EFFECT OF SELECTED AUXILIARIES ON TERRY COTTON DYEING.

By
K. Rani

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I INTRODUCTION

Textiles are a highly scientific area of study, at present because of the Technological development. The average consumer, however does not look for an indepth, science oriented body of knowledge about textiles, but does need to know enough facts about textiles to obtain maximum satisfaction. An adequate basic knowledge about textiles and textile products will enable the consumer to evaluate the products in terms of beauty, serviceability, comfort and ease of care. Textiles fulfil many purposes in our lives that the study of textiles can be approached in a number of ways.

Textile industry is at cross-road today. Changing fashions world-wise has created new fibres and processing techniques. The traditional cotton market is slowly changing giving way to man-made fibres. Among man-mades on account of the various advantages terylene became an essential raw material for textile mills. The first scale of polyester, terylene filament yarn was made just after second world war point out Robert and Solanki(1981). Strength, wearability and crease recovery are the properties mainly responsible for the popularity of terylene fibre.

The twentieth century con[redacted] can now choose among cotton, linen, wool, silk, rayon, acetate, [redacted] nylon, aramid, acrylic, [redacted] novloid, vinyon, saran, vinal, olefin, azlon, spandex, rubber, glass and terylene. The difficulty of choosing is compounded because many of these fibres can be blended with each other example nylon/ wool or [redacted]. Hirama et al (1976) opine that the production of terylene is rising [redacted] and that there is a [redacted] trend towards [redacted] blended fabrics.

The technique of blending fibres has become no doubt a matter of history in textiles, but the rapid [redacted] and [redacted] of newer and newer synthetic fibres in the market have [redacted] the scope of belending by providing [redacted] blend [redacted] to the textile [redacted] engaged in producing variety in textiles to cater to the need of the [redacted]. Terylene fibres are blended with wool and cotton for obtaining durable apparel items feel Nayal and [redacted] (1981) and Mahajan (1976). But blending is providing many problems in [redacted] such as in [redacted] of chemicals or [redacted] which in turn lead to faulty dyeing and printing - Neal (1977).

The purpose of dyeing is to produce economically a uniform shade without any variation in tone or depth. When the dyes are taken up at a fast rate by the material being dyed, the final dyeing is likely to be uneven. A judicious use of retarding agents and exhausting agents as well as adjustment of the temperature of dyeing produces even dyeing with maximum dye utilisation - Sadov et al (1973).

The hydrophobic nature and the compactness of fibre structure of synthetic fibres, especially terylene fibres make their dyeing difficulty. Dyeing of these fibres is done either at the boil or at the atmospheric pressure in the presence of carriers, which among other functions, swell the fibre, there by facilitating the entry of the dyestuff molecules in the fibre or by the use of elevated temperature like 130°c even at 210°c. Disperse dyes are the only class of dyes suitable for dyeing terylene, are essentially water insoluble and need the presence of dispersing agents in the dye bath. Most of the disperse dyes are sensitive to various dye bath auxiliaries, so it is wise to evaluate these auxiliaries. The use of the right type of auxiliaries employed in the proper concentrations has been found to be absolutely necessary to produce the dyeing economically.

In case of reactive dyes for cotton the application involves two steps - exhaution on to the fibre substances for which exhaution agents like common salt and glaubers salt are necessary and fixation of the dye with the help of an auxiliaries like soda ash, trisodium phosphate, sodium hydroxide and sodium bicarbonate. Use of auxiliaries to fix the hydrolysed reactive dye, like fixing the direct dyes, may be practised to increase the colour value.

Hence the investigator felt the need to study the effect of selected auxiliaries on Terry cotton dyeing.

The specific objectives of the study are -

1. Dyeing terrycotton with disperse and reactive dyes with selected auxiliaries.
2. Finding out the effect of the dyed samples by visual inspection and laboratory tests.

II REVIEW OF LITERATURE

Literature collected for the study are reviewed under the following headings:

A. Importance of Textiles
B. Blends and their Role
C. Importance of Terrycotton in Clothing
D. Dyeing of Textiles
E. History of Dyeing
F. Dyeing Methods
G. Dyeing Methods of Terry Cotton
H. Reactive and Disperse Dyes
I. Auxiliaries.

A. Importance of Textiles:

Importance of Textiles are dealt under the following headings:

1. Definition
2. History
3. Importance

1. Definition

Leone (1972) and Carolyn (1975) declare "Textiles" are woven fabrics, the term also means all spinnable fibres or materials suitable for weaving in addition to fabrics produced by knitting, felting, and all laces made of natural or man made fibres.

"Textiles" originally a woven fabrics, now a broad term applied to fibres, filaments, yarns and their products made by spinning, weaving, knitting, knotting, felting and other twisting and interlacing processes. The International Encyclopaedia of Science (1965).

"Textiles" is a material made of natural or man - made fibres and used for the manufacture of such items as clothings, household furniture, and automobile fittings" — Encyclopedia of Science and Technology (1960) and Marks (1959).

2. History:

Textile fibres and their use predate recorded history. Archeological evidence indicates that textiles of fine quality were made thousands of years before the oldest preserved accounts that refer to them. All early fibres were composed of natural plant or animal products, cotton, flax, wool and silk were most important and were employed most frequently, later mineral matter in the form of rock asbestos was used. Early in the twentieth century the first man-made fibres, rayon become a practical reality. Since the late 1930's scientists have produced literally dozens of new fibres among which exists terylene. Fabrics are characterised by certain properties, components or definite parts. Each individual fabric does not possess every possible components, so blending came into existance to over come this problem points out Joseph (1972).

3. Importance:

From earliest time to today people have used textiles of various types for covering, warmth, personal adorement and to display wealth. Everyone is an ultimate consumer affirm Korn Reich (1952) and Gale (1968).

Next to food, fibres play a vital role in meeting man's elementary needs of life food, clothing and shelter, in that order fibres provides raw materials for textiles which clothe millions - Tortora (1978).

B. Blends and their Role:

This aspect comprises:

1. Definition
2. History
3. Reasoning.

1. Definition:

Roy (1980) and Barve (1969) define blends as placing together two or more yarns of different fibres in an ultimate mixture so that the ultimate value of the fabric can be enhanced by the joint and positive qualities of the components of the blend.

Combining of staple fibres of different properties so that in fabric form a uniform mixture of the different staples is obtained - Duell (1957).

2. <u>History</u>:

Cheetham (1966) informs us that blends are known from Second World War one of such earliest blend is a linen and wool union.

Patridge (1973) feels that evidence of blends can be traced to quite an early period of civilisation and historical writings. It is known that union fabrics made of wool and linen, silk and linen were used 2000 years ago and samples are preserved in musiums.

3. <u>Reasoning</u>:

Shah and Thakore (1981) and Goswami <u>et al</u> (1977) say blending may be done to produce improved functionality, quality, softness, novel effects, colour effect, appearance, drape and cover, abrasion properties, minimising wrinkling, cost and shrinkage.

C. Importance of Terry cotton in Clothing:

Gupta (1976) and Holme (1979) tell us that the performance of terry cotton is indicated by elegance, social symbol, durability, fashion, cross dyeing possibility, better utility performance, attractive prints and colours these factors made these fabrics acceptable and satisfying to the consumer and made them permanent features in textile field.

D. Dyeing of Textiles:

Encyclopedia of Chemistry (1960), The Encyclopedia of Chemistry (1966) opine that dyes are substances which have colour and can be made fast to textiles by the process of dyeing termed as chromophores.

Van Nostands Scientific Encyclopedia (1976), Webster's New Twentieth Century Dictionary (1979) define dye stuffs as a soluble material capable of imparting permanent colour and produces a visual stimulation interpreted as colour by the viewer and the process is known as dyeing.

E. History of Dyeing:

It is believed that dyeing was practised as early as 3000 B.C. in China. Later on many vegetable and natural dyes were developed.

The New era was intiated by William Perkin in (1856) by discovering "Perkin Mauve" from aniline. Then came the revolution of use of synthetic dyes which ranges from direct dyes to azo dyes says Trotman (1970).

F. Dyeing Methods:

Joseph (1980) feels that dyeing can be for a textiles material as stock dyeing, top dyeing, yarn dyeing, piece dyeing, dope dyeing, Union dyeing, poly chromatic dyeing, slub dyeing and cross dyeing.

Miller (1970) states that when fibres differ in their affinity to dyes or if a fabric contains fibre types with not the same affinity for dyes, a procedure known as cross dyeing must be adopted. In brief cross dyeing is used in order to colour a mixture or blend of fibres which possess different dye affinities. So terry cotton can be dyed by this process.

G. Dyeing Methods for Terry Cotton:

Debryshire, Parr (1978) and Schieffer (1977) declare that dyeing of terry cotton blend is usually carried out as cross dyeing process. It is usually as a two bath process, but recently however one bath process have also been introduced which needs special equipment and facilities.

Douglas (1974) mentions that blend may be dyed in steps that is, one fibre is dyed and rinsed, the second fibre is then dyed and the fabric was rinsed. This can be repeated if more than two fibres are present that require different types of dyes which cannot be applied in a compatible bath.

The dyeing of polyester can be done by either carrier dyeing, high temperature dyeing or thermosol dyeing. After disperse dyeing an intermediate reduction clearing is done, to remove disperse dye adhering to cotton part. Then the cotton component is then dyed with reactive dye by jigger dyeing, pad batch process or continuous process Srivastava (1979) and Farrell (1981).

1. Carrier dyeing
2. High temperature dyeing
3. Jigger dyeing.

1. Carrier dyeing:

Moncrief (1970) tells us that by using a carrier which enable the chain molecules to move easily, increasing the distance between them, so that the diameter of the fibre increases which in turn accommodate more dyestuff molecules. Tumescol (CP) have been used for terylene in this method.

1. High temperature dyeing:

At temperatures of 120°C to 130°C the chain molecules are much freer to move and the dye stuff can penetrate the fibres well. So that good, medium and heavy shades can be obtained within a reasonable time to say one hour by using auxiliaries like diastin TCI and Lyogen DFT.

2. Jigger dyeing:

Cockett and Hilton ~~(1988)~~ (1961) say that after dyeing terylene part cotton component can be dyed with reactive dye in a hand driven jigger.

H. Reactive and Disperse Dyes:

The various aspects included under this are:

1. Reactive dye
2. Disperse dye

1. Reactive dye:

The literature which comes under are:

a. Definitions
b. History
c. Properties of reactive dye
d. Discription of jigger.

a. Definitions:

Hawley (1977) and Carolyn (1975) opine a dye under suitable condition is capable of reacting chemically with a substance to form a corvalent dye substrate linkage.

James (1975) and Abrahart (1968) define a reactive dye as a dye which under the conditions of application enters into chemical combination with the substrate, a covalent bond being formed.

b. <u>History</u>:

Hundred years after the discovery of Mauvine in (1856) cross and Bevan in (1895) probably first discovered reactive dye via covalent bond. This development ended up in gradual steps in 1967 in 1972 by various dye stuffs introduced for the reactive groups say Bird and Boston (1975) and Buher <u>et al</u> (1967). It took exactly 100 years following W.H. Perkins preparation of the first synthetic dye Mauvine before the first reactive dyes for cellulose were used commercially. In 1956 ICI introduced three bright procion reactive dyes a yellow, a red and a blue until that time dyes owed their fastness on cellulose to some type of physical association with the fibre - American Dyestuff Reporter (1976), AITC Industries Ltd.

c. <u>Properties of reactive dyes</u>:

Bogle (1977) and Ramsay (1981) point out that reactive dyes are characteristic of good dye fibre bond stability, bleach fastness, less cost, average light fastness, and pressing fastness properties.

D. Description of jigger:

A hand driven jigger consists of a container holding two rollers and guiding rods with a handle to rotate says the Dalal Obermier and Dalal (1978).

2. Disperse dyes:

The various aspects discussed under this are:

a. Definitions
b. History
c. Properties
d. Beam dyeing machine

a. Definitions

Gordon (1979) describes that disperse dyes are originally introduced for dyeing cellulose acetate and usually applied from fine aqueous suspension.

Kulkarni and Trivedi (1967) define disperse dye stuffs that disperse in water in the presence of a wetting agent or dispersing agent. The speciality of disperse dyes is that it disperses it self into the fibre.

b. History

In 1922 Britishern pioneered in the development of disperse dyes and progressed to the stage of use of amine anthraquinon in a state of fine suspension or in a colloidal state and in the presence of an emulsifying agen or colloid say Lube (1955) and Herman and Norman (1966).

The first members of the disperse dyes were introduced in 1924 by Baddiley and Shepherdson of the British dyestuff corporation and by Ellis of the British Celanese Company opine Encyclopedia of Polymer Science (1966) and Blackburn and Victor (1980).

c. Properties

Fielding (1977) and Leube (1977) declare that disperse dyes are water insoluble. High temperature is required to apply the dye even the aid of carriers increase its fixation. These dyes are colour fast to many tests.

d. Beam dyeing machine

Kyents apparatus and installation manufacturing company describes it as a reversible axial pump producing static pressure for temperature upto 130°C with sampling device.

Klein (1976-'77) describes the beam dyeing machine as a horizontal kier with the perforated beam held in horizontal position. It can have 3 to 6 small diameter beam introduced in an autoclave or a single large diameter perforated cylinder.

I. <u>Auxilaries:</u>

Literature about the auxilaries are reviewed under the following headings:

1. Definitions
2. History
3. Classification
4. Characteristics

1. <u>Definitions:</u>

Webster and Collins (1979) Hawley (1977) and Mehra (1980) state that an auxiliary is a helping, aiding, assisting, or support by joint excertion, influence or use on both natural and synthetic fibres in the preparation and finishing.

Daruwalla (1980) feels that the meaning of auxiliary is "of being helpful to".

Processing of textile material involves the use of diverse types of compounds to performs various functions. These compounds are variously known as "Textile Auxiliaries" "Textile Chemical" "Textile Process Chemical". Horsfall and Lawrie (1949).

2. <u>History</u>

The industry may almost be said to have started with the discovery of soap but foundation was laid in 1876 by discovery of Turkey red oil in 1876. And next solid achievement was made in 1914 to 1918 and from then much attention was paid to to increase the efficiency and performance of processing affirm Withaker and Wilcock (1942) and Withaker (1980).

3. Classification:

Mehra (1979) classified auxilliaries as wetting agents, dye fixing agents, detergents, dyeing assistants, stain removers, swelling agents, levelling agents, and so on.

Shenai (1976) classified auxiliaries those which are used in textile processing and after the purposes are served they have to be removed and those which continue to form the integral part of the material.

4. Characteristics:

Abraham, Kurt Dallion and Takekoshi (1974) are pointing out that the auxiliaries should be characterized by efficiency, economy, competability, availability, stability, easy handling, leveling power, good liquor ratio, reservation of blend component, odourlessness absence of toxicity, irritation, smoke formation accompanied by migrating, retarting, benetration, foam forming powers with low cost and light fastness properties.

III EXPERIMENTAL PROCEDURE

The experimental procedure comprises of the following aspects:

A. Dyeing the Samples

B. Testing the Samples

A. Dyeing the Samples:

The various aspects of dyeing are:

1. Selection of the Material
2. Selection of the Dyes
3. Selection of the Auxiliaries
4. Selection of the Dyeing Method
5. Method of Dyeing
6. Numbering the Samples

1. Selection of the Material:

Blends of terylene and cotton are achieving great popularity and will be of even greater importance in the future. Terylene fibre when blended with cotton in 67/33 proportion gives a fabric triple the strength and life of 100 per cent cotton and 50/50 gives the double strength besides being an excellent combinations opine Parikh and Aiyer (1980) and Press (1959). Nishida et al (1978) expressed that 67/33 blend provides some of the hand and character associated with fine cotton and there is enough terylene present, to offer excellent wearability and workability which made the selection of 67/33 terrycotton blend acceptable and satisfying affirm Rajkumar and Srivastava (1980). Hence Terry Cotton material was selected for this study.

The details about the selected material are given in Appendix - I.

2. Selection of the Dyes

Terry cotton can be dyed with different classes of dyes with varying degrees of success they are:

a. Disperse / reactive

b. Disperse / Vat

c. Disperse / Indigosol point out Colourage (1980)

The selection of particular class of dyes would depend upon the type of material, the fastness properties required, economy, and equipment available declares Brauks (1980.

The investigator preferred Disperse/reactive classes of dyes because of the fastness property, suitability and availability of equipment.

a. Selection of the disperse dye:

The only dyestuff that has affinity for terylene under ordinary conditions are those which may be applied from aqueous dispersion opines Moncrief (1970).

Disperse dyes are manufactured and sold under the following names - Foron dye stuffs, Dispersal and Duranal, Resolin, Dianix, Sumikaron, Palanil, Samaron and Terasil lists Jagannathan (1975).

The investigator selected Foron Orange ERL, since Foron exhibits high order of fastness properties, high molecular weight and sublimation property, has got good bath exhaution, rapid diffusion, and high fixation yield, hardly any colour is left on the fibre surface at the end of dyeing declares Naskar (1980).

b. Selection of the reactive dye:

Reactive dyes were preferred due to the limitations in fastness and shade properties of other dyes for dyeing cotton-Ganmito (1981).

Reactive dyes offer bright shades unattainable in other classes of dyes, a full spectrum of shades from the brightest to the dullest, excellent levelling property, high solubility, high reactivity coupled with rapid diffusion and economy of energy usage - Fuels (1977).

As per Marsh's (1979) idea Procion dyes are ionic in character and posses good solubility in cold and hot water with the addition of glauber's salt or common salt. Therefore for cross dyeing Procion orange M2R was selected.

3. Selection of the Auxiliaries:

The auxiliaries which could be used on terry cotton are grouped as follows:

a. Auxiliaries for terylene

b. Auxiliaries for cotton

a. Auxiliaries for terylene

Auxiliaries for terylene are Orthophenyl Phenol, Trichlorobenzene, Lyogen DFT, Benzoic acid, Orthophenyl diphenyl, Phenyl phenol, Methy Salicylate, Latyl carriers, Palanyl carriers, Dicene-60, Phenyl - methyl carbinal, Sevipalan, and Tetrahydronaphthalene.

Out of the above mentioned auxiliaries Orthophenyl phenol, Trichlorobenzene and Lyogen DFt were selected.

Tumescol (OP) is a sodium salt of orthophenyl phenol and is soluble in boiling water. It is effective over the wide range of P_H and is cheaper. It should be noted that no amount of carrier is left in the dyed fabric, otherwise it will affect the light fastness of the dye. Hence it was selected.

Dilatin (TCY) (Trichlorobenzene) gives good exhaustion even at temperature of 190°F and do not affect the light fastness and is effective to any P_H It is a swelling agent for polyester fibre.

Lyogen DFT is substantive to disperse dyes and is an effective levelling agent on dyeing of synthetics. It also exhibits dispersing properties with increase in dye bath stability and it is a levelling agent for disperse dyes - Sandoz Technical Information.

b. <u>Auxeliaries for cotton</u>

The various auxeliaries used for cotton are - Trisodium Phosphate, Soda ash, Caustic soda, Sodium chloride and Urea.

Selected auxiliaries were trisodium phosphate and soda ash since they are the accelerators of dye fixation but the others are only swelling and levelling agents.

4. Selection of the Dyeing Method:

The dyeing of terry cotton could be done by two bath process, and one bath process - Venkatesh et al (1980).

Two bath process was selected due to the possibility of doing it with the available equipment.

5. Method of Dyeing:

Here the dyeing of terylene was done by both carrier dyeing and high temperature dyeing for comparison. After disperse dyeing an intermediate reduction cleaning was done to remove disperse dyes adhering to cotton part. The goods were well rinsed before dyeing with reactive dyes. The cotton component was then dyed with reactive dye by using hand driven jigger - Mitsubishi (1978) and Garner (1949).

a. Carrier dyeing:

Ingredients

Foron orange RRL (1%)	-	1g. on 100 g weight of fabric.
Tumescol (OP)	-	12cc/litre.
Dispersol	-	1g/litre
Sodium acetate	-	5g/litre

The dye bath was prepared with dispersing agent and Tumescol (OP) at 60°C. The PH of the dye bath was adjusted with acetic acid so that it lies in the range of 5 to 6.5 and the goods were worked for 10 minutes. Then the required amount of dye stuff was added and the temperature was raised to boil and dyeing was continued for the minimum period of 60 minutes. Then goods were removed, washed and dried. The whole procedure was carried out in hand driven jigger (Plate-I) - Sandos Technical Information and Imperial Chemical Industries Ltd.

b. High temperature dyeing

Ingredients:

Foron orange BRL (1%)	- 1 g dye on 100 g weight of fabric
Dispersing agent	- 1g/litre
Acetic acid	- 1cc/litre
Sodium acetate	- 1g/litre
Dilatin TCI	- 2g/litre
Lyogen DFT	- 2g/litre
Liquor ratio	- 1:5

The PH was maintained at 5 to 5.5 and the sample was worked for one hour at 130°C on a beam dyeing machine (Plate - II). Rinsing was then followed.

c. Cross dyeing

Ingredients

Procion orange m2R	- 1g or 100g weight of fabric (1%)

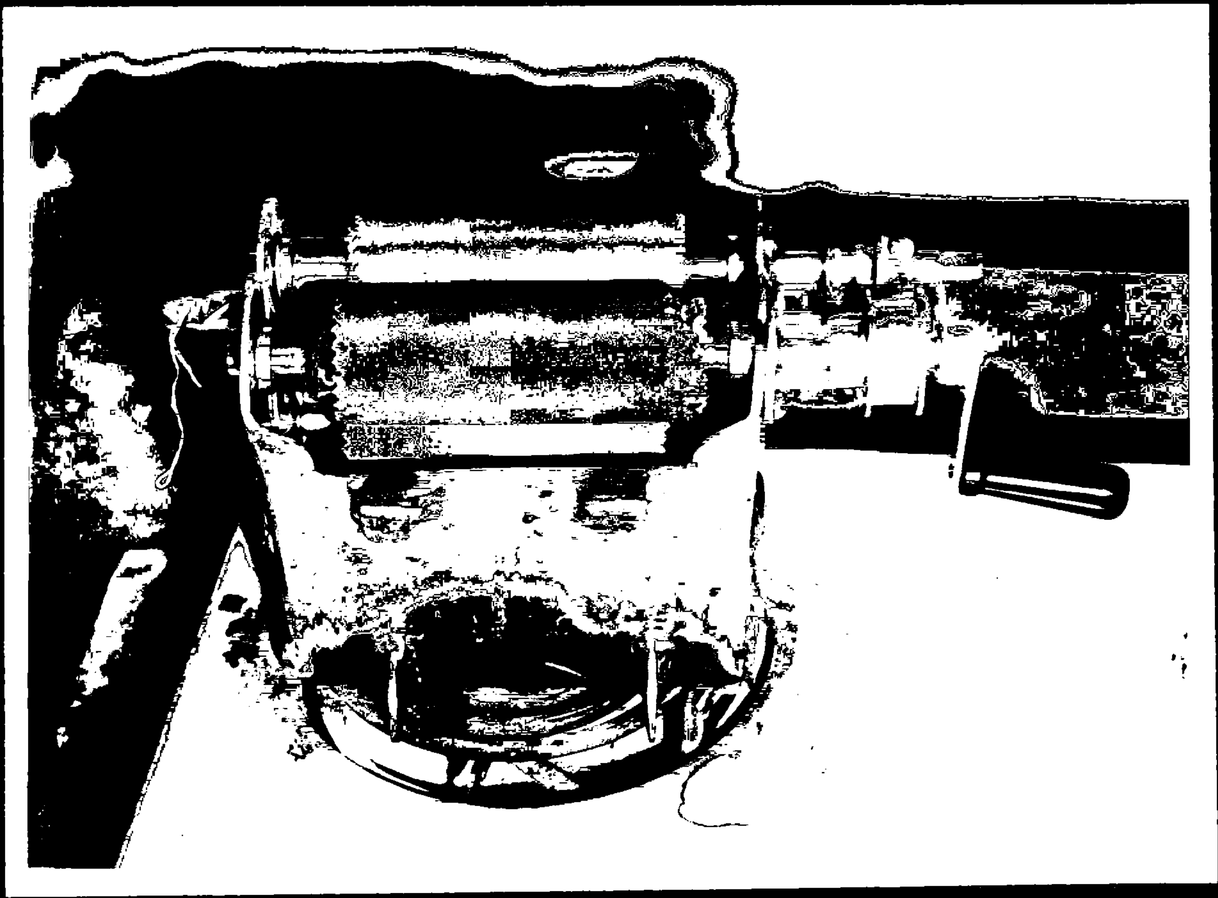


PLATE - I JIGGER

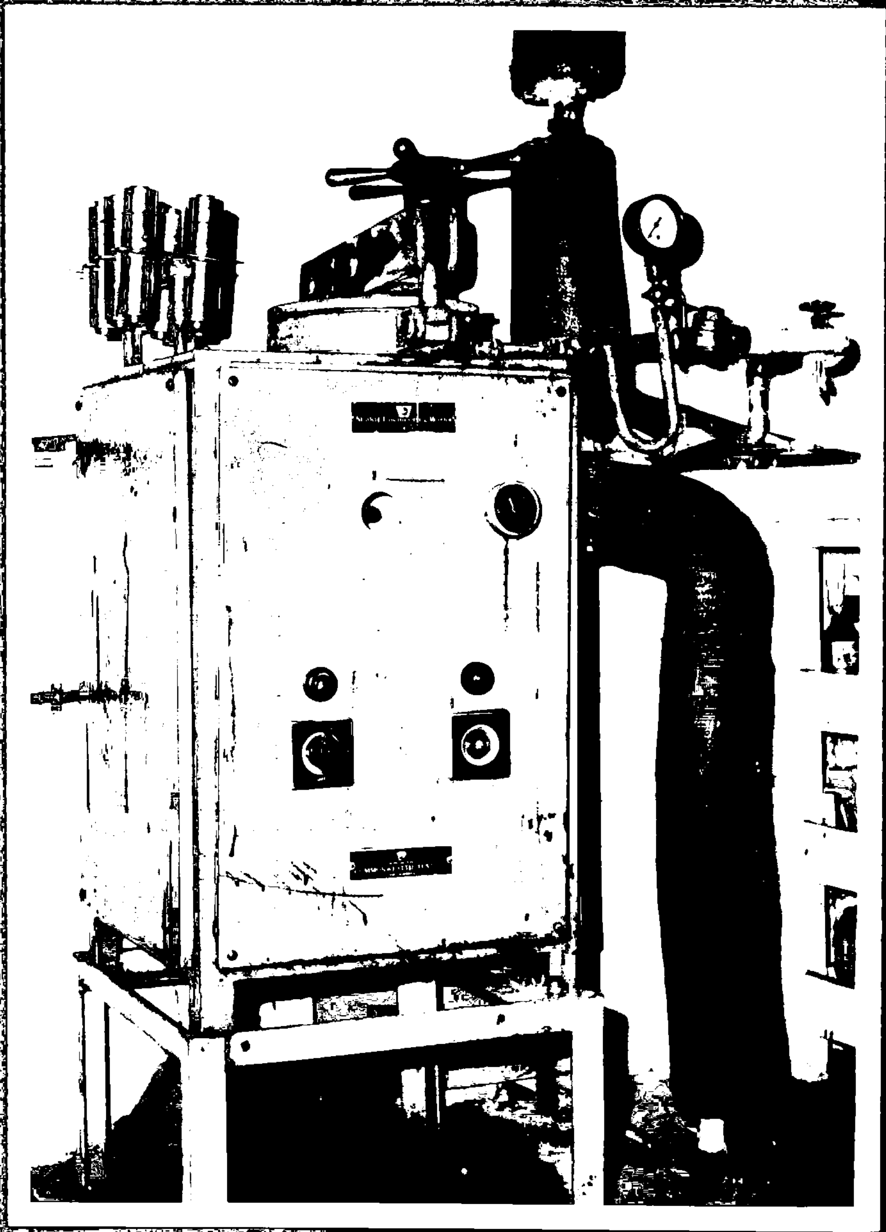


PLATE - II BEAM DYEING MACHINE

Sodium chloride - 100g/litre

Soda ash - 30g/litre

For sample with trisodium - phosphate -25g/litre

The sample was treated in the dye batch for 15 minutes at 60°C after adding common salt solution, worked for 15 minutes and finally soda ash or trisodium phosphate was added and 30 minutes of treatment was given at 60°C. The whole procedure carried out in hand driven jigger. Then it was removed, rinsed in water and treated with soap solution for 5 minutes.

6. Numbering the Samples

The samples obtained were numbered as follows:

0 - Basic sample dyed with disperse and reactive dye in carrier and cross dyeing methods without auxiliaries.

A - Sample dyed with disperse and reactive dyes with tumescol (OP) and trisodium phosphate as auxiliaries and cross dyeing method.

B - Sample dyed with disperse and reactive dyes with tumescol (OP) and soda ash as auxiliaries in carrier and cross dyeing methods.

O_1 - Basic sample dyed with disperse and reactive dyes without auxiliaries in high temperature and cross dyeing methods.

A_1 - Sample dyed with disperse and reactive dyes with dilatin TCI, Lyogen DFT, and trisodium phosphate as auxiliaries in high temperature and cross dyeing methods.

B_1 - Sample dyed with disperse and reactive dyes with dilatin TCI, Lyogen DFT, and soda ash as auxiliaries in high temperature and cross dyeing methods. Samples are given in Appendix IIa and IIb.

B. Testing the Samples:

This aspect comprises of:

1. Visual inspection
2. Laboratory tests
3. Colour fastness tests.

1. Visual inspection:

Visual inspection of dyed samples was done for uniformity of colour, depth of shade and lustre. The judges were post-graduate students majoring in Textiles and Clothing numbering 15 and their staffs numbering 5. Proforma used for the visual inspection is given in Appendix -III.

2. Laboratory tests:

The various laboratory tests are:

a. Abrasion resistance
b. Tear strength
c. Bursting strength
d. Pilling test.

a. Abrasion resistance:

Booth (1970) declares that abrasion is just one aspect of wear and is the rubbing away of the component fibres and yarns of the fabric.

The samples were fed into Eureka's abrasion resistance tester (Plate III). The machine consisted of a duro aluminium plate supported by three pillers. On the top of each piller is a ball caster, which gives two simple harmonic motions in a "Lissajous Figure". The top plate has four slabs with sample holder. The mushroom shaped sample holders rest upon one of the four small abrant tables. These mushroom shaped holders rub the sample on the surfaces which were fixed with emery paper No.III with 200g head weight. Seventy rubs were standardised and were given to each and every sample.

b. Tear Strength:

Grover and Hamby (1969) state that the strength is a measure of the resistance to tearing of either the warp or filling series of yarn.

The sample was fed into the tear tester manufactured by Sri Ram Institute for Industrial Research (Plate - IV). The instrument consists mainly of a pendulum supported on a solid shaft mounted on ball bearings for free oscillation.

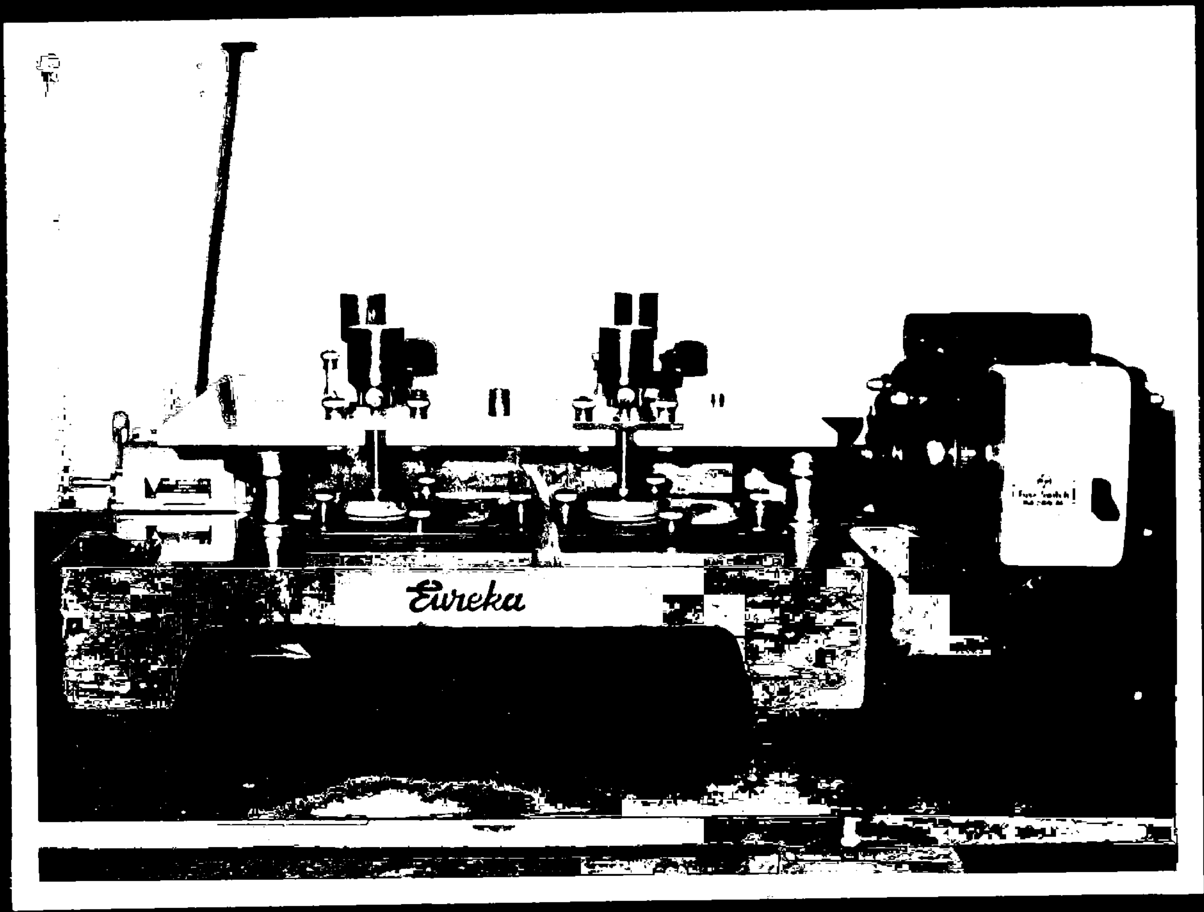


PLATE - III ABRASION RESISTANCE TESTER

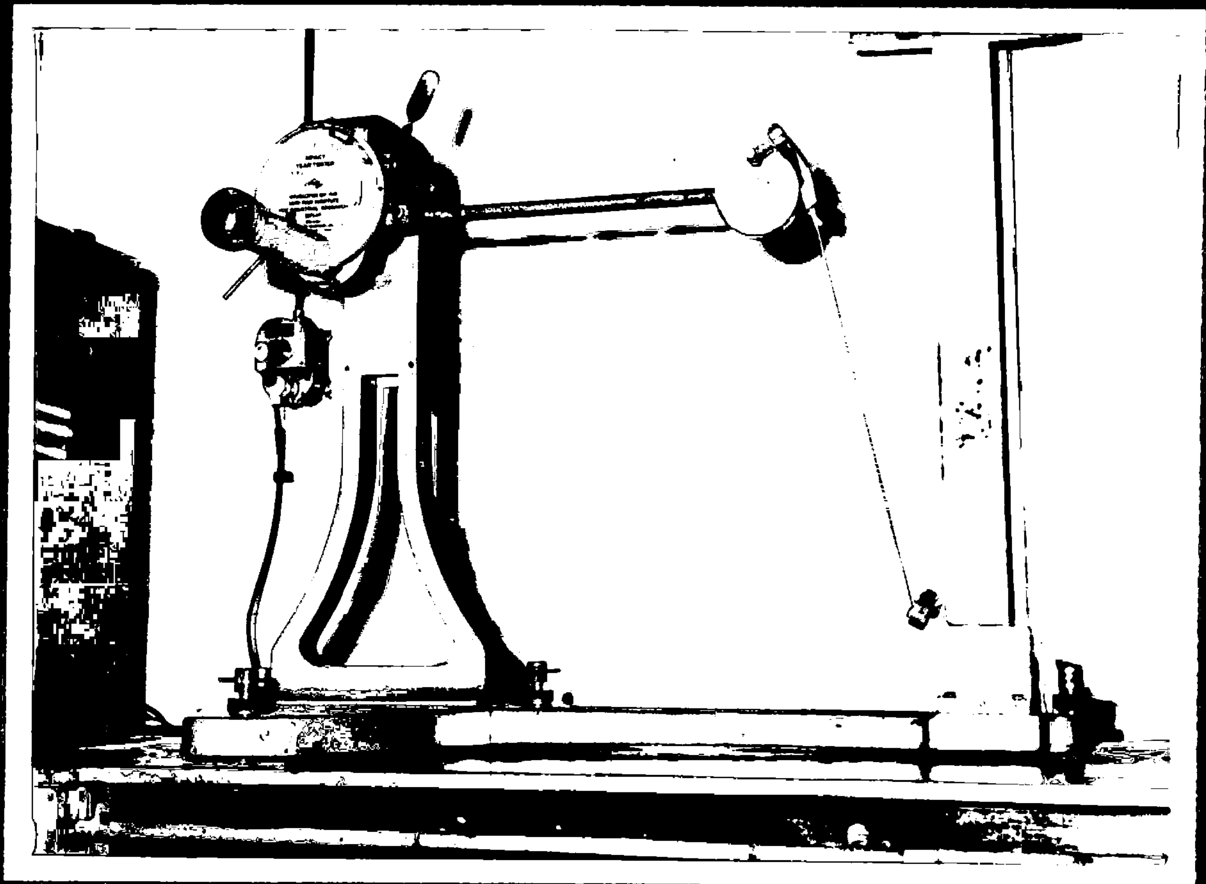


PLATE - IV TEAR STRENGTH TESTER

A moving clamp is attached to the pendulum weight and a fixed clamp is attached to the base. A catch holds the pendulum in the horizontal position on the right hand side of the unit and is released when required by the release. Readings were noted in pounds per square inch.

c. Bursting strength:

The bursting test measures a composite strength of both the warp and filling yarns simultaneously and indicate the extent to which fabric can withstand bursting, type of force with pressure applied.

The sample was fed into Bourdon's patent bursting strength tester (Plate - V). The instruments essentially consists of two parts, namely the pressure developing system and the clamping device. In the instruments load is applied on the hydraulic principle. The liquid used as the compressing medium being glycerine the hydraulic pressure is developed by means of a screw driven piston - Hall(1965).

d. Pilling tests:

Lyle (1977) say pills are bunches or balls of tangled fibres on the surface of a fabric that are held to the surface by one or more fibres.

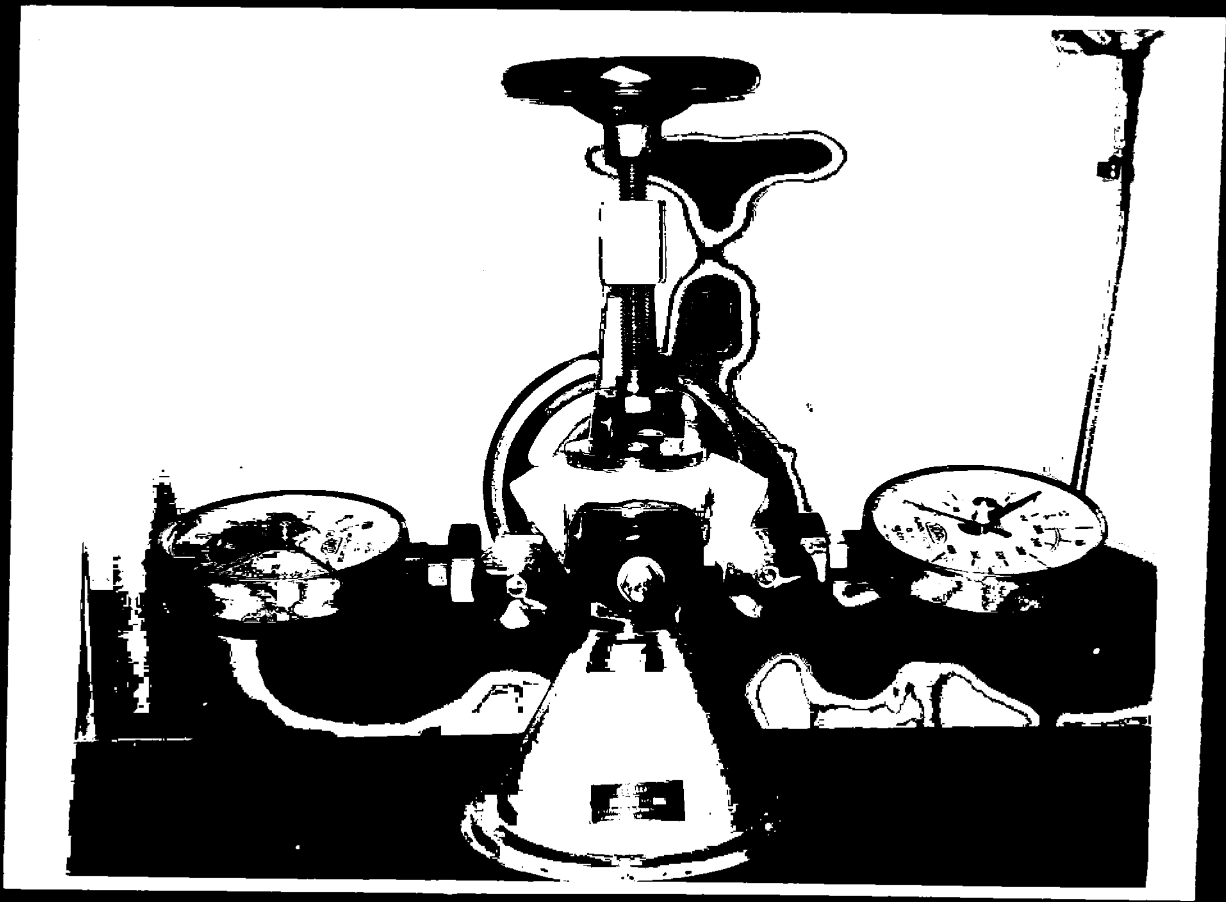


PLATE - V BURSTING STRENGTH TESTER

The samples were fed into Foricon Pilling Tester (Plate - VI). Which consists of two wooden boxes of 9 x 9 inches with 1/8 inch lining. This rotates at a rate of 60 revolutions per minute.

A piece of fabric measuring 5 x 5 inches is sewn so as to be a firm fit. When placed around a rubber tube 6 inches long 1 1/4 inch out side diameter and 1/8 inch thick. This sample was compared with the standards.

3. Colour Fastness Tests:

Tests which fall into this category are:

a. Fastness to sunlight
b. Fastness to perspiration
c. Fastness to laundering
d. Fastness to pressing wet and dry
e. Fastness to crocking wet and dry.

a. Fastness to sunlight:

As per Wingate's (1972) instruction a 3 x 5 inches fabric was taken and one inch of fabric was exposed to sunlight for 8 hours a day. After one week the next part was exposed for 2 weeks and the subsequent parts for 3 weeks and 4 weeks respectively. After one month it was compared with the original.

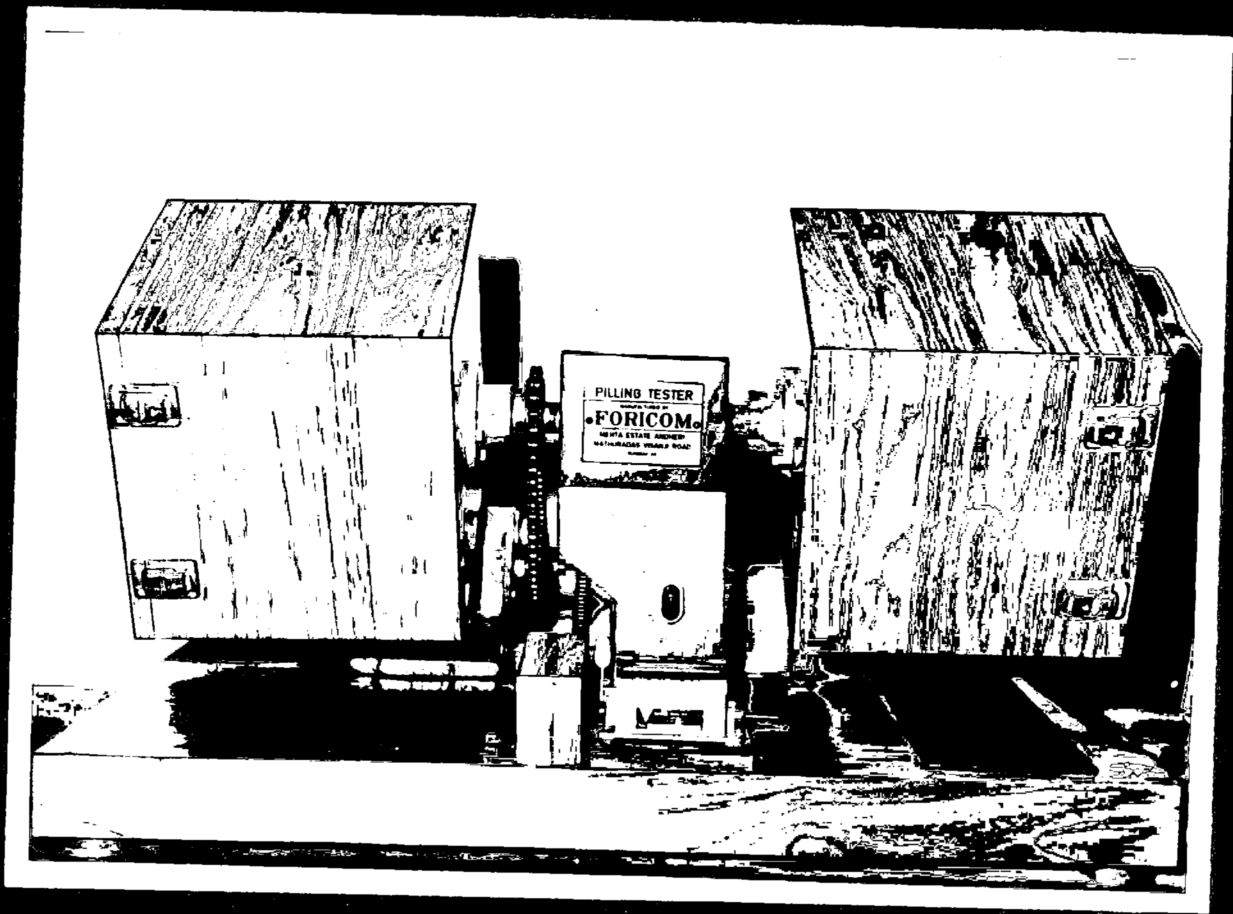


PLATE = PILLING TESTER

B. Fastness to perspiration:

As per Potter and Corbman (1957) a piece of 1 x 3 inches of samples was soaked in dilute acetic acid solution the sample was rolled in a piece of undyed cloth and left for 4 days. This was compared with the original for any shade variation.

C. Fastness to laundering:

A 3 x 1 inch sample was washed with warm water and soap, rinsed in clear water and then dried. It was ironed and the colour of the washed and unwashed samples was compared and the white fabrics was examined for any discolouration as per Taylor (1972).

D. Fastness to pressing -wet and dry:

As per Hall's (1965) and Wingate's (1942) declaration a sample of 3 x 1 inch along with a white material was ironed with a very hot iron. After the sample was cooled, it was compared with the original fabric. The white fabric was examined for any discolouration. It was done both in wet and dry condition.

E. Fastness to crocking-wet and dry:

To test the fastness to crocking, a dry sample of 3 x 1 inch was rubbed against a white cloth. The same test was done with a wet sample-white cloth was observed for any discolouration and results were noted - Lyle (1977), and Potter and Corbman (1967).

IV RESULTS AND DISCUSSION

Results of different aspects of the experiment are discussed under the following headings:

A. Visual Inspection

B. Laboratory Tests, and

C. Colour Fastness Tests.

A. Visual Inspection:

Visual Inspection comprises of:

1. Depth of Shade of the Samples.
2. Uniformity of Colour of the Samples, and
3. Lustre of the Samples.

1. Depth of Shade of the Samples:

Findings are shown in Table I and Figure 1.

TABLE I

DEPTH OF SHADE OF THE SAMPLES

Condition of the Process	Sample Number	Depth of Shade in Percentage		
		Dark	Medium	Light
Carrier dyeing at 100°C	O	0	5	95
	A	75	25	0
	B	10	95	5
High Temperature dying at 130°C	O_1	0	10	90
	A_1	85	15	0
	B_1	25	75	0

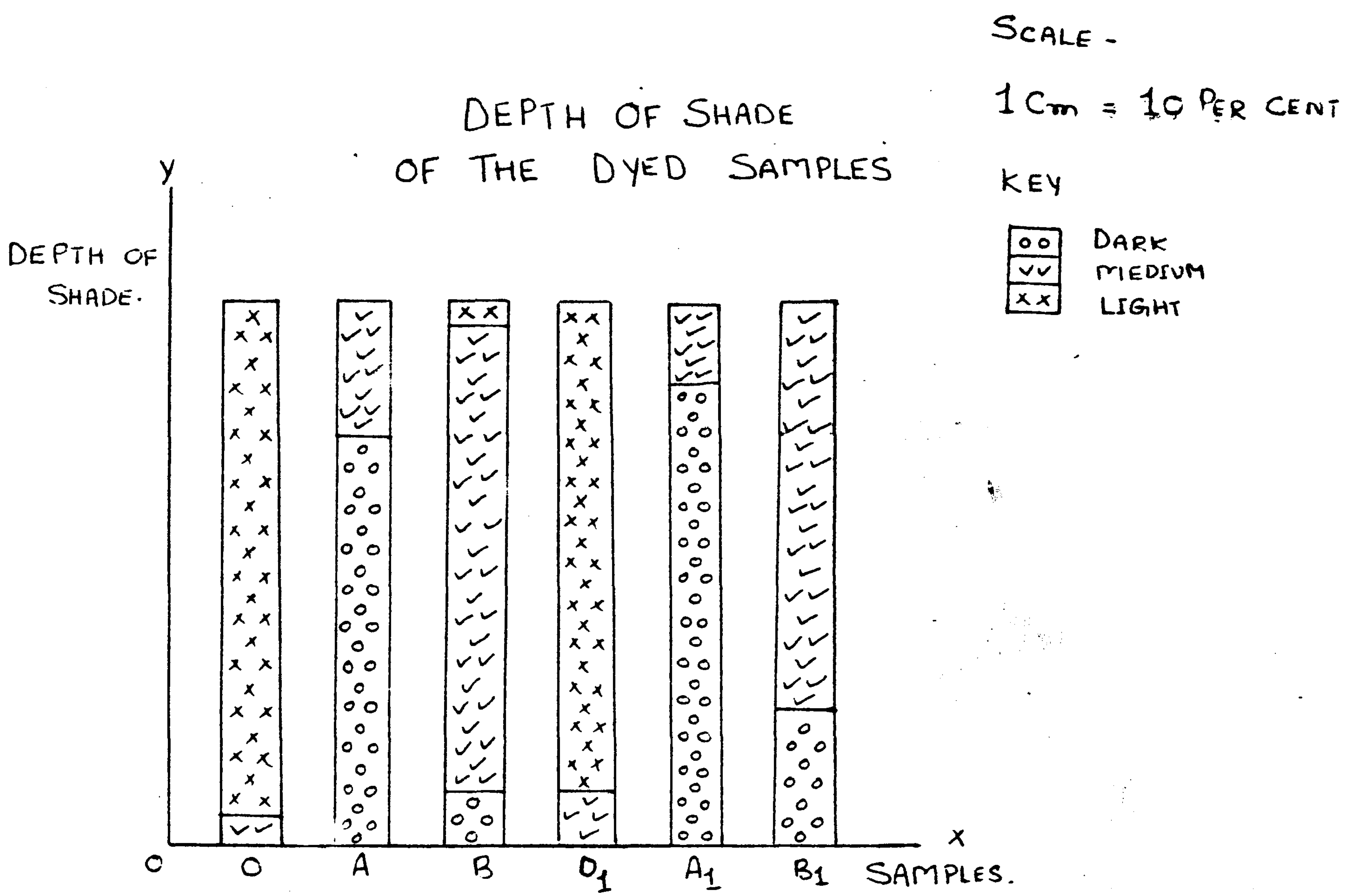

DEPTH OF SHADE
OF THE DYED SAMPLES
SCALE -
1 Cm = 10 PER CENT
KEY
DARK
MEDIUM
LIGHT
y
DEPTH OF SHADE.
x
O
O
A
B
O_1
A_1
B_1
SAMPLES.

FIGURE - 1

Table I shows that sample O was graded by 95 per cent of judges as light in shade and the remaining as medium in shade, where as A was rated as dark and medium in shade by 75 and 25 per cent judges respectively. Sample B was categorised by 85 per cent of judges as medium in shade and the same was graded as dark and light by 10 and five per cent visualisers respectively.

Samples dyed under high temperature were rated by the judges as follows: O_1 was judged as light in shade by 90 per cent of the judges and the remaining rated it as medium. Sample A_1 was graded by 85 per cent judges as dark in colour and the remaining as medium, in shade. But B_1 was considered as medium in shade and dark in shade by 75 per cent and 25 per cent judges respectively.

It could be concluded that samples OO_1 dyed without auxiliaries in carrier dyeing and high temperature dyeing were light in colour. But samples AA_1 dyed with auxiliaries (Tumescol (OP) or Dilatin TCI and Lyogen DFT, and Trisodium Phosphate) were said to be dark in shade, whereas BB_1 dyed with auxiliaries (Tumes col (OP) or Dilatin TCI and Lyogen DFT and Soda ash) were rated as medium in colour. All the samples dyed with auxiliaries eventhough under different dyeing methods showed the same shades eventhough the rating was different.

Koshti (1974) declares that the rate of diffusion of dyes with in the fibre is increased by three possible lines:

a. The use of dye of a small molecular size

b. The use of agents to increase the penetrability of the fibre and

c. The use of high temperature.

This is proved in the sample A_1 where the dyeing was conducted at high temperature with suitable auxiliaries and high molecular weight dye Foron Orange EBL. When compared to A which was dyed with same conditions except that it was carrier dyeing.

Venkatesh et al (1980) opine reactive dyes are used in combination with disperse dyes for producing bright, fashion shades such as turquoise and orange.

2. Uniformity of Colour of the Samples:

Visual inspection regarding uniformity of colour of the samples are indicated in Table II and Figure 2.

TABLE II

UNIFORMITY OF COLOUR OF THE SAMPLES

Condition of the process	Sample Number	Percentage of Uniformity of Shade		
		Very Good	Good	Fair
Carrier dyeing at 100°C	0	60	40	0
	A	50	30	20
	B	40	55	5
High Temperature dyeing at 130°C	0_1	10	25	65
	A_1	70	30	0
	B_1	25	70	5

Table II reveals that sample 0 was rated as very good as for the uniformity of colour by 60 per cent of the judges, the remaining 40 per cent graded it as good. The uniformity of colour of sample A was categorized by 50 per cent of the judges as very good, 30 per cent as good and 20 per cent as fair. Where as B was considered to be good in uniformity of colour by 55 per cent, very good by 40 per cent, and fair by five per cent of the judges.

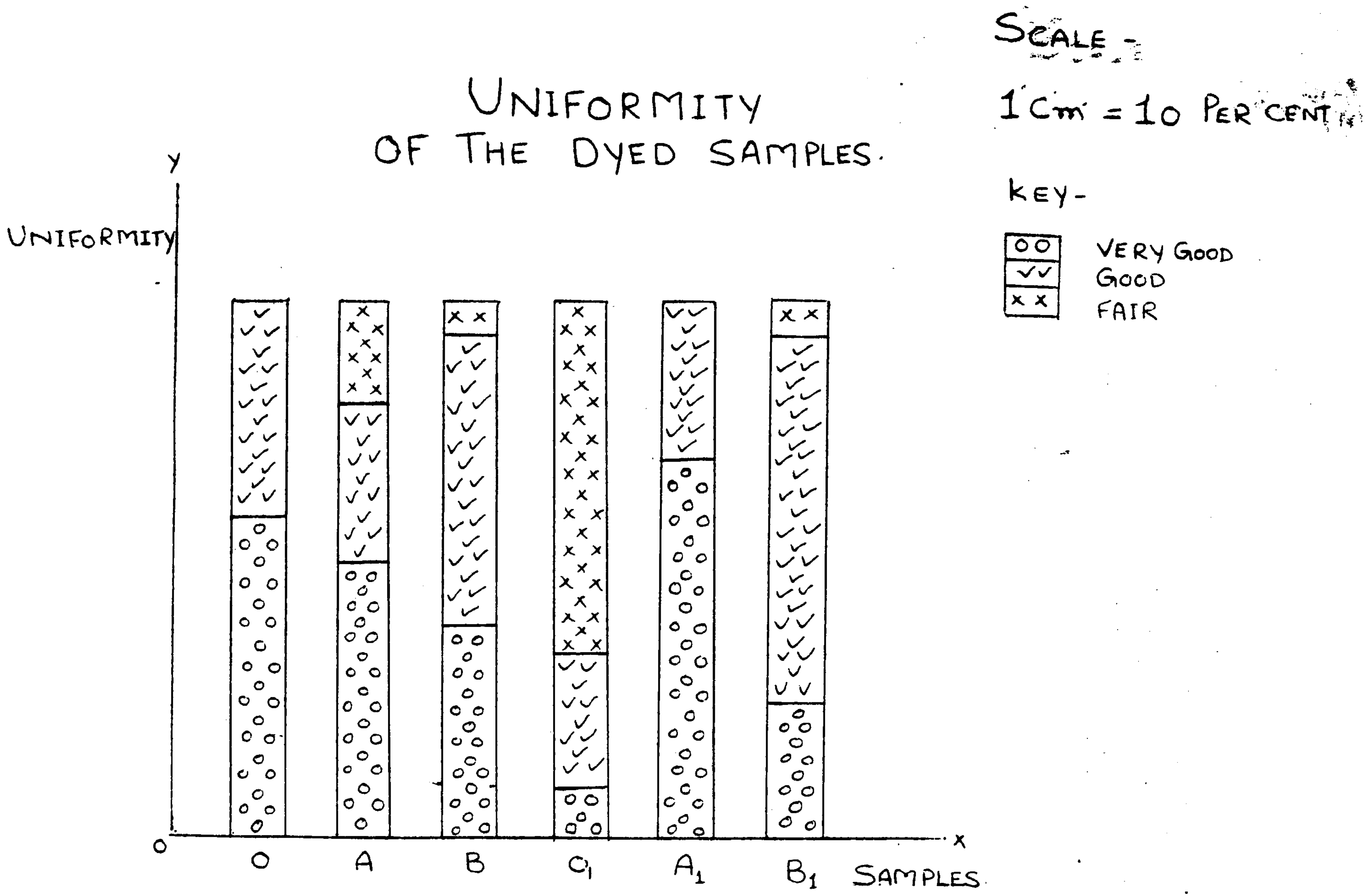

UNIFORMITY
OF THE DYED SAMPLES.
Y
UNIFORMITY
O
X
O
A
B
C1
A1
B1
SAMPLES
SCALE -
1 Cm = 10 PER CENT
KEY -
VERY GOOD
GOOD
FAIR

FIGURE - 2

Sample C_1 was rated as fair in uniformity of shade by 65 per cent of the judges, 25 per cent rated it as good and the remaining 10 as very good. Sample A_1 was categorised as very good by 70 per cent judges and the remaining 30 per cent judged it as good. But B_1 was said to be good by 70 per cent of the judges, 25 per cent as very good and the rest as fair.

It could be concluded that samples AA_1 (that is samples dyed with Tomescol (OP) in carrier dyeing, Dilatin TCI, and Lyogen BPT in high temperature dyeing with trisodium phosphate in cross dyeing) and BB_1 (Same Auxiliaries as AA_1 but soda ash was used instead of trisodium posphate) were concluded as good and very good in uniformity by majority of the judges.

Hollis (1976) affirms that dye bath assistants produces fiber swelling, allowing penetration, partially solubilises the dye molecule, promotes absorption of the dye with uniformity. This principle is clearly proved by only very good uniformity in the samples which were dyed with auxiliaries and vice versa with the samples dyed without auxiliaries.

3. Lustre of the Samples:

Table III and Figure 3 reveal the ratings of the judges regarding the lustre of the samples.

TABLE III

LUSTRE OF THE SAMPLES

Condition of the process	Sample Number	Ratings about lustre in Percentage		
		Very Good	Good	Fair
Carrier dyeing at 100°C	O	35	55	10
	A	20	35	45
	B	10	75	15
High Temperature dyeing at 130°C	O_1	10	30	60
	A_1	50	45	5
	B_1	15	70	15

Sample O was categorised as good in lustre by 55 per cent judges, 35 per cent rated the same as very good and 10 per cent as fair. Sample A was rated as fair in lustre by 45 per cent, good by 35 per cent and very good by 20 per cent of the judges. Sample B was considered good by 75 per cent, fair by 15 per cent and very good by 10 per cent of the judges.

LUSTRE OF THE DYED SAMPLES.

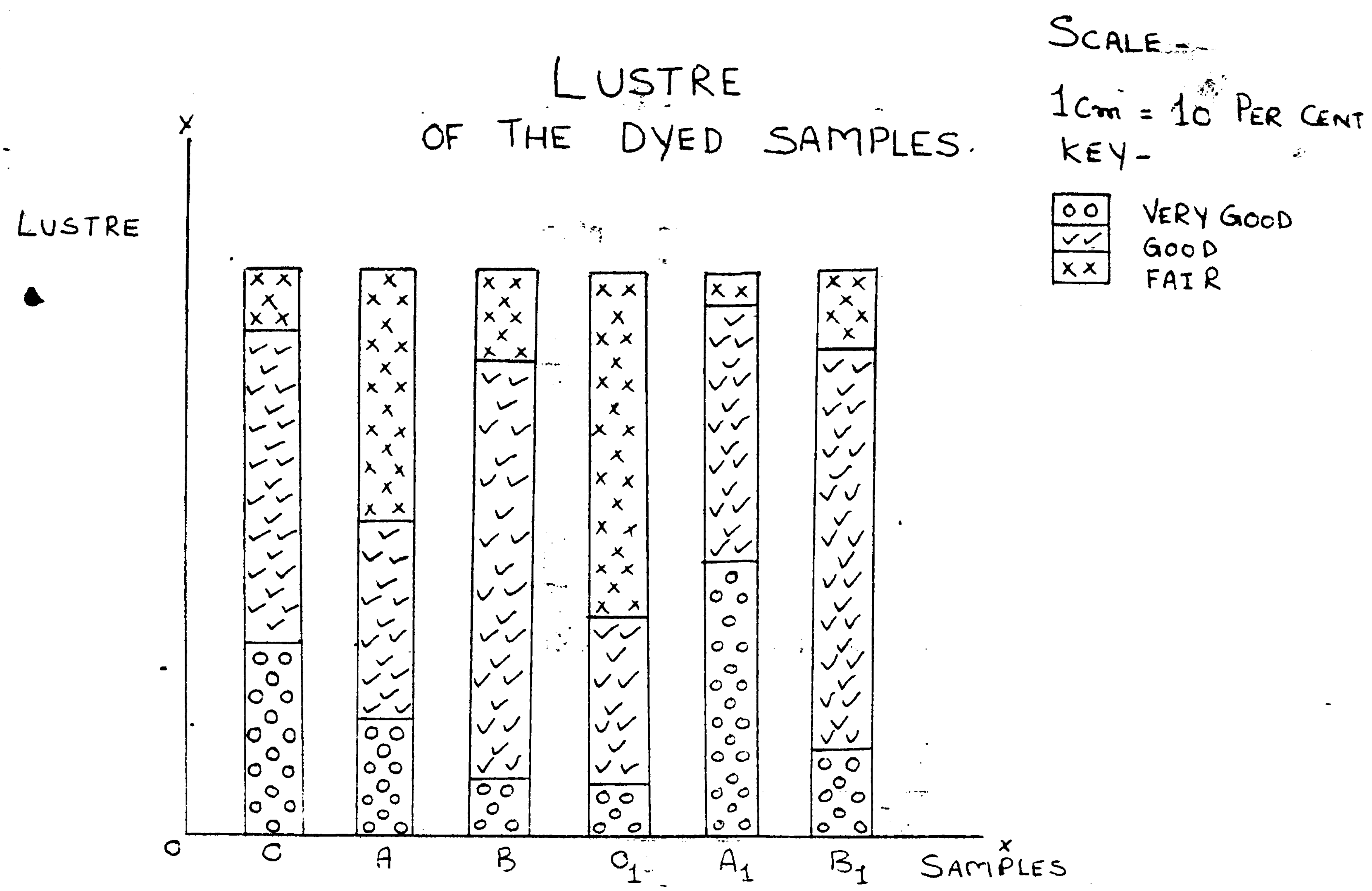


FIGURE = 3

Coming to samples dyed with high temperature method O_1 was graded as fair in lustre by 60 per cent judges, good by 30 per cent judges and very good by 10 per cent of the judges. Sample A_1 was rated as very good in lustre by 50 per cent of judges, good by 45 per cent and fair by five per cent of the judges. Sample B_1 was considered good in lustre by 70 per cent of the judges where as it was rated as very good and fair by 15 per cent of the judges separately.

It could be concluded that only samples BB_1. were considered as good in lustre by majority of the judges.

When all the three properties were compared together OO_1 were possessing light shade of colour, with O very good uniformity and good lustre but O_1 with fair uniformity and lustre. Where as AA_1 have dark shade of colour with very good uniformity but A with fair lustre and A_1 with very good lustre. Coming to BB_1 they have the best harmonising properties of medium shade, good uniformity and good lustre.

This shows that auxiliaries used for BB_1 were having same effect on their properties both in carrier and high temperature methods, AA_1 were differing only in lustre but the effect of auxiliaries on the remaining two properties was the same. But OO_1 where no auxiliaries used showed diversified effect on the properties as discussed in the visual inspection.

B. Laboratory Tests:

Findings of the different test are discussed under the following headings:

1. Abrasion resistance of the samples
2. Tear strength of the samples
3. Bursting strength of the samples
4. Pilling test

1. Abrasion resistance of the Samples:

Table IV and Figure 4 show the details of the results.

TABLE IV

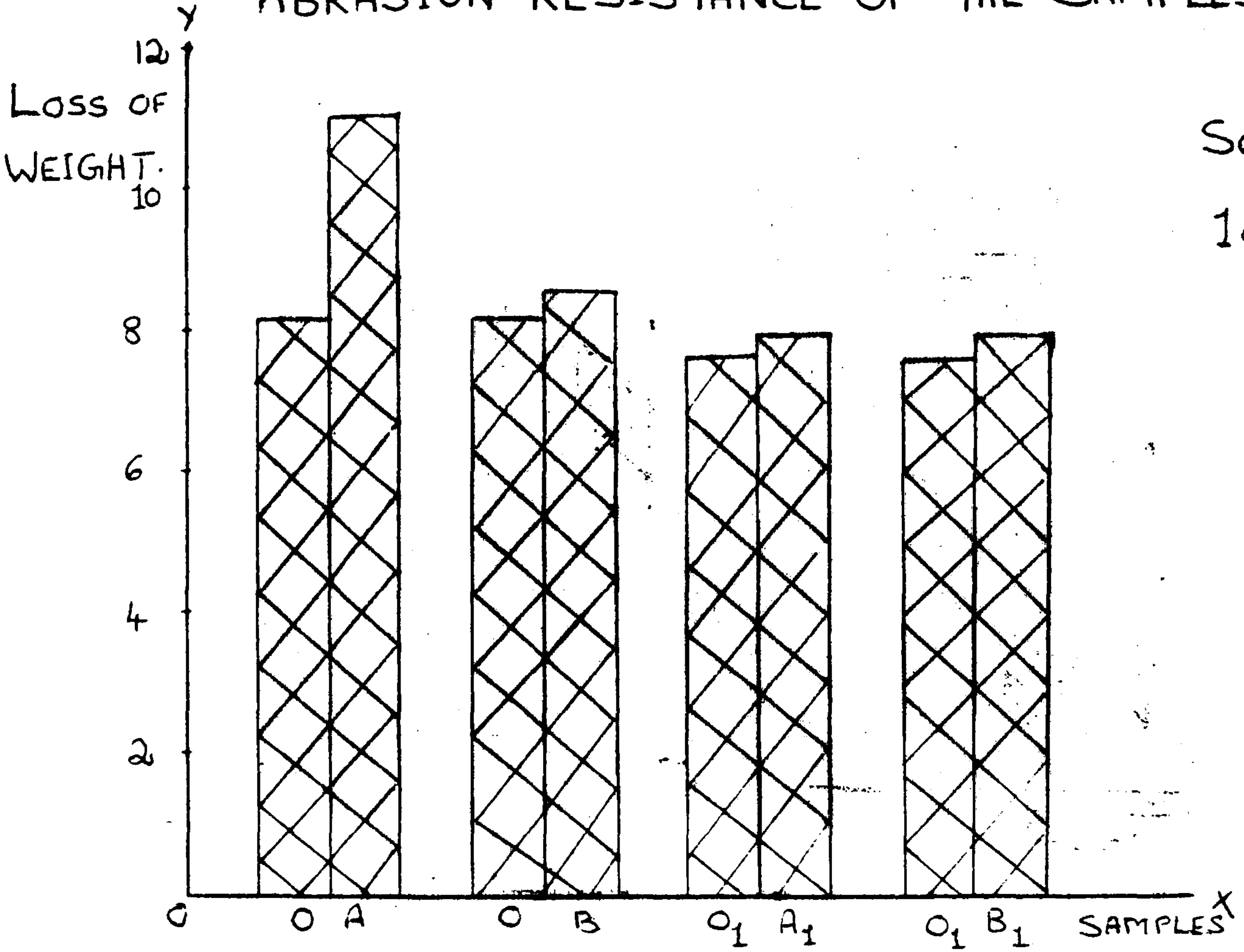
ABRASION RESISTANCE OF THE SAMPLES

Condition of the Process	Sample Number	Mean Loss or gain in mg	Loss or gain in per-ventage	Decrease or increase over the original	't' value
Carrier dyeing at 100°C	O	10.2	8.1	--	--
	A	13.4	11.0	-2.9	1.060
	B	10.2	8.5	-0.4	1.1804
High temperature dyeing at 130°C	O_1	9.2	7.6	--	--
	A_1	10.6	7.9	-0.3	0.09984
	B_1	8.4	7.9	-0.3	0.19897

Table IV clearly shows that in all the dyed samples the loss in weight due to abrasion was more when compared with the original.

Statistical analysis proved that the difference, was not significant.

ABRASION RESISTANCE OF THE SAMPLES.



SCALE -

1cm = 1 mg Loss of WEIGHT.

FIGURE - 4

Shenai and Shah (1981) say that the inclusion of 30 - 40 per cent cotton in terylene cotton blend leads to pa proportional increase and superior abrasion resistance than all cotton fabric. The above results proved that this excellent resistance to abrasion in the blend is not, affected by auxiliaries or method of dyeing.

2. Tear Strength of the Samples:

Table V and Figure 5 give the details of tear strength of the samples.

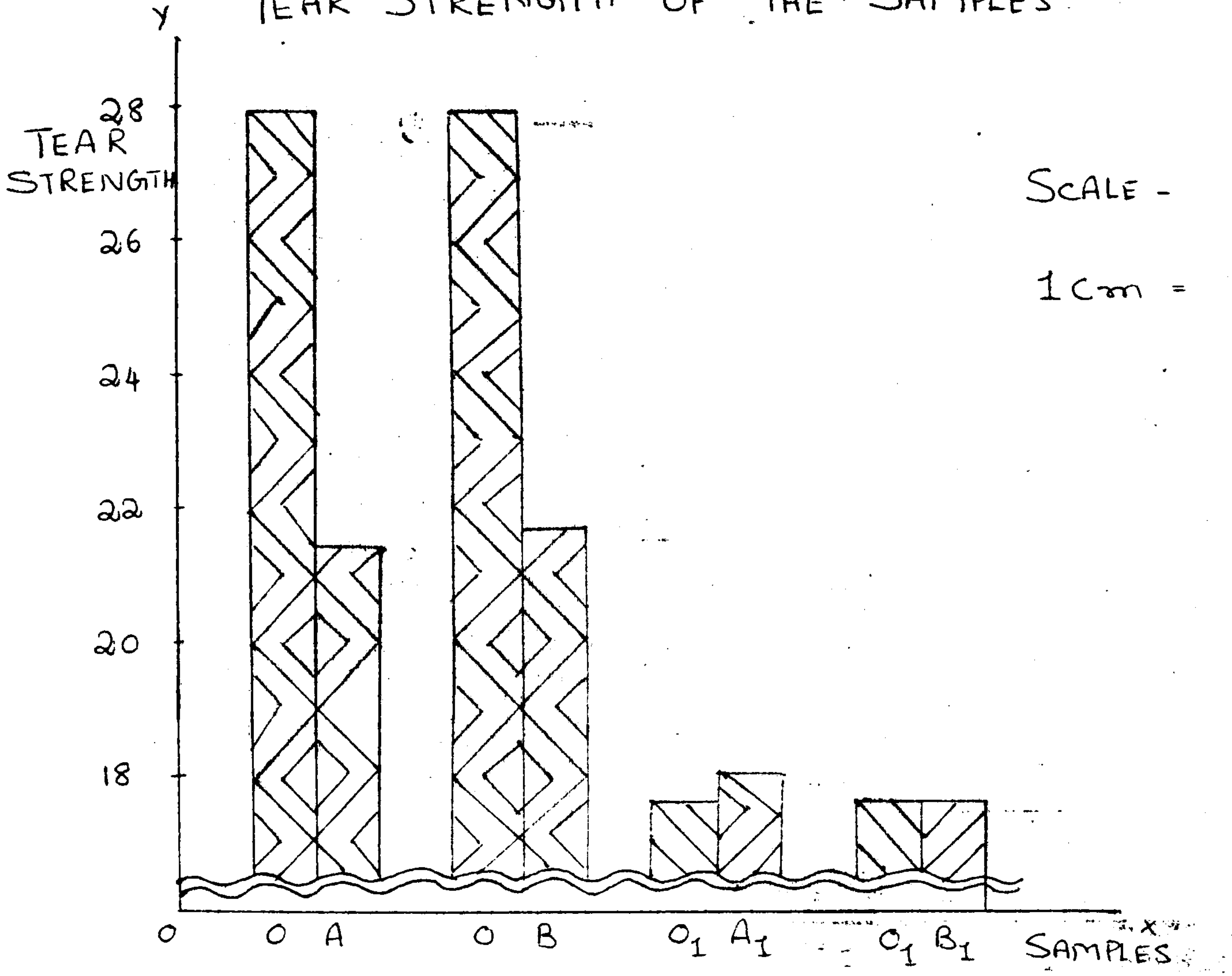
TABLE V

TEAR STRENGTH OF THE SAMPLES

Condition of the process	Sample Number	Mean value in lbs/inch²	Decrease or increase over the original	't' value
Carrier dyeing at 100°C	O	27.942	--	--
	A	21.418	-6.52	2.622*
	B	21.712	-6.230	3.623*
High temperature dyeing at 130°C	O_1	17.636	--	--
	A_1	18.016	0.380	0.2309
	B_1	17.636	--	--

* Significant at 5 per cent level.

TEAR STRENGTH OF THE SAMPLES



SCALE -

1 Cm = 1 POUND PER SQUARE INCH

FIGURE - 5

From Table V it is clear that the tear strengths of all the samples except A_1 were less when compared with the original.

The 't' values for dyed verses original in the case of samples A and B were found to be significant at five per cent level. But here the tear strength was decreased.

In high temperature dyeing, the difference, between the tear strength of the samples A_1 and B_1 to that of Sample C_1 were not much; in fact it was not statistically significant. Hence this proved that the same auxiliaries at high temperature method had improved the tear strength of the samples.

3. Bursting strength of the samples:

Table VI and Figure 6 show the results of bursting strength test.

TABLE VI

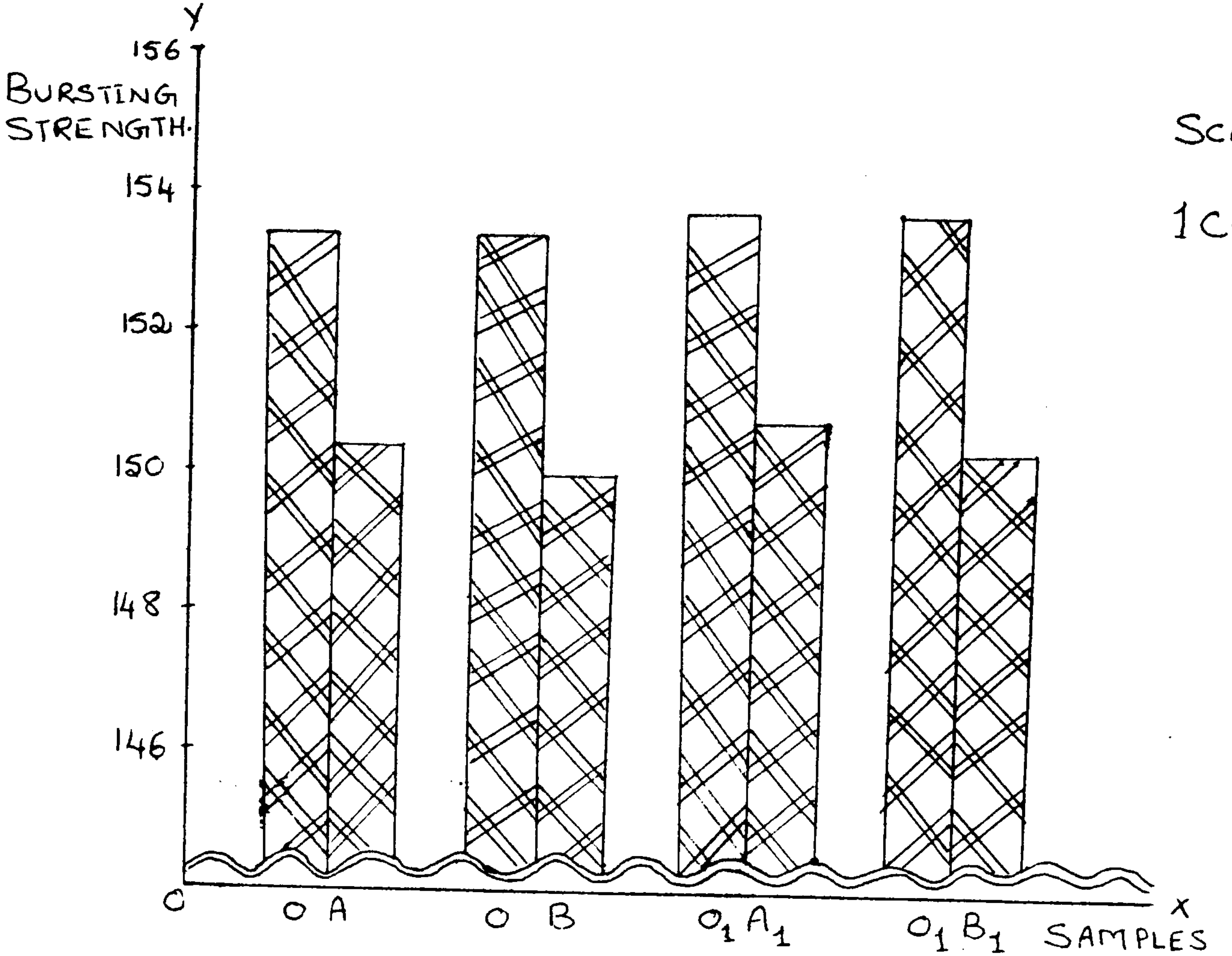
BURSTING STRENGTH OF THE SAMPLES

Condition of the process	Sample Number	Mean value $lbs/inch^2$	Decrease or increase over original	't' value
Carrier dyeing at $100^\circ C$	0	153.4	--	--
	A	150.4	-3.0	3.576*
	B	150.0	-3.4	3.113*
High temperature dyeing at $130^\circ C$	0_1	153.8	--	--
	A_1	150.8	-3.0	1.335
	B_1	150.4	-3.4	1.513

* Significant at 5 per cent level

Table VI shows that in all the samples the bursting strength was decreased compared to original. The 't' value of A and B verses 0 were found to be significant but it was not so in A_1 and B_1. This shows that in high temperature method auxiliaries have got no destructive effect on bursting strength, but it is so in carrier method.

BURSTING STRENGTH OF THE SAMPLES



SCALE –

1 Cm = 1 POUND PER SQUARE INCH

FIGURE - 6

4. Pilling Test:

When the samples which were exposed to pilling test were compared with the standards they came into the category of second standard that is moderate pilling. But when compared between the samples, pilling was more in samples A, B, A_1, B_1 than the originals.

C. Colour Fastness Tests:

Colour Fastness of the samples were discussed under the following headings:

1. Fastness to Sunlight
2. Fastness to Perspiration
3. Fastness to Laundering
4. Fastness to Pressing-Wet and Dry
5. Fastness to Crocking-Wet and Dry.

1. Fastness to Sunlight:

All the samples showed fading due to sunlight. Detailed inspection by the investigator proved that the cotton part was faded to a great extent than the polyester.

Mccleary *et al* (1967) say that reactive dyes have got moderate light fastness. Bogle (1977) says that reactive dye on textiles fade more readily to sunlight in a x reasonably dry environment.

The samples dyed with carrier dyeing method faded more than the samples dyed with high temperature. This proves the theory of Debryshire (1978) that is 'colour fastness of carrier dyed materials, is unsatisfactory'.

2. Fastness to Perspiration:

All the samples showed fastness to perspiration.

3. Fastness to Laundering:

Fastness to laundering was good in all samples.

4. Fastness to Pressing-wet and dry:

All the samples showed lack of fastness to pressing both in wet and dry conditions in different degrees.

In wet pressing O showed moderate transfer of colour to the white material but A to a greater extent when compared with O. Sample B showed a little lesser amount of running of colour than O. It occured in high temperature samples also in the same way that is in O_1 moderate transfer of colour when compared to A but it was lesser in B_1. Blending of colour was more in samples dyed with high temperature method than in the samples dyed by carrier method.

It wet pressing, when compared to the original, Sample A showed greater extent of colour running where as Sample B showed lesser amount of colour running.

In dry pressing samples A_1 and B_1 showed little colouration on white material when compared to original.

but the degree was less when compared with the samples which were pressed under wet conditions. Other samples showed no change.

5. Fastness to Crocking - Wet and Dry:

All the samples were fast to both wet and dry crocking.

Shenai (1977) and Neal (1977) opine that renewed interest in Terylene Cotton blends has developed recently. These blends can be dyed by disperse reactive dyes because of the

a. Brightness of shade
b. Ease of dyeing, and
c. Fastness properties.

Sample dyed at high temperature showed greater degree of depth of shade, Uniformity and lustre in A_2, B_1 when compared to AB. Sample A_1B_1 showed greater strength in tear test and bursting test. They even showed good fastness proertics. So it could be included that auxiliaries used in high temperature dyeing were less destructive of its properties when compared to auxiliaries used in h-igh-te) carrier dyeing.

V SUMMARY AND CONCLUSION

Scientific blending of complementary fibres is aimed at providing the consumer with a better and more reasonably priced product, to improve the performance by modifying physical properties and to confer aesthetic qualities by introducing colour contrasts. The main reason of blending is the economical development of man made fibres in the face of rising prices of natural fibre, one such blend is Terry Cotton, blended in 67/33 proportion.

Blends of Terylene and cellulosic fibres are established for shirtings, suitings, lingerie and dress goods. But dyeing of terylene cellulose fibre blends is becoming a problem. A number of dyeing method may be employed in dyeing terylene cotton unions. The simplest procedure is a single bath method but needs a mixture of disperse and reactive dyes, which is not available at present.

Improved fastness properties will be obtained by the use of a two bath method. Besides the various methods numerous auxiliaries are available now, the effect of these on polyester cotton blend is yet to be studied completely. So the investigator selected the topic namely "Effect of Selected Auxiliaries on Terry Cotton, dyeing.

Dye fixatives selected were Milatin TCI, Lyogen DFT and Tumescol (OP) for polyester dyeing and Trisodium Phosphate and Soda ash for cotton portion.

The results of the experiment could be summarised as follows:

1. Depth of shade was dark in samples AA_1 which were dyed with trisodium phosphate irrespective of dyeing methods.

2. Uniformity of colour of the samples O A B dyed with carrier dyeing and A_1 dyed with high temperature dyeing was rated as very good by majority of the judges.

3. Lustre too was found to be very good in sample A_1 as rated by 50 per cent of the judges.

4. Loss of weight due to abrasion resistance was found to be less for the dyed samples. But there is no significance difference between the dyed samples and original.

5. Tear strengths of all the samples except A_1 and B_1 were significant when compared with original. Hence this proved that the auxiliaries at high temperature method had improved the tear strength of the samples.

6. In the case of bursting strength with the original, A and B were found to be significant, proving that auxilaries have got no destructive effect on bursting strength in Sample A_1 and B_1.

7. Pilling on dyed samples were found to possess the same second standard, moderate pilling which is acceptable.

8. All the samples were colourfast to perspiration, laundering, and both dry and wet crocking. But cotton portion of all the samples faded to sunlight. In the same way all the samples bleeded for dry and wet pressing.

By considering the above points one could conclude that in general samples dyed with high temperature dyeing for polyester and cross dyed for cotton portion were rated as first. Specially A_1 was considered to be the best one in all aspects namely visual inspection, laboratory tests and colour fastness tests except in fastness to pressing. So the investigator feels that best suited auxiliaries for the dyeing of terry cotton are dilatin TCI, lyogen DFT, for terylene and Trisodium phosphate for cotton at high temperature method of dyeing.

Recommendations:

The investigator feels that experimenting about auxiliaries is a very vast subject. There are plenty of auxiliaries available as mentioned in the experimental procedure, to dye different types of fibres which can be studied.

There are innumberable number of blends and blend ratios which needs some research work to be done. Even different methods of dyeing blends and synthetics that is in one bath process, Thermosol dyeing and so on. Dye mixtures can also be tried to dye blends.

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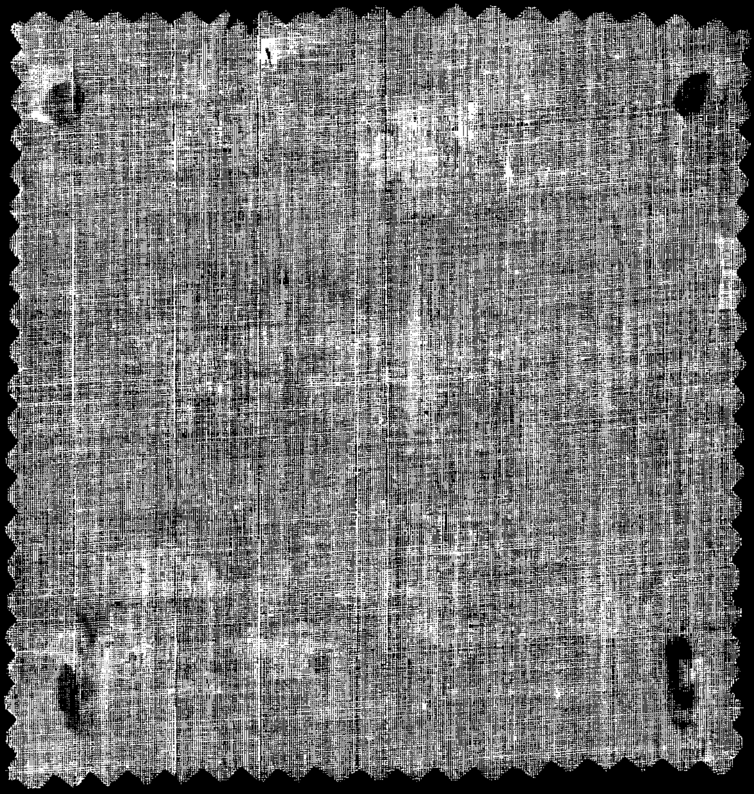
APPENDICES

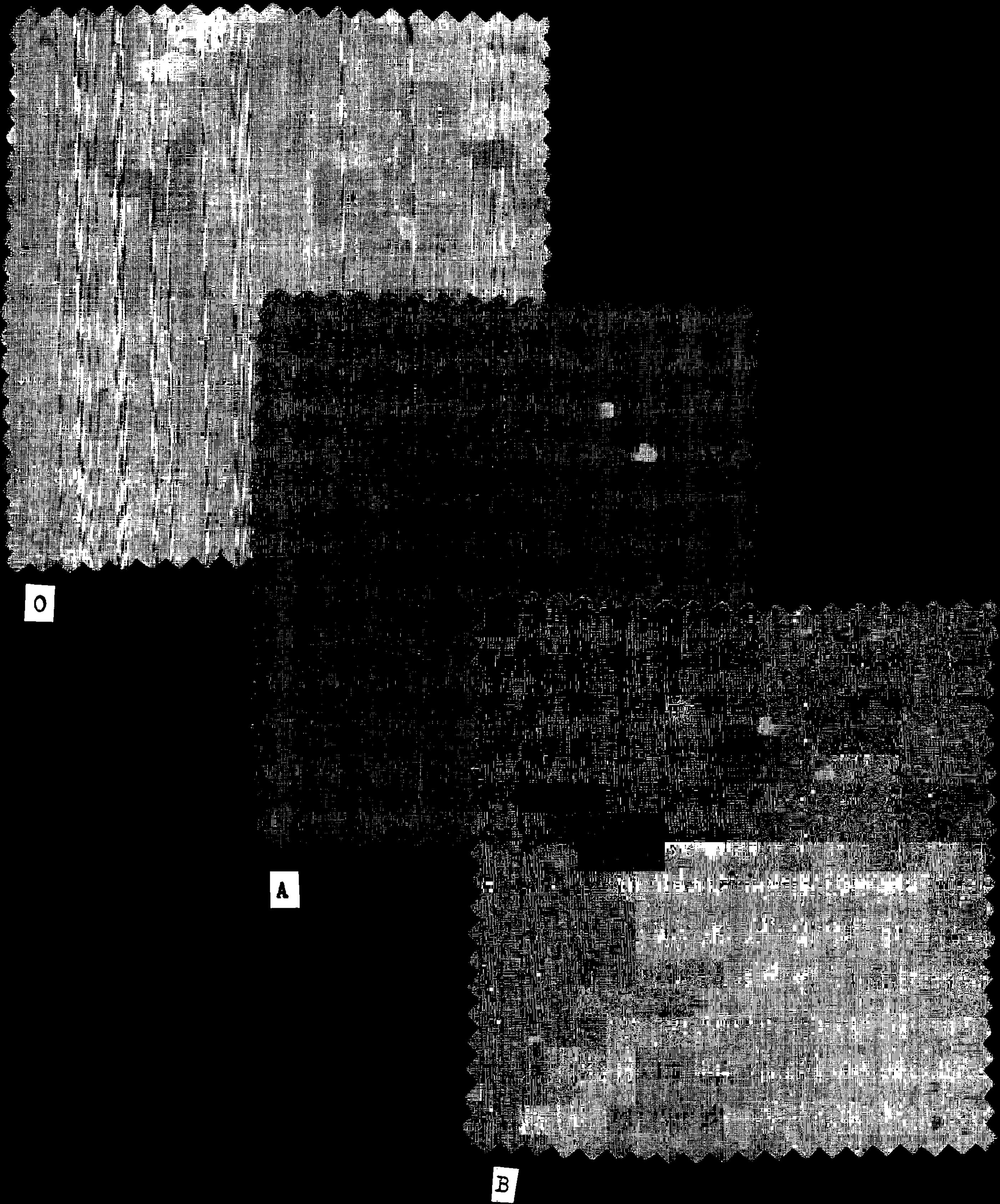
APPENDIX I

DETAILS OF THE SELECTED MATERIAL

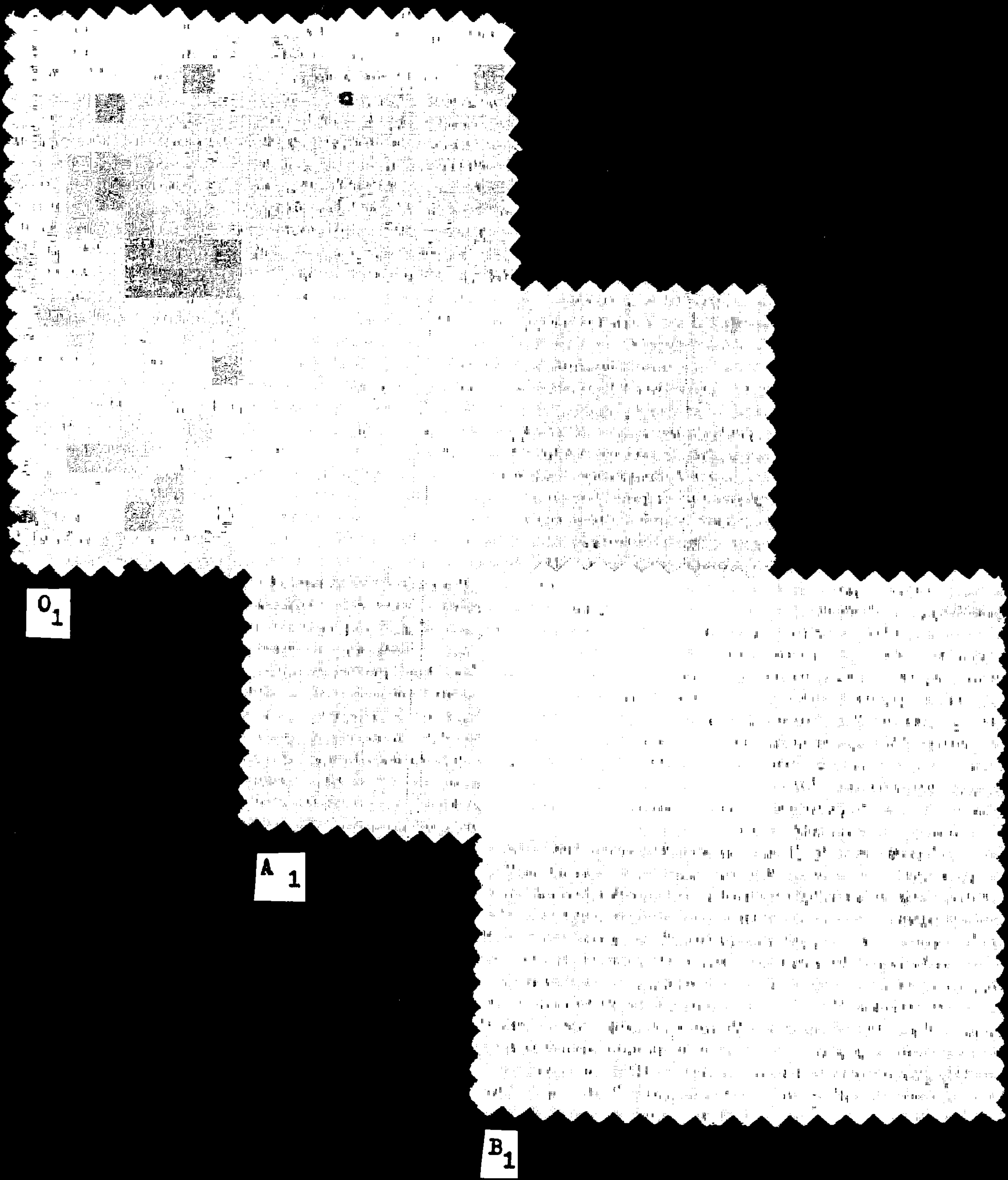
Name of the material	-	Terry Cotton
Composition of the blend	-	67/33
Count	-	2/40s.
Width	-	36 inches
Cost	-	Rs.20/metre.



APPENDIX - Ia - GREY SAMPLES



APPENDIX IIa - DYED SAMPLES



APPENDIX - IIb DYED SAMPLES

APPENDIX III

PROFORMA TO EVALUATE THE DYED SAMPLES

S. No.	Sample Number	Depth of the shade			Uniformity			Lustre		
		Dark	Medium	Light	Very Good	Good	Fair	Very Good	Good	Fair
1.	O									
2.	A									
3.	B									
4.	O_1									
5.	A_1									
6.	B_1									

APPENDIX IV

STATISTICAL ANALYSIS

$$'t'\ \text{value} = \frac{\bar{X}_1 - \bar{X}_2}{S} \sqrt{\frac{n_1\ n_2}{n_1 + n_2}}$$

Where $\bar{X}_1$ = mean of sample one

$\bar{X}_2$ = mean of sample two

S = combined standard deviation

n_1 = number of observation in sample I

n_2 = number of observation in sample II

$$S = \sqrt{\frac{n_1\ S_1^2 + n_2\ S_2^2}{n_1 + n_2 - 2}}$$

Where S_1 = Standard deviation of sample one

S_2 = Standard deviation of sample two

Example - $'t' = \frac{\bar{X}_1 - \bar{X}_2}{S} \sqrt{\frac{n_1\ n_2}{n_1 + n_2}}$

$\bar{X}_1$ = 8.5 n_1 = 5

$\bar{X}_2$ = 7.9 n_2 = 5

S = ?

XXX $'t' = \frac{8.5 - 7.9}{5} \sqrt{\frac{5 \times 5}{5 + 4}}$

$$s = \sqrt{\frac{n_1 s_1^2 + n_2 s_2^2}{n_1 + n_2 - 2}}$$

$n_1 = 5$

$s_1^2 = (5.671)^2$

$n_2 = 5$

$s_2^2 = (1.326)^2$

$$s = \frac{5 \times (5.671)^2 + 5 \times (1.326)^2}{5 + 5 - 2}$$

$s = 4.606$

Therefore $t = \frac{0.6}{4.606} \sqrt{\frac{25}{10}}$

$$'t' = 0.2060$$