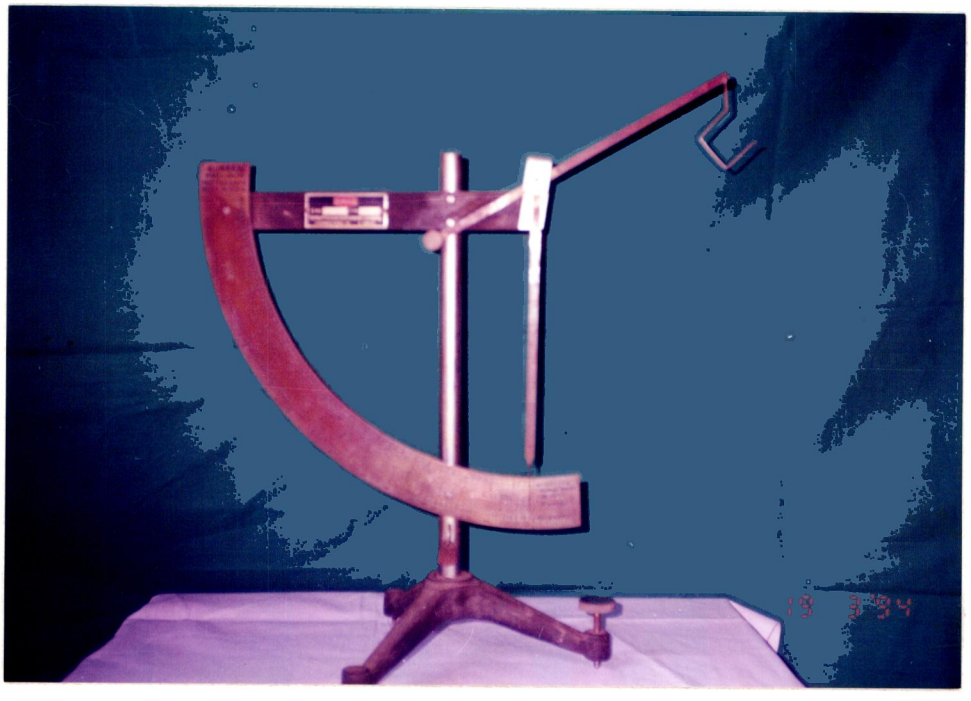


PLATE-IV
YARN AND CLOTH QUADRANT
BALANCE

To find out the fabric count of the sample, pick glass of one square inch was used. Measurements were made with the fabric in a flat and relaxed conditions. The pick glass was placed on the sample and the yarns were counted along warp and weft directions. The procedure was repeated five times at five different places in each sample.

The higher the fabric count the better strength, the feel, drapability, weight, hand and stability of the fabric Booth (1982).

b. Fabric weight:

According to Booth (1982) the weight of the fabric can be described in two ways either as the "weight per unit area" or "the weight per unit length".

A Eureka yarn and Cloth Quadrant Balance was used to determine the fabric weight (Plate IV). Each sample was cut from the material using a template, hung on the hook of the Quadrant Balance and the corresponding reading of the sample was taken in ounces per square yard. The same procedure was repeated for five times in each sample. The mean fabric weight of each sample was calculated and recorded.

PLATE - V
THICKNESS TESTER

c. Fabric Thickness:

Skinkle (1972) points out that fabric thickness test is used to find out the density of fabric in connection with such properties as air permeability, water permeability and thermal conductivity.

The Hungarian Thickness Tester (Plate V) was used to determine the thickness of original and the bleached samples. The thickness tester had a broad anvil upon which a presser foot was pressed by a spring. The sample was placed on the anvil without tension or creases and the pressure foot was lowered on to the sample by releasing the raising lever very slowly and allowed to rest upon the sample. The dial then indicated the thickness of the sample in thousandth of an inch. Each division on the dial read 0.01 mm. The dial reading was recorded. Five readings were taken from different places of the sample and the mean was calculated.

d. Tensile Strength and Elongation:

Tensile strength is defined as the ability of a material to resist rupture by external tension. Grover and Hambay (1969) define that the breaking strength is a measure of the resistance of the fabric to a tensile load or stress in either the warp or filling direction.

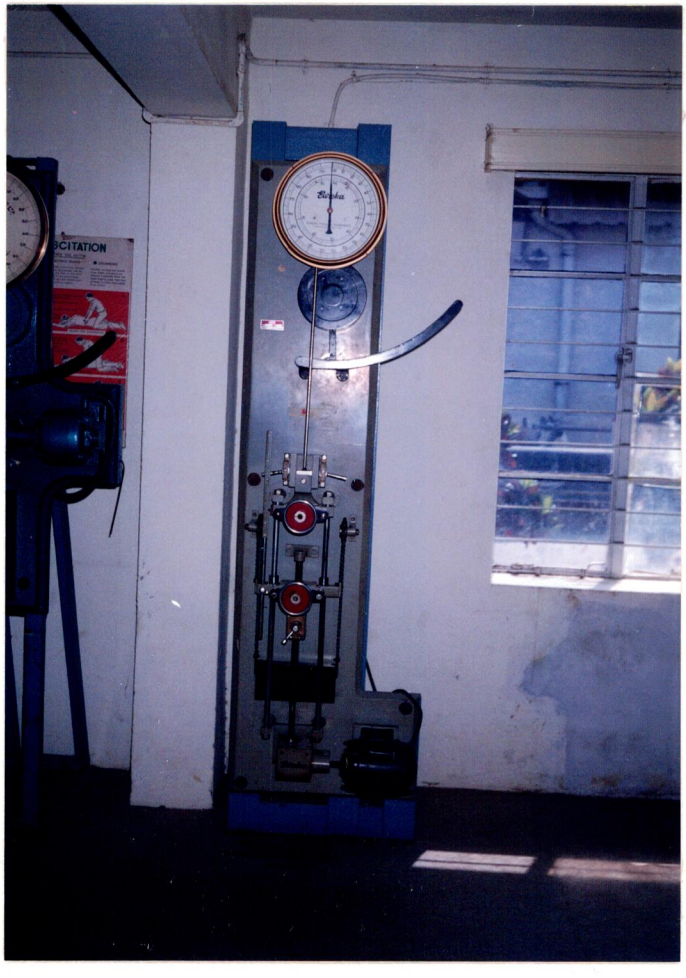


PLATE-VI
TENSILE STRENGTH TESTER

Elongation is non-recoverable stretch. According to Grover and Hamby (1969) elongation measures the extent of deformation along the axis of a material under a tensile stress and is expressed as a per cent change in length based on the original length of the test samples.

As suggested by Skinkle (1972), ravelled strip method was used for the experiment. The sample was cut out to measure 3.75 cms (1.5") wide and 32.5 cms (13") long and ravelled out to 2.5 cms (1") width and 30cms (12") length by drawing the yarns from four sides. Five samples were taken from grey, scoured and mercerised and dyed samples in both warp and weft directions.

The most common pendulum type of breaking strength tester (Plate VI) was used to measure the breaking strength and elongation of the samples. The dial of the machine was calibrated in pounds and kilograms. The capacity of the machine and the rate of transverse were 200 pounds (90 kgs), and 12" (30cms) per minute respectively. The gauge length was calibrated in pounds and kilograms. The sample was clamped between the two jaws; care was taken to see that the reading was recorded in kilograms and in inches for elongation as soon as the sample was broken.

PLATE - VII
BURSTING STRENGTH TESTER

e. Bursting Strength:

According to the ISI Handbook of Textile Testing (1982), the bursting strength test is applicable to all textile fabrics, irrespective of the composition of the fibre and the processing given.

Eureka Brand Bursting Strength Tester (Plate VII) was used for determining the bursting strength of the samples. The bursting tester had a rubber diaphragm and a ring clamp mechanism for holding the samples. A rotating handle enables to increase the pressure and burst the sample. There were two dials in which the readings were calibrated in pounds per inch and kg per cm. square.

The sample was placed over the diaphragm in a flat tensionless condition. Then it was clamped securely by means of the clamping ring. The pressure was increased smoothly by rotating the handle in clockwise direction to burst the sample. The bursting strength was noted down directly from the dial. The process was repeated for all the five samples, the samples being taken at random. The mean value was calculated.

f. Abrasion resistance:

The Eureka Martindale Abrasion Resistance Tester (Plate VIII) was used to determine the abrasion

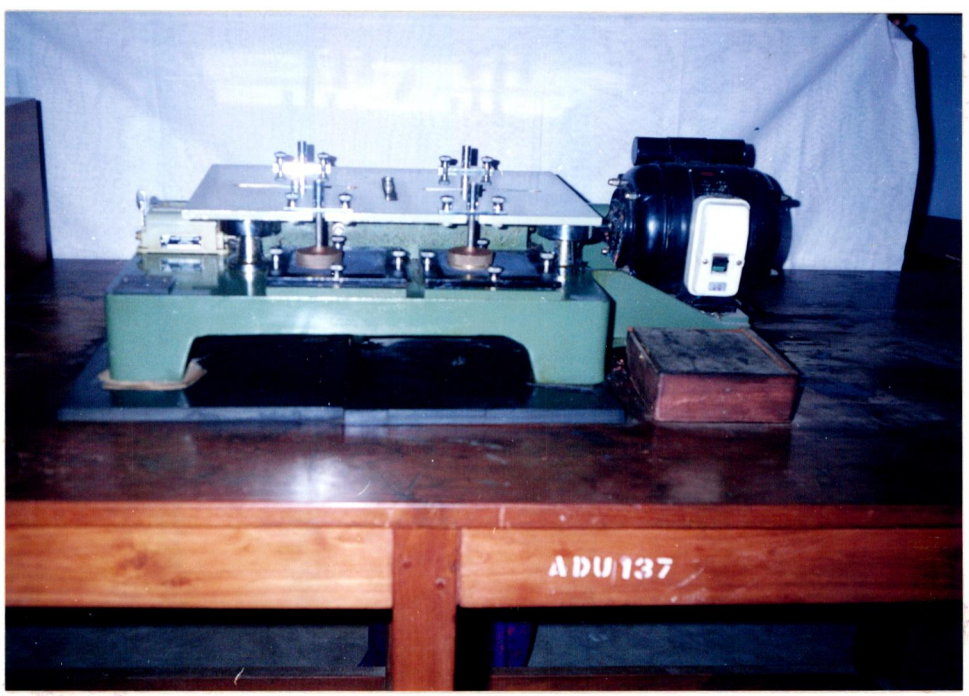


PLATE - VIII
ABRASION RESISTANCE TESTER

resistance of the samples. Universal Carborandum (J298 LC) was used as an abradant. Five samples were cut from different places of the same material using the template. Like wise samples were cut from original, scoured and bleached and dyed materials. The initial weight of each sample was found out; then the sample was mounted on a sample holder. The sample holder with two hundred grams weight was used for this purpose.

The rubs were standardised to seventy five. The samples were made to rub against the abrasive surface. After seventy five rotations the sample was removed and the final weight of the same sample was found out. Weight loss due to abrasion was calculated. The greater the loss in weight, the lesser the resistance to abrasion. The test was repeated for five times and the mean weight loss was calculated.

g. Drapability:

Jacob and Subramanian (1990) remarked that drape is one of the visual component in the visual assessment of a fabric.

The Eureka Drape Meter (Plate IX) was used for characterising the draping properties of fabrics. A circular sample of 12 inches diameter was cut using a template and was draped over a disc which is

PLATE - IX
DRAPEMETER

subsequently smaller in diameter than the sample. A light source and lens located below the disc projects an image of the draped sample on the brown paper (12 inches in diameter) which is placed over the glass cover. According to the out line of the image the brown paper too was cut. The weight of the brown paper before and after cutting were noted. Then the drape co-efficient was calculated using the formula,

$$\text{Drape co-efficient} = \frac{PS - PQ}{PS} \times 100$$

where,

PS = Actual weight of the circular brown paper

PQ = Weight of the projected area cut from the circular brown paper

h. Drop Test:

Booth (1982) says that the drop test is a count of the number of drops required to penetrate through to the underside of the fabric, when all the drops fall on the same place.

A burette filled with distilled water was clamped to a stand. The sample was mounted on a wooden embroidery frame and the height between the test samples and burette nozzle was kept constant as in Plate X. The nozzle of the burette was opened to allow the drop of water to fall on the samples. The stop watch was started

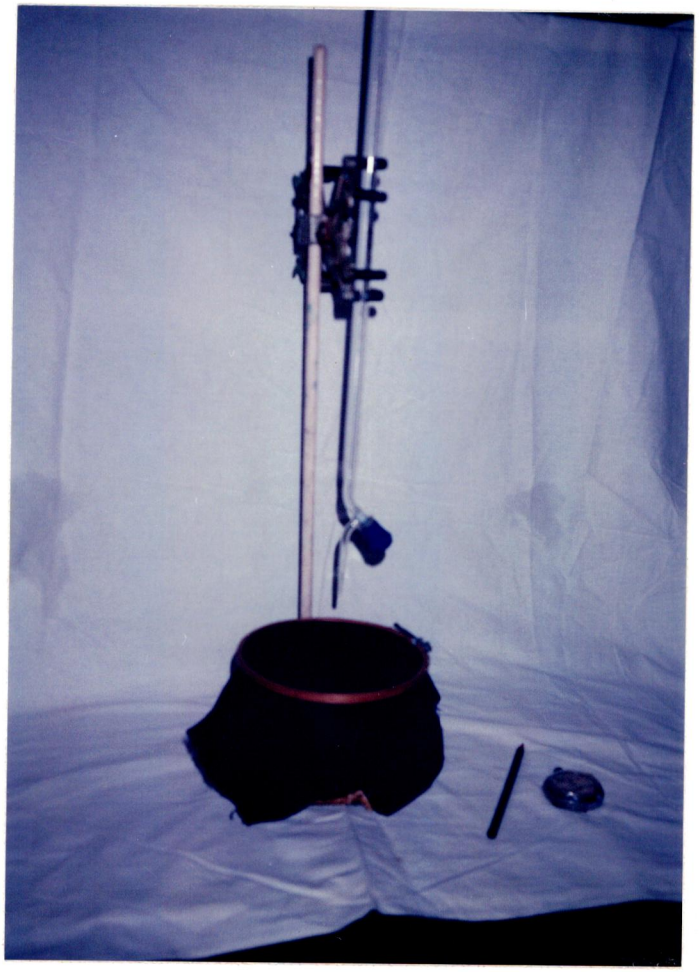


PLATE -X
DROP TEST

3. Statistical Analysis

The results obtained in the laboratory tests were analysed statistically using suitable test.

Student `t' test was used to check whether the difference between the two blend proportions in each stage was significant or not.

According to Gupta (1991) `t' test is based on `t' distribution and are commonly called students `t' distribution. The `t' distribution is used when the sample size is 30 or less than 30.

Gupta (1982) states that `t' distribution be applied in the following aspects:

(i) `t' test for the significance of single mean, population variance being unknown.
(ii) `t' test for the significance of the difference between two sample means, the population variances being equal but unkown.

(iii) `t' test for significance of an observed sample correlation co-efficient.

A model of the statistical analysis is presented in Appendix V .

Results and Discussion

V RESULTS AND DISCUSSION

The findings of the study are discussed under the following headings.

A. Visual Inspection

B. Laboratory Tests

A. Visual Inspection:

The results of the visual inspection conducted are given under the following heads.

1. Visual inspection of the scoured and bleached samples
2. Visual inspection of the dyed samples

1. Visual inspection of the scoured and bleached samples:

The visual inspection of the scoured and bleached samples against original is given in Table II.

TABLE II

VISUAL INSPECTION OF THE SCOURED AND BLEACHED SAMPLES (IN PERCENTAGE)

Samples	Condition of the sample	General appearance			Texture			Colour		
		Good	Fair	Poor	Smooth	Medium	Rough	Bright	Medium	Dull
A	Plain 50:50 Original	15	55	30	0	35	65	0	15	85
A_1	Scoured and Bleached	75	25	0	20	65	15	75	20	5
B	Twill 50:50 Original	5	50	45	0	35	65	0	20	80
B_1	Scoured and Bleached	80	20	0	35	50	15	60	40	0
C	Plain 70:30 Original	25	60	15	0	30	70	0	40	60
C_1	Scoured and Bleached	75	25	0	20	70	10	70	30	0
D	Twill 70:30 Original	10	45	45	5	45	50	0	45	55
D_1	Scoured and Bleached	75	20	5	20	70	10	75	25	0

From Table II it is clear that 80 per cent of the judges rated B_1 (50:50 twill weave) as good in general appearance whereas 75 per cent of the judges rated samples A_1, C_1 and D_1 as good in general appearance. The samples A and C were rated as fair by 55 and 60 per cent of judges respectively. The grey samples B and D were judged as fair in general appearance by 50 and 45 per cent of judges respectively.

As far as texture is concerned plain woven samples A_1 (50:50) and C_1 (70:30) were rated as medium by 65 per cent and 70 per cent of the judges. The samples B_1 and D_1 were rated as medium in texture by 50 and 70 per cent of the judges respectively.

With reference to colour 75 per cent of the judges considered the samples A_1 (50:50 plain weave) and D_1 (70:30, twill weave) as bright whereas B_1 (50:50 twill weave) and C_1 (70:30 plain weave) were judged as bright by 60 and 70 per cent judges respectively. In contrast, majority of the judges rated A, B, C and D (grey samples) as dull in colour.

Hence it can be concluded that the pretreatments scouring and bleaching improve the general appearance, texture and colour irrespective of blend ratio and weave.

TABLE III
VISUAL INSPECTION OF THE DYED SAMPLES (IN PERCENTAGE)

Samples	Condition of sample	General appearance			Texture			Colour			Evenness of dye		
		Good	Fair	Poor	Smooth	Medium	Rough	Bright	Medium	Dull	Even	Fairly even	Uneven
	Plain 50:50												
A_2	Vat	70	30	0	25	55	20	70	20	10	80	20	0
A_3	Direct	45	50	5	10	80	10	30	55	15	55	45	0
	Twill 50:50												
B_2	Vat	60	40	0	25	60	15	70	30	0	80	20	0
B_3	Direct	35	60	5	20	60	20	35	60	5	60	30	10
	Plain 70:30												
C_2	Vat	75	25	0	10	70	20	70	15	15	85	15	0
C_3	Direct	70	30	0	15	50	35	45	45	10	80	20	0
	Twill 70:30												
D_2	Vat	50	45	5	15	50	35	45	45	10	80	20	0
D_3	Direct	50	50	0	20	65	15	40	50	10	55	45	0

2. Visual inspection of the dyed samples:

The details of visual inspection regarding the dyed samples are presented in Table III.

From the Table III, it is obvious that the vat dyed plain woven samples A_2 (50:50) and C_2 (70:30) were rated as good in general appearance by 70 per cent and 75 per cent of the judges whereas samples. B_2 (50:50 twill weave) and D_2 (70:30 twill weave) were judged as good in general appearance by 60 per cent and 50 per cent of judges respectively.

With regard to texture the samples A_3 and C_3 were rated as medium in texture by 80 and 50 per cent of judges respectively. The samples B_3 and D_3 (Twill weave, 50:50 and 70:30 blend proportions respectively) were rated as medium in texture by about 60 per cent and 65 per cent respectively. The samples C_2 and D_2 which are vat dyed samples of plain and twill weave belonging to same category were rated as medium in texture by 70 per cent and 50 per cent of the judges respectively.

As far as colour is concern, the samples A_2 and C_2 were judged as bright by 70 per cent of judges whereas the samples A_3 and C_3 were rated as medium by 55 and 45 per cent of judges respectively. Majority of judges that is 70 per cent and 45 per cent of the judges considered the samples B_2 and D_2 as bright in colour,

the rest considered the sample as medium. The samples B_3 and D_3 were rated as medium in colour by 60 and 50 per cent of the judges.

With reference to evenness of dye A_2 and C_2 were judged as even by 80 and 85 per cent of judges. Whereas the samples A_3 and C_3 were rated as even by 55 and 80 per cent of judges. Nearly 80 per cent of the judges rated B_2 and D_2 as evenly dyed whereas the samples B_3 and D_3 were rated as medium by 60 and 55 per cent of the judges.

To conclude that vat dyed samples appeared to be good in general appearance, medium in texture, bright in colour and evenly dyed. Among the two combination of the blends, 70:30 appeared good, as far as plain weave is concerned, with regards to twill weave 50:50 ratio seems to be advantageous.

B. Laboratory Tests:

Findings of the laboratory tests conducted are given under the following aspects.

1. Fabric count
2. Fabric weight
3. Fabric thickness
4. Tensile strength
5. Bursting strength
6. Abrasion resistance
7. Drapability
8. Drop test
9. Colour fastness to sunlight

TABLE IV

FABRIC COUNT

Sample	Condition of the sample	Warp count			Weft count		
		Mean warp	Loss or gain over original	Percentage loss or gain over original	Mean weft	Loss or gain over original	Percentage loss or gain over original
A	Plain 50:50 Original	41	--	--	34	--	--
A_1	Scoured and Bleached	43	2	4.88	35	1	2.94
A_2	Vat	44	3	7.32	37	3	8.82
A_3	Direct	43	2	4.88	37	3	8.82
B	Twill 50:50 Original	41	--	--	40	--	--
B_1	Scoured and Bleached	43	2	4.88	41	1	2.5
B_2	Vat	46	5	12.20	43	2	5.0
B_3	Direct	45	4	9.76	40	0	0
C	Plain 70:30 Original	41	--	--	33	--	--
C_1	Scoured and Bleached	44	3	7.32	38	5	15.15
C_2	Vat	45	4	9.76	38	5	15.15
C_3	Direct	44	3	7.32	38	5	15.15
D	Twill 70:30 Original	43	--	--	41	--	--
D_1	Scoured and Bleached	46	3	6.98	43	2	4.88
D_2	Vat	47	4	9 30	43	2	4.88
D_3	Direct	44	1	2.33	43	2	4.88

1. Fabric count:

Fabric count in warp and weft directions of the original sample, scoured and bleached sample and dyed samples are given in Table IV.

From Table IV it is clear that warp counts of the samples A, B, C and D were found to be 41, 41, 41 and 43 whereas the weft count of the same samples were 34, 40, 33 and 41. It is evident that scouring and bleaching as well as dyeing have increased the warp and weft counts of all the samples.

Among the sixteen samples the percentage of gain seems to be more in vat dyed samples which are A_2, B_2, C_2 and D_2 with regard to warp counts. As far as weft count is concern, the percentage gain in fabric weight was more or less same in all the categories.

Among the two proportions of blends the percentage of gain is more in 70:30 cotton/jute blends of plain weave but it is not so in twill weave except weft count.

2. Fabric weight:

The fabric weight of all the samples are given in Table V and Figure I.

From Table V it is clear that the mean fabric weights of the samples A, B, C and D seem to be

TABLE V

FABRIC WEIGHT

Sample	Condition of the sample	Mean weight per square yard in ounces	Loss or gain over original	Percentage loss or gain over original	Samples compared	't' value
A	Plain 50:50 Original	6.40	-	-	A Vs C	6.5003*
A_1	Scoured and Bleached	6.90	0.5	7.813	B Vs D	2.7461**
A_2	Vat	7.70	1.3	20.313	A_1 Vs C_1	2.2361**
A_3	Direct	7.10	0.7	10.938	B_1 Vs D_1	4.4722*
B	Twill 50:50 Original	6.40	-	-	A_2 Vs C_2	6.5003*
B_1	Scoured and Bleached	7.10	0.7	10.938	B_2 Vs D_2	6.5335*
B_2	Vat	7.60	1.2	18.750	A_3 Vs C_3	4.9593*
B_3	Direct	7.30	0.9	14.063	B_3 Vs D_3	6.0003*
C	Plain 70:30 Original	5.75	-	-		
C_1	Scoured and Bleached	6.65	0.9	15.652		
C_2	Vat	7.05	1.3	22.609		
C_3	Direct	6.65	0.9	15.652		
D	Twill 70:30 Original	6.05	-	-		
D_1	Scoured and Bleached	6.60	0.55	9.091		
D_2	Vat	7.20	1.15	19.008		
D_3	Direct	7.00	0.95	15.703		

* Significant at 1% level
** Significant at 5% level

SCALE:
On X axis 1 cm = 1 Sample
On Y axis 1 cm = 1 ounce Per Square Yard

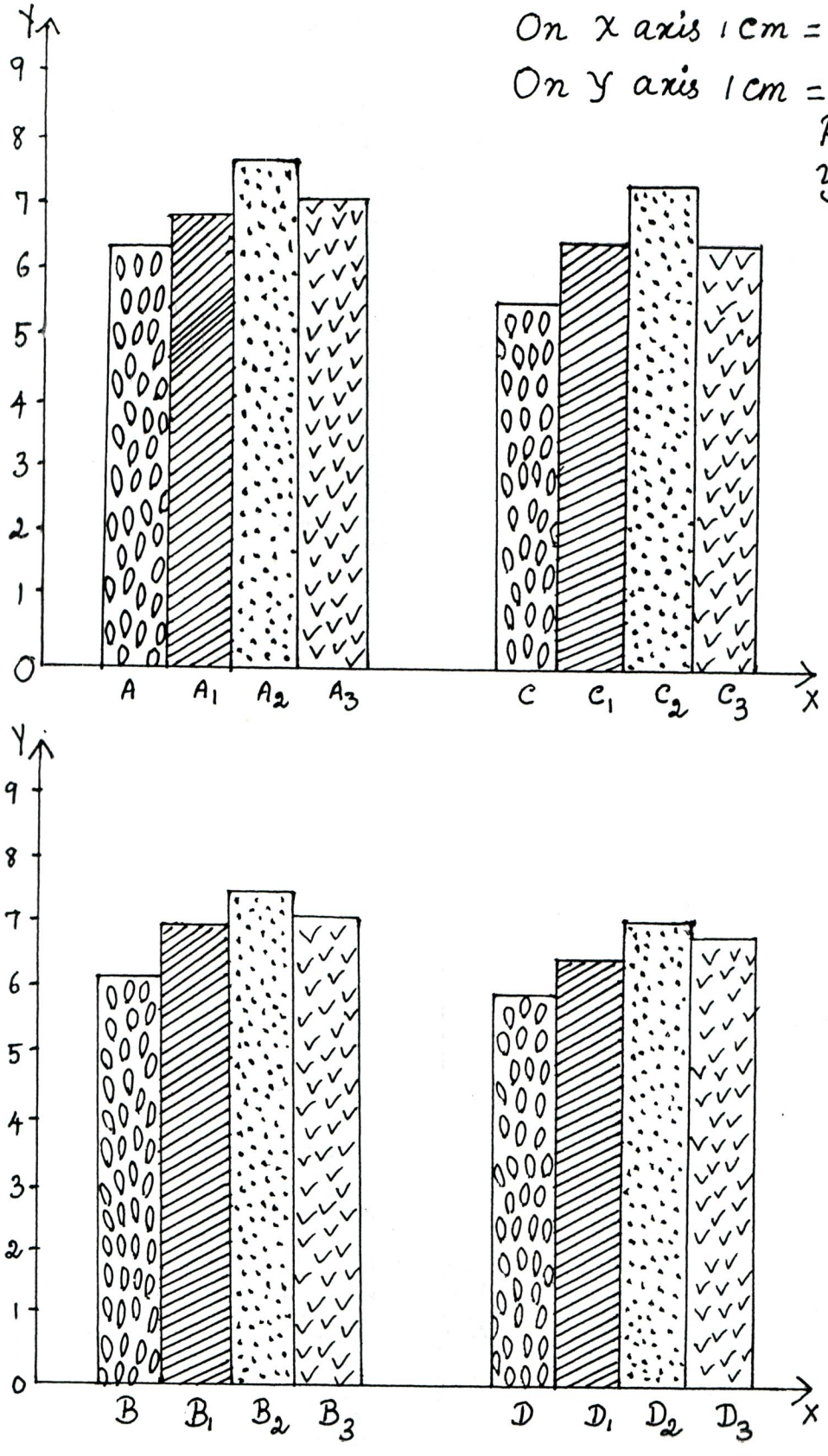


FIGURE - I FABRIC WEIGHT

KEY:

original | Scoured and Bleached | vat | Direct

6.4, 6.4, 5.75 and 6.05 ounces per square yard. The fabric weight was found to be increased for scoured and bleached as well as dyed samples in all the categories. The maximum gain was found in vat dyed samples irrespective of weave and proportions of fibre content.

With regard to plain weave in both the proportion of blends, the percentage of gain was found to be more in 70:30 cotton/jute blend ratio than in 50:50 cotton/jute blend. Considering the twill weave the percentage of gain was found to be more in D_2 and D_3, (70:30 proportion) vat and direct dyed samples than in respectively while B_1 has more gain of weight when compared to D_1.

The results were analysed statistically, it was found that the difference between the samples A Vs C, B_1 Vs D_1, A_2 Vs C_2, B_2 Vs D_2, A_3 Vs C_3 and B_3 Vs D_3 were significant at 1 per cent level while the others namely difference between B Vs D and A_1 Vs C_1 were significant at 5 per cent level.

3. Fabric thickness:

The thickness of the samples are shown in Table VI.

TABLE VI

FABRIC THICKNESS

Sample	Condition of the sample	Mean fabric thickness in mm	Loss or gain over original	Percentage loss or gain over original	Samples compared	't' value
A	Plain 50:50 Original	0.622	-	-	A Vs C	3.6377*
A_1	Scoured and Bleached	0.710	0.088	14.148	B Vs D	5.8515*
A_2	Vat	0.674	0.052	8.360	A_1 Vs C_1	10.8151*
A_3	Direct	0.660	0.038	6.109	B_1 Vs D_1	4.4722*
B	Twill 50:50 Original	0.556	-	-	A_2 Vs C_2	0.9938*
B_1	Scoured and Bleached	0.670	0.114	20.504	B_2 Vs D_2	2.2289**
B_2	Vat	0.718	0.162	29.137	A_3 Vs C_3	1.9194*
B_3	Direct	0.700	0.144	25.899	B_3 Vs D_3	2.7942*
C	Plain 70:30 Original	0.600	-	-		
C_1	Scoured and Bleached	0.636	0.036	6.000		
C_2	Vat	0.670	0.070	11.666		
C_3	Direct	0.644	0.044	7.333		
D	Twill 70:30 Original	0.528	-	-		
D_1	Scoured and Bleached	0.628	0.100	18.939		
D_2	Vat	0.694	0.166	31.439		
D_3	Direct	0.672	0.144	27.273		

* Significant at 1% level
** Significant at 5% level

The table VI clarifies that the pretreatments and dyeing increases the thickness of all the samples. In grey stage itself 50:50 plain and twill woven samples were thicker than 70:30 plain and Twill woven samples. The maximum gain of thickness was found in vat dyed samples except A_2 (50:50 plain woven) while it had less percentage of gain over original when compared to other samples. The minimum gain was found in sample C_1 which is 70:30 (cotton/jute) plain woven pretreated sample.

Statistical analysis of the above results revealed that there was significant difference at 1 per cent level between samples A Vs C, B Vs D, A_1 Vs C_1 and B_1 Vs D_1 while B_2 Vs D_2 and B_3 Vs D_3 have the difference at 5 per cent level.

4. Tensile strength:

The tensile strength of the grey, scoured and bleached and dyed samples are given in Table VIIa and VIIb. Table VIIa deals with the warp tensile strength and elongation and Table VIIb and Figure II explains the weft tensile strength and elongation.

TABLE VII - a

WARP TENSILE STRENGTH AND ELONGATION

Sample	Condition of the sample	Strength (Kg)			Elongation (inches)		
		Mean Strength (Kg)	Loss or gain over original	Percentage loss or gain over original	Mean elongation (inches)	Loss or gain over original	Percentage loss or gain over original
A	Plain 50:50 Original	22.8	--	--	2.18	--	--
A_1	Scoured and Bleached	22.0	-0.8	-3.509	2.46	0.28	12.844
A_2	Vat	22.6	-0.2	-0.877	2.28	0.10	4.587
A_3	Direct	22.4	-0.4	-1.754	2.36	0.18	8.257
B	Twill 50:50 Original	23.6	--	--	1.34	--	--
B_1	Scoured and Bleached	22.2	-1.4	-5.932	1.44	0.10	7.463
B_2	Vat	26.6	3.0	12.712	1.66	0.32	23.881
B_3	Direct	21.6	-2.0	-8.475	1.54	0.20	14.925
C	Plain 70:30 Original	23.0	--	--	2.00	--	--
C_1	Scoured and Bleached	17.4	-5.6	-24.348	2.06	0.06	3.000
C_2	Vat	21.2	-1.8	-7.826	2.04	0.04	2.000
C_3	Direct	15.2	-7.8	-33.913	1.80	-0.20	-1.000
D	Twill 70:30 Original	23.4	--	--	1.30	--	--
D_1	Scoured and Bleached	28.4	5	21.368	1.40	0.10	7.692
D_2	Vat	25.6	2.2	9.402	1.36	0.06	4.615
D_3	Direct	24	1.4	5.983	1.42	0.12	9.231

4. a. Warp tensile strength and elongation:

From Table VIIa it is evident that the grey samples A, B, C and D had the strength (in kg) as 22.8, 23.6, 23.0 and 23.4 respectively. Due to the pretreatments and dyeing there was a considerable loss in warp strength except sample D which is 70:30 (cotton/jute) twill weave sample.

Gain over original was found in samples B_2, D_1, D_2 and D_3. Among the 50:50 plain woven samples, more loss was in Sample A_1 (Scoured and bleached) while A_2 (vat dyed) had less loss over original. In B category B_2 gains the warp strength at about 12.7 per cent while B_3 has loss of strength at about 8 per cent. In 70:30 (cotton/jute) plain woven samples, C_3 has maximum loss whereas the loss of C_2 was less. In 70:30 twill woven samples, all the samples gained the strength over original, the maximum gain was found in D_1 (scoured and bleached) at about 21.3 per cent and minimum gain in D_3 (direct dyed) at about 5.9 per cent.

With reference to elongation, almost all the samples showed increase in elongation over original. The percentage increase in length was more in samples B_2, B_3 and A_1. With regard to proportion of blend, 50:50 had more gain in elongation when compared to 70:30 (cotton/jute) irrespective of weave variation.

TABLE - VII b

WEFT TENSILE STRENGTH AND ELONGATION

Sample	Condition of the sample	Strength (Kg)					Elongation (inches)				
		Mean strength (Kg)	Loss or gain over original	Percentage loss or gain over original	Samples compared	't'value	Mean Elangation in inches	Loss or gain over original	Percentage loss or gain over original	Samples compared	't'value
A	Plain 50:50 Original	14.6	-	-	A Vs C	3.1378**	1.04	-	-	A Vs C	4.8088*
A_1	Scoured and Bleached	14.4	-0.2	-1.370	B Vs D	3.9445*	0.86	-0.18	-17.308	B Vs D	4.0020*
A_2	Vat	16.4	1.8	12.329	A_1 Vs C_1	6.4874*	1.04	0	0	A_1 Vs C_1	6.3256*
A_3	Direct	13.6	-1.0	-6.849	B_1 Vs D_1	3.8903*	0.68	-0.36	-34.615	B_1 Vs D_1	11.0054*
B	Twill 50:50 Original	15.4	-	-	A_2 Vs C_2	3.1624**	1.00	-	-	A_2 Vs C_2	2.4494**
B_1	Scoured and Bleached	13.8	-1.6	-10.390	B_2 Vs D_2	5.8231*	1.00	0	0	B_2 Vs D_2	0
B_2	Vat	15.8	0.4	2.597	A_3 Vs C_3	6.0001*	1.22	0.22	22.000	A_3 Vs C_3	5.4773*
B_3	Direct	17.0	1.6	10.390	B_3 Vs D_3	2.9939**	0.96	-0.04	-4.000	B_3 Vs D_3	5.1711*
C	Plain 70:30 Original	16.2	-	-			0.86	-	-		
C_1	Scoured and Bleached	18.8	2.6	16.049			1.06	0.20	23.256		
C_2	Vat	17.4	1.2	7.407			1.16	0.30	34.884		
C_3	Direct	17.2	1.0	6.173			0.96	0.10	11.628		
D	Twill 70:30 Original	20.0	-	-			1.00	-	-		
D_1	Scoured and Bleached	20.0	0	0			1.22	0.22	22.000		
D_2	Vat	21.2	1.2	6.000			1.24	0.24	24.000		
D_3	Direct	19.2	-0.8	-4.000			1.34	0.34	34.000		

* Significant at 1% level
** Significant at 5% level

SCALE:
On x axis 1 cm = 1 Sample
On y axis 1 cm = 2 Kilo grams

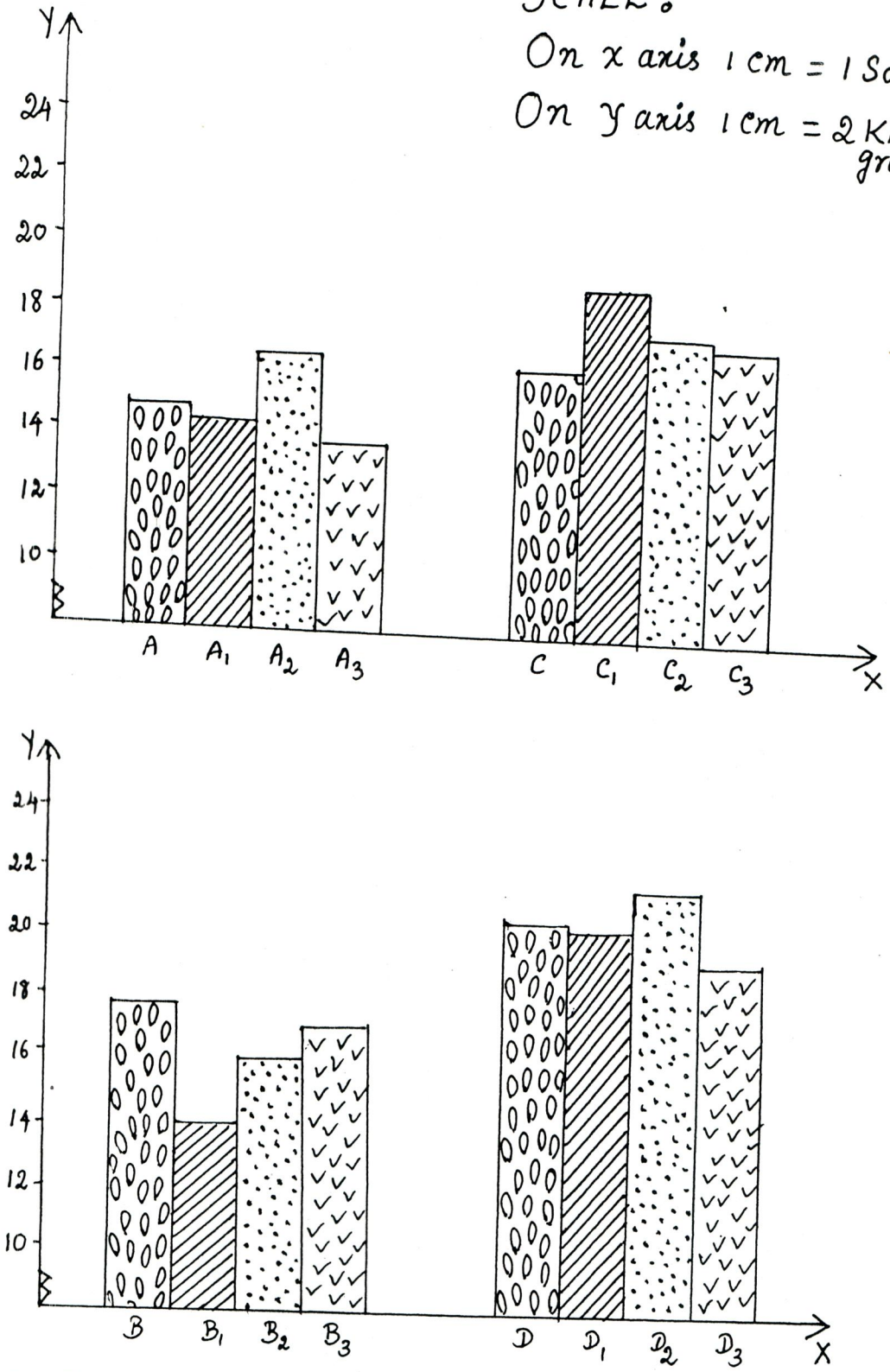


FIGURE-II WEFT TENSILE STRENGTH

KEY:

original | Scoured and Bleached | vat | Direct

4. b. Weft tensile strength and elongation:

The Table VIIb gives the weft tensile strength and elongation of all the samples. The original samples A, B, C and D had the strength (in kg) of 14.6, 15.4, 16.2 and 20.0 respectively. In 50:50 plain woven samples, A_2 (vat dyed) had a gain of strength at about 12.3 per cent and A_3 (direct dyed) had a loss of strength at about 6.9 per cent over original. In B category B_1 (Scoured and bleached) had a loss of strength at about 1.6 kgs over original and B_3 (direct dyed) has gain of strength 1.6 kgs over the original. Among C group all the samples gained strength over original.

In D category the sample D_2 has increased in strength while D_3 decreased to about 4 per cent.

The statistical results show that one per cent significance was found between B Vs D, A_1 Vs C_1, B_1 Vs D_1, B_2 Vs D_2 and A_3 Vs C_3. The samples A Vs C, A_2 Vs C_2 and B_3 Vs D_3 have the significant differences at 5 per cent level.

As far as elongation was concerned, 70:30 (cotton/jute) proportion of plain and twill weave have gained the elongation over the original whereas maximum samples in 50:50 plain weave and twill have been reduced in their elongation. The more loss was found in A_3 (50:50 Plain weave, direct dyed sample).

The statistical analysis proved that the samples A Vs C, B Vs D, A_1 Vs C_1, B_1 Vs D_1, A_3 Vs C_3 and B_3 Vs D_3 are having significant differences at 1 per cent level. The sample A_2 Vs C_2 alone is significant at about 5 per cent level.

5. Bursting strength:

Bursting strength of the sample is given in Table VIII and Figure III.

TABLE VIII

BURSTING STRENGTH

Sample	Condition of the sample	Mean strength (Kg)	Loss or gain over original	Percentage loss or gain over original	Samples compared	't' value
A	Plain 50:50 Original	4.22	-	-	A Vs C	2.6888**
A_1	Scoured and Bleached	5.20	0.98	23.223	B Vs D	16.4989*
A_2	Vat	5.32	1.10	26.066	A_1 Vs C_1	2.9408**
A_3	Direct	4.36	0.14	3.318	B_1 Vs D_1	4.0001*
B	Twill 50:50 Original	5.56	-	-	A_2 Vs C_2	2.5256**
B_1	Scoured and Bleached	7.96	2.40	43.166	B_2 Vs D_2	10.0376*
B_2	Vat	6.12	0.56	10.072	A_3 Vs C_3	2.7498**
B_3	Direct	5.20	-0.36	-6.475	B_3 Vs D_3	20.8199**
C	Plain 70:30 Original	4.56	-	-		
C_1	Scoured and Bleached	6.80	2.24	49.123		
C_2	Vat	5.84	1.28	28.070		
C_3	Direct	4.80	0.24	5.263		
D	Twill 70:30 Original	6.88	-	-		
D_1	Scoured and Bleached	8.20	1.32	19.186		
D_2	Vat	7.96	1.08	15.698		
D_3	Direct	7.24	0.36	5.233		

* Significant at 1% level
** Significant at 5% level

SCALE:

On x axis 1cm = 1 Sample

On y axis 1cm = 1 Kg.

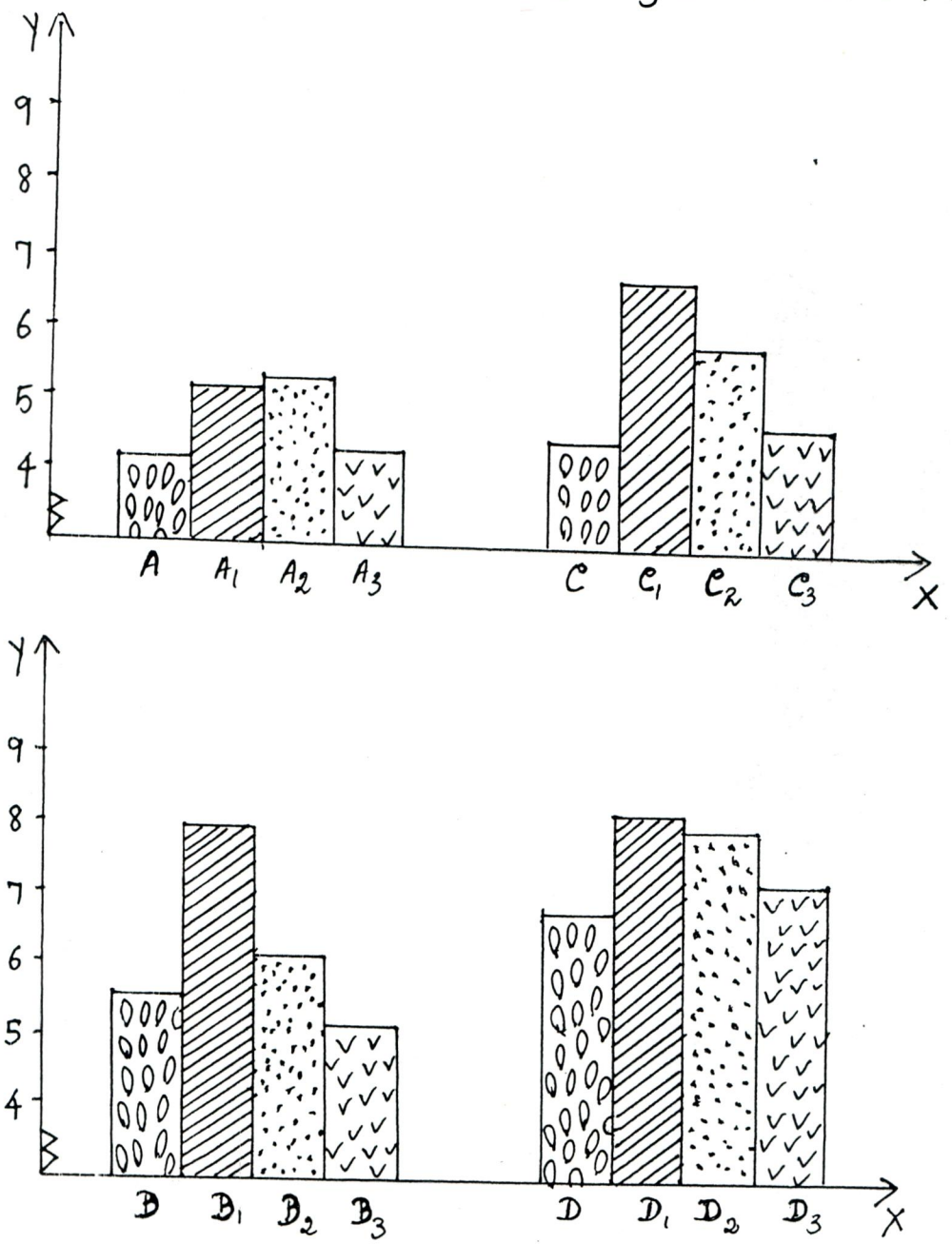


FIGURE - III

BURSTING STRENGTH

KEY:

original

Scoured and Bleached

Vat

Direct

The table tells that all the samples except B_3 had gained in bursting strength over the originals. Maximum gain was found in Sample C_1 (70:30 cotton/jute plain weave) and minimum was found in sample A_3 (50:50 cotton/jute plain weave). Among the 50:50 plain woven samples vat dyed (A_2) sample gained more of bursting strength that was 26 per cent and twill weave sample B_1 gained about 43 per cent over original B. Among the categories C and D, the sample C_1 gained 49 per cent of bursting strength over C and maximum gain was found in D_1 which was 19 per cent over D.

Analysing the plain weave in two proportion of blends, 70:30 plain woven samples C_1, C_2, and C_3 had more percentage of gain than the samples A_1, A_2 and A_3 which are plain woven and 50:50 blend proportion. With regards to twill weave, the 70:30 blend proportion gained more except one sample D_1 which gained only 19 per cent over D whereas B_1 gained 43 per cent over B.

Statistically analysing the above results, the difference between the samples B Vs D, B_1 Vs D_1, B_2 Vs D_2 were found to be significant at 1 per cent level. There was significant difference at 5 per cent level in the samples, A Vs C, A_1 Vs C_1, A_2 Vs C_2, A_3 Vs C_3 and B_3 Vs D_3.

6. Abrasion resistance:

The results of abrasion resistance is given in the Table IX and Figure IV.

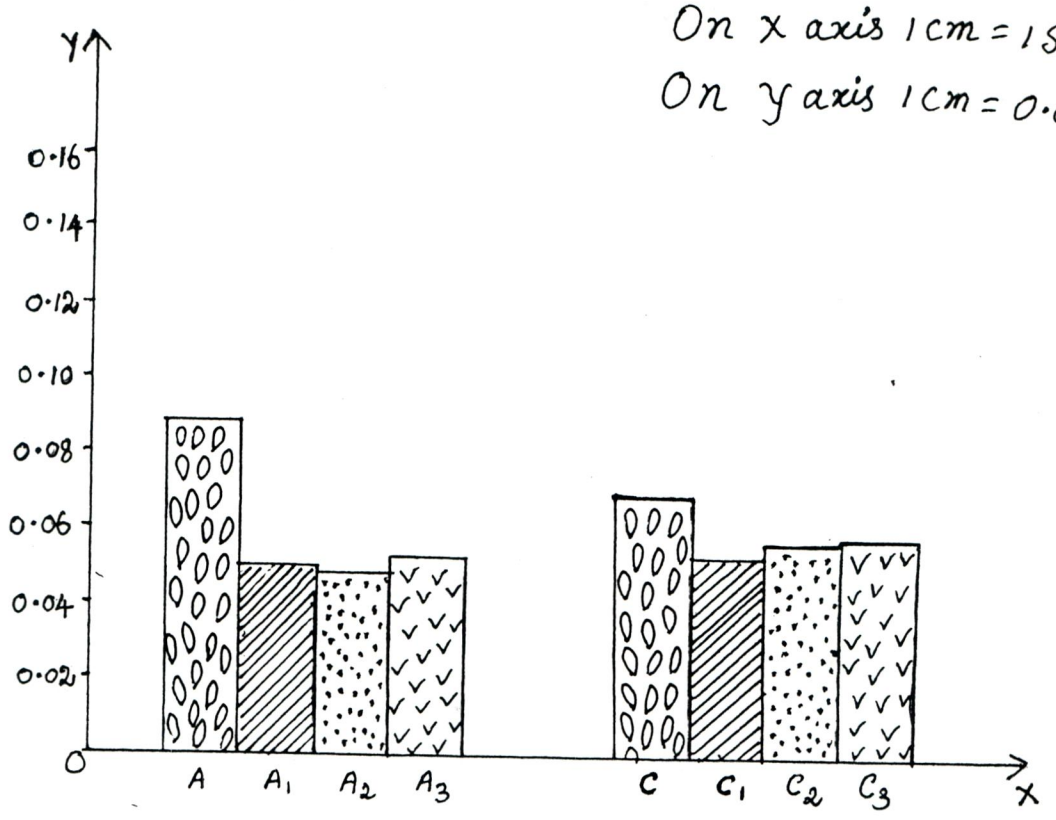
TABLE - IX

ABRASION RESISTANCE

Sam-ple	Condition of the sample	Mean loss in (gms)	Loss or gain over origi-nal	Percentage loss or gain over original	Samples compared	't' value
A	Plain 50:50 Original	0.0896	-	-	A Vs C	7.4053*
A_1	Scoured and Bleached	0.0492	- 0.0492	-54.91	B Vs D	8.7114*
A_2	Vat	0.0478	-0.0418	-46.65	A_1 Vs C_1	3.8889**
A_3	Direct	0.0536	-0.036	-40.18	B_1 Vs D_1	2.7521**
B	Twill 50:50 Original	0.1210	-	-	A_2 Vs C_2	4.1144**
B_1	Scoured and Bleached	0.0858	-0.0352	-29.09	B_2 Vs D_2	6.7083*
B_2	Vat	0.0810	-0.04	-33.06	A_3 Vs C_3	4.1432**
B_3	Direct	0.0892	-0.0318	-26.28	B_3 Vs D_3	3.4848**
C	Plain 70:30 Original	0.0692	-	-		
C_1	Scoured and Bleached	0.0538	-0.0154	-22.25		
C_2	Vat	0.0566	-0.0126	-18.21		
C_3	Direct	0.0584	-0.0108	-15.61		
D	Twill 70:30 Original	0.0890	-	-		
D_1	Scoured and Bleached	0.0758	-0.0132	-14.83		
D_2	Vat	0.0724	-0.0166	-18.65		
D_3	Direct	0.0796	-0.0094	-10.56		

* Significant at 1% level
** Significant at 5% level

SCALE:
On x axis 1 cm = 1 Sample
On y axis 1 cm = 0.02 gms



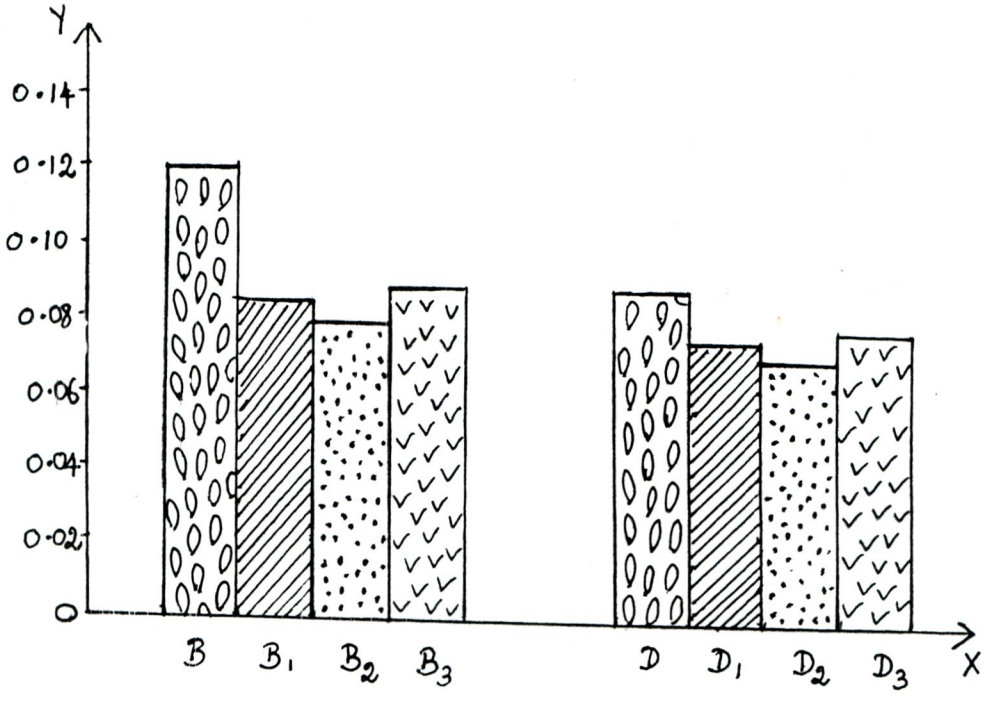


FIGURE - IV ABRASION RESISTANCE

KEY:

original | Scoured and Bleached | vat | Direct

From the Table IX it is clear that in the A category the loss of weight due to abrasion was less in sample A_3 dyed in direct dye. The loss is more in sample A_1 which is pretreated that is scoured and bleached sample. Whereas in B category the minimum percentage of loss is found in sample B_3 (26.3 per cent) and maximum in B_2 (33 per cent). In samples C_1,, C_2 and C_3 minimum loss of 15.6 per cent was found in C_3 and maximum of 23.3 per cent in C_1. The ratio of 70:30 (cotton/jute) twill samples had minimum loss of 10.6 per cent in D_3 and 18.65 per cent of maximum loss in D_2.

Comparing the percentage of loss of A category and C category, the loss of weight due to the abrasion was found to be more in A group than in C group. Among the B and D categories the loss of weight was more in B category than in D category. Hence 50:50 proportion of cotton-jute blended fabric has less resistance to abrasion irrespective of type of weave.

The statistical analysis reveals that there was significant difference existed between samples A Vs C, B Vs D, B_2 Vs D_2 at 1 per cent level whereas between samples A_1 Vs C_1, B_1 Vs D_1, A_2 Vs C_2, A_3 Vs C_3 and B_3 Vs D_3 at 5 per cent level.

7. Drapability:

Table X gives the drape co-efficient of all the samples in percentage.

TABLE - X

DRAPABILITY

Sample	Condition of the sample		Drape co-efficient (in %)	Gain over original	Percentage gain over original
A	Plain 50:50	Original	14	- -	-
A_1		Scoured and Bleached	17	3	21.429
A_2		Vat	20	6	42.857
A_3		Direct	18	4	28.571
B	Twill 50:50	Original	28	-	-
B_1		Scoured and Bleached	20	-8	-28.571
B_2		Vat	24	-4	-14.286
B_3		Direct	22	-6	-21.429
C	Plain 70:30	Original	21	-	-
C_1		Scoured and Bleached	22	1	4.762
C_2		Vat	22	1	4.762
C_3		Direct	22	1	4.762
D	Twill 70:30	Original	34	-	-
D_1		Scoured and Bleached	29	-5	-14.706
D_2		Vat	28	-6	-17.647
D_3		Direct	26	-8	-23.529

From the table X it is evident that the grey stage the drape co-efficient of samples A, B, C and D were 14,28,21 and 34 percentage respectively. The processes pretreatment and dyeing increased the drape character of the plain woven samples in both the blend ratios. The 50:50 blend ratio of plain woven samples gained more drape co-efficient than 70:30 plain woven samples. But as far as twill weave was concerned, there was loss of drape due to the pretreatments and dyeing. The maximum loss was found in samples B_1 and D_3 whereas minimum loss was experienced by sample B_2.

8. Drop Test:

The drop test of the original, bleached and dyed samples are given in Table XI and Figure V.

TABLE - XI

DROP TEST

Sample	Condition of the sample	Mean absorbing time in seconds	Gain over original	Percentage gain over original
A	Plain 50:50 Original	180.00	-	-
A_1	Scoured and Bleached	12.6	167.4	93.00
A_2	Vat	14.6	165.4	91.88
A_3	Direct	55.8	124.2	69.00
B	Twill 50:50 Original	249.00	-	-
B_1	Scoured and Bleached	22.6	226.4	90.92
B_2	Vat	10.0	239.0	95.98
B_3	Direct	33.8	215.2	86.43
C	Plain 70:30 Original	168.2	-	-
C_1	Scoured and Bleached	12.4	155.8	92.63
C_2	Vat	16.4	151.8	90.25
C_3	Direct	41.4	126.8	75.39
D	Twill 70:30 Original	218.4	-	-
D_1	Scoured and Bleached	16.8	201.6	92.308
D_2	Vat	18.2	200.2	91.666
D_3	Direct	17.2	201.2	92.125

SCALE:
On x axis 1 cm = 1 Sample
On y axis 1 cm = 25 Seconds

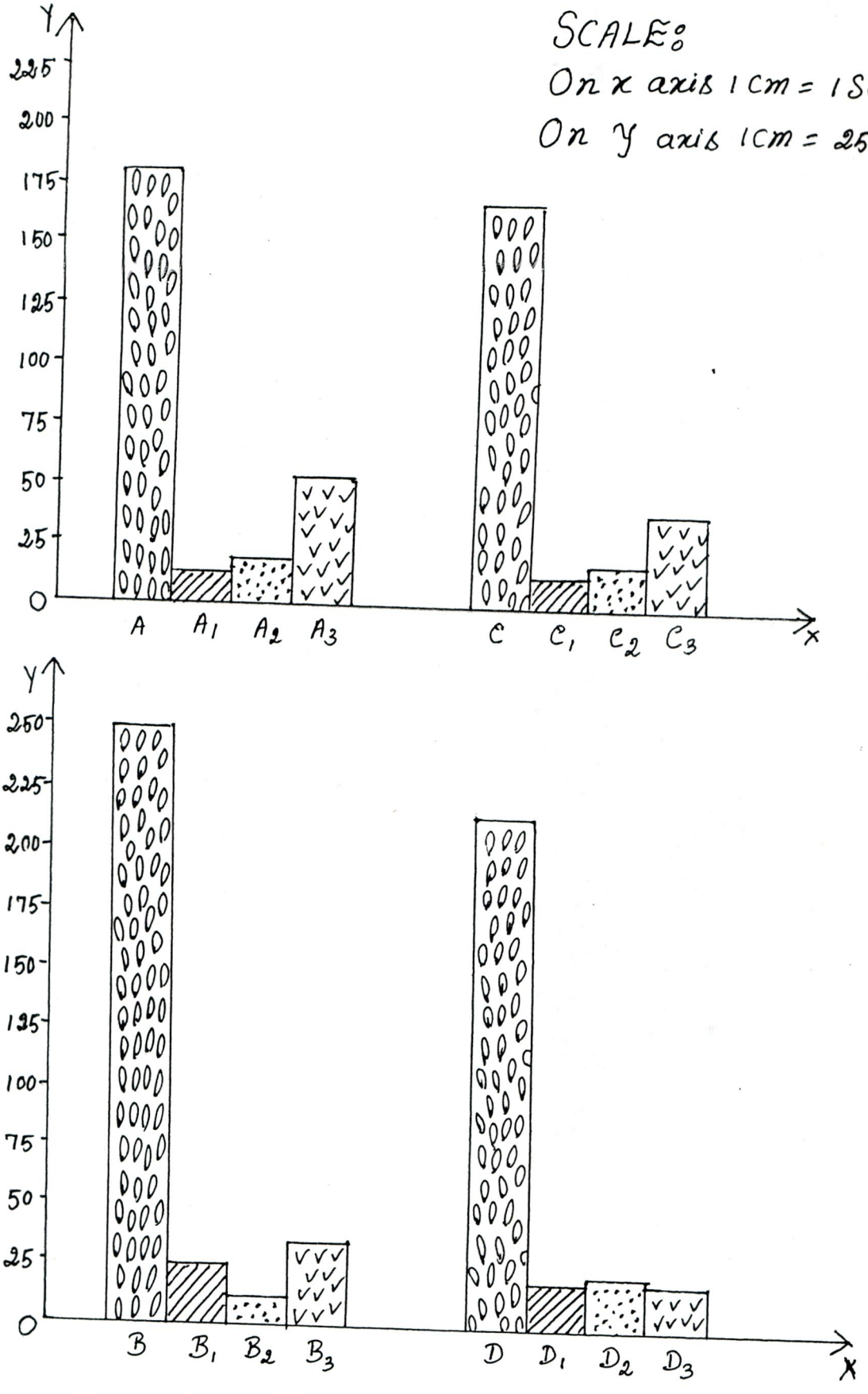


FIGURE - V DROP TEST

KEY:

Original

Scoured and Bleached

Vat

Direct

The Table reveals taht the original samples A, B, C and D took 180, 249, 168 and 218 seconds to absorb one drop of water. Almost in all the categories except B_1, the samples which were scoured and bleached took less time to absorb one drop of water. Sample B_1 (50:50 cotton/jute Twill) took 22.6 seconds and 33.8 seconds respectively.

Analysing the percentage of gain over original, it is clear that the plain woven direct dyed samples of both the proportions of blends took more time to absorb the water.

A conclusion can be made that the pretreatment and dyeing include the absorbing power of all the samples. Before dyeing plain woven samples absorbed water quicker than the Twill woven samples but dyeing caused plain woven samples to take more time to absorb one drop of water than twill samples.

9. Colour fastness to Sunlight:

The results of the colourfastness to sunlight are given in the Table XII.

TABLE XII

COLOUR FASTNESS TO SUNLIGHT

Condition of the samples	Samples	Change in colour
Plain 50:50		
Vat	A_2	5
Direct	A_3	2/3
Twill 50:50		
Vat	B_2	5
Direct	B_3	3
Plain 70:30		
Vat	C_2	5
Direct	C_3	2
Twill 70:30		
Vat	D_2	5
Direct	D_3	3

Grey scale ratings to evaluate the fastness grade

5 - No change

4 - Slightly changed

3 - Noticeably changed

2 - Considerably changed

1 - Much changed.

From the abvoe table, it is evident that the vat dyed samples are colour fast to sunlight, as the colour did not change even after weeks exposure.

Summary and Conclusion

V SUMMARY AND CONCLUSION

The cotton textile industry is an important one since nearly 2/3 of the total clothing requirements are met by cotton textiles. The per capita consumption, of all textiles, has increased, particularly the increase in cotton textile consumption is nearly 40 per cent.

From time immemorial, cotton has been the principle fabric of our country, as it can be worn round the clock, irrespective of the weather. Today in addition to cotton, we have many other synthetic fibres which are produced using chemicals. These fibres are slowly gaining popularity and they even try to occupy the place of cotton. But researches have proved that synthetic fibres are hazardous to health and the production of these fibres causes environmental pollution.

A time has come when people would like to revert back to cotton which is a pollution free fibre. But due to deforestation, there is a great scarcity and price increase for cotton goods. Hence it is not possible to meet the clothing requirements of the entire nation with cotton alone.

It is preferable to combine cotton with some other natural fibre which is available in plenty. Jute is one such natural fibre which is economical in price. Further both cotton and jute are ecofriendly.

In this study, an attempt has been made to weave cotton-jute union fabrics by using cotton-jute blended yarns varying proportions. Blended yarns of cotton-jute were used in two ratios 50:50 (cotton/jute) and 70:30 (cotton/jute).

The procedure adopted for the study comprised of the following steps.

1. Weaving:

Cotton-jute union fabrics were woven using simple loom adopting plain and twill 2/2 weaves. The cotton-jute union fabrics were produced in two different ratios of blends 50:50 (cotton/jute) and 70:30 (cotton/jute) used for weft side. In both the fabrics pure cotton was used for warp side.

2. Dyeing:

The woven fabrics in both the ratios were given scouring and bleaching treatment prior to dyeing. Later, dyeing was carried out by using vat and direct dye. The colour selected in both the dyes were violet.

3. Evaluation:

Original, scoured and bleached and dyed samples of the two fabrics were evaluated visually and by laboratory tests.

The findings of the study are listed below:

1. Visual inspection revealed that the samples were either medium or rough in texture. The scoured and

bleached samples were better in general appearance, texture and colour than grey samples. Among the dyed samples vat dyed samples were better than direct dyed samples. Visual inspection showed that there was not much difference due to weave or blend variations.

2. In each sample the warp and weft counts were found to be increased over original irrespective of weave or blend proportions.

3. Scouring and bleaching and dyeing caused increase in fabric weight of the samples. Generally, the fabric weight of 50:50 cotton/jute blends were more than 70:30 cotton/jute blends. As far as gain over original is concerned, plain woven samples of 70:30 cotton/jute blended fabrics gained more weight than 50:50 cotton/jute blended fabrics.

4. Thickness was increased due to the pretreatment and dyeing. The samples of 50:50 cotton/jute blend ratio were thicker than 70:30 cotton/jute blend ratio. With regard to percentage of gain over original, samples of 70:30 cotton/jute blend proportion possessed more thickness than 50:50 cotton/jute samples.

5. Tensile strength of twill fabrics in both proportions of blends are greater than the plain fabrics. Warp tensile strength seemed to be more or less the same in all samples whereas the warp elongation was found to be

more in 50:50 cotton/jute samples than the samples of 70:30 cotton/jute and it was true in plain weave also.

With regard to weft tensile strength, twill samples had more strength than the plain samples in both the blend ratios. As far as proportion of blend is concerned, the 70:30 cotton/jute samples had higher strength and elongation along weft direction than 50:50 cotton/jute fabrics.

6. Bursting strength was also increased in scoured and bleached and dyed samples. The increase was found to be more in scoured and bleached samples than dyed samples. With reference to proportion variation, 70:30 cotton/jute blends had more bursting strength than 50:50 proportion.

7. Resistance to abrasion was found to be better in plain and twill weaves of 70:30 cotton/jute than 50:50 cotton/jute blend proportion. The undyed samples had less resistance to abrasion than dyed samples. Loss of weight in plain sample was lesser than the twill woven sample.

8. Drape co-efficient of 50:50 cotton/jute blends. In twill woven samples the drape co-efficients were decreased over originals irrespective of blend proportions.

9. Drop test proved that the pretreatment and dyeing improved the absorbency of the samples where as dyed samples were found to be less absorbent than scoured and bleached samples. The samples of 70:30 cotton/jute blend ratio were found to have good absorbency.

10. Vat dyed samples were better than direct dyed samples as far as cotton fastness to sunlight was concerned.

CONCLUSION:

The investigation reveals that jute can be successfully blended with cotton. Except fabric weight, fabric thickness and drapability all other performance tests proved that the blend proportion 70:30 cotton/jute is better than the 50:50 cotton/jute blend ratio. Better results can be obtained through the use of vat dyes.

RECOMMENDATIONS;

1. A study on cotton-jute blends of various proportions woven at power loom can be taken up.
2. Attempts can be made to give enzyme and resin finishes for cotton-jute blends.
3. Count variation can be tried on cotton-jute blends to make it suitable for apparel purpose.
4. Wear study can be conducted to contrast the cotton jute blended fabrics which are given special finishing treatments from the unfinish cotton-jute blended fabrics.

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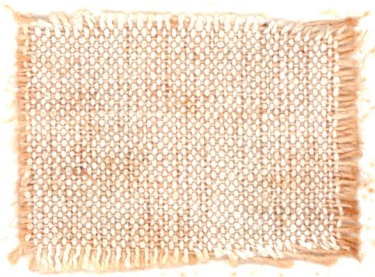
Appendices

APPENDIX-I

ORIGINAL

SCOURED AND BLEACHED



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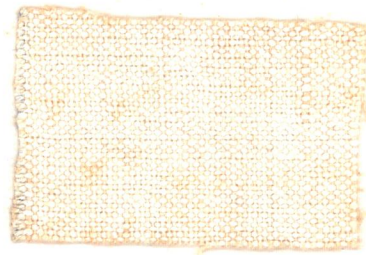

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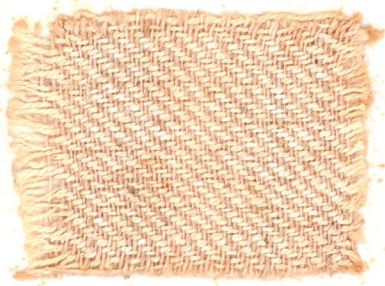
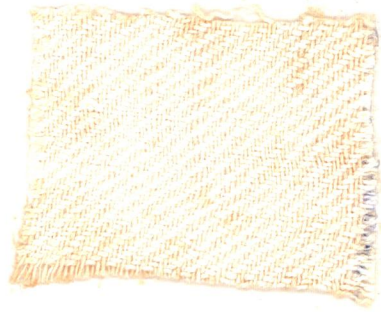
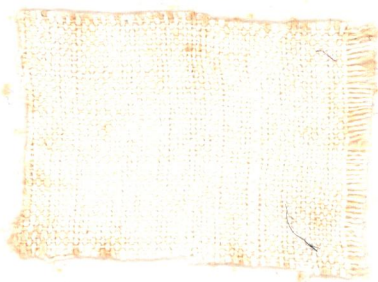
COTTON/JUTE



TWILL

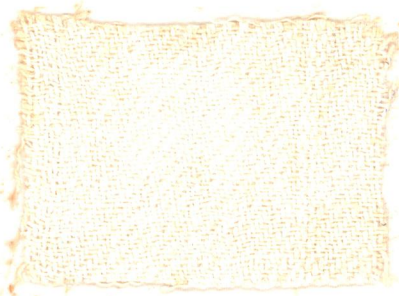


PLAIN

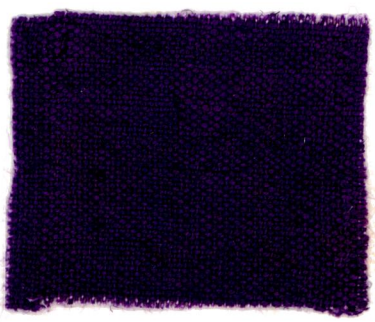
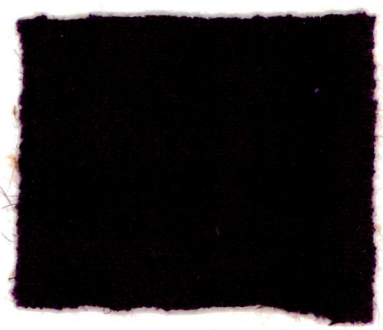


70:30
COTTON/JUTE

TWILL



APPENDIX-II

	VAT DYED		DIRECT DYED
		PLAIN	
50:50 COTTON/JUTE		TWILL	
		PLAIN	
70:30 COTTON/JUTE		TWILL	

APPENDIX - III

SCOURING AND BLEACHING PROCEDURE

Scouring and bleaching were carried out following the procedure adopted by UBL, as the work was carried out there.

RECIPE:

Volume of water	= 35 lit
Kiersol	= 90 cc
Kier stabilizer	= 540 cc
Peroxide	= 360cc
Super wet 444	= 25 cc

REQUIREMENTS:

Temperature	= 100°C
Total weight of the sample	= 2.58 kgs

PROCEDURE:

The samples were made wet and put into the water containing the above recipes. The temperature was brought to 100°C and maintained as same for 2 hours. This was followed by through rinsing in soft water.

APPENDIX IV a

PROFORMA USED TO EVALUATE SCOURED AND BLEACHED SAMPLES

Samples	General appearance			Texture			Colour		
	Good	Fair	Poor	Smooth	Medium	Rough	Bright	Medium	Dull
A									
A_1									
B									
B_1									
C									
C_1									
D									
D_1									

APPENDIX IV b

PROFORMA USED TO EVALUATE DYED SAMPLES

Samples	General appearance			Texture			Colour			Evenness of dye		
	Good	Fair	Poor	Smooth	Medium	Rough	Bright	Medium	Dull	Even	Fairly even	Uneven
A_2												
A_3												
B_2												
B_3												
C_2												
C_3												
D_2												
D_3												

APPENDIX - V

STATISTICAL ANALYSIS

According to Asthana (1976) 't' score or t-statistic is used to find out the difference between the observed and the actual value in terms of the standard error of the mean and to study its significance. The 't' distribution is commonly called students' 't'. distribution and alos used when sample size is 30 or less and the population standard deviation is unknown.

Testing differences between means of two samples (dependent samples or paired observations).

To test the hypothesis, the following statistics is followed:

$$t = \frac{d - 0}{S} \times \sqrt{n} \quad \text{or} \quad t = \frac{\bar{d}\sqrt{n}}{S}$$

where, d = mean of the differences

S = Standard deviation of the differences

The value of S is calculated as follows:

$$S = \sqrt{\frac{\Sigma(d - \bar{d})^2}{n - 1}}$$

It should be noted that t is based on (n - 1) degrees of freedom.

For example comparison of sample A and C for fabric weight is given.

A	C	d	$(d - \bar{d})^2$
6.5	6.00	0.50	0.0225
6.5	5.75	0.75	0.01
6.5	5.50	1.00	0.1225
6.25	5.75	0.50	0..225
6.25	5.75	0.50	0.0225
		$\bar{d}$= 0.65	$(d-\bar{d})^2$ = 0.02

$\bar{d}$ = 0.65 ; $(d-\bar{d})^2$ = 0.2

n = 5 ; (n - 1) = 4

$$S = \frac{0.2}{4} = 0.2236$$

S = 0.2236

$$t = \frac{0.065 \times \sqrt{5}}{0.2236}$$

$$t = \frac{0.065 \times 2.2361}{0.2236}$$

t = 6.50029

Since the calculated t value is greater than the table t-value at 1% level with degree of freedom 4. The difference between A and C are significant at 1% level.