EFFECT OF KEROSENE AND TURPENTINE OIL IN PIGMENT PRINTING

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A THESIS SUBMITTED TO THE AVINASHILINGAM INSTITUTE FOR HOME SCIENCE AND HIGHER EDUCATION FOR WOMEN (DEEMED UNIVERSITY), COIMBATORE, IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF

MASTER OF SCIENCE IN TEXTILES AND CLOTHING

MAY 1991

ACKNOWLEDGEMENT

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The investigator wishes to express her deep sense of overwhelming gratitude and profound thanks to Mrs. G.KRISHNABAI, M.Sc., M. Phil., Dip. Ed. (Madras), Lecturer (Selection Grade), Department of Textiles and Clothing, Avinashilingam Institute for Home Science and Higher Education for Women (Deemed University), Coimbatore, not only for her careful attention and intrinsic interest, but also for her kind help, valuable guidance and potent suggestions throughout the study.

She wishes tc convey her sincere thanks to Dr. (Miss) R. RAJI, M.S. (Tennessee), Ph. D. (Madras), Head, Department of Textiles and Clothing, for her kind suggestions and constant help given during the study.

Her thanks are due to Dr. (Mrs.) RAJAMMAL P. DEVADAS, M.A., M.Sc., Ph. D. (Ohio State), D.Sc. (Madras), Vice-Chancellor, Avinashilingam Institute for Home Science and Higher Education for Women (Deemed University), Coimbatore and Dr. (Mrs.) LAKSHMI SHANTA RAJAGOPAL, M.S. (Tennessee), Ph. D. (Madras), Dean, Faculty of Home Science for providing the opportunity to conduct the study.

She expresses her heartful thanks to Mr. VELUSAMI and Mr. SHANMUGAM, Double Star Brothers, Tirupur for their help and co-operation.

She records her heartful thanks to the Director, SITRA, for providing the Library facilities for reference work.

Last but not the least, she expresses her respectful gratitude to her parents, who have made things work out for the best. Her sincere and heartful thanks to her friends, for their kind suggestions and help.

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INTRODUCTION

I. INTRODUCTION

Textiles are used in the production or processing of many things used in day-today living. Textiles used for clothing and furnishings are aesthetically pleasing and they vary in colour, design and texture. Textiles are mostly used is clothing. Shelters too are made more comfortable and attractive by the use of textiles. Textiles changes in tune, with the fashion changes and also to the changing needs of the people.

The term "Textile Printing" is rather an ambiguous one, is used to indicate the patterning of cloth by means of printing and dyeing. According to Miles (1981), "Textile printing has yielded fabrics in which utility has been allied with great beauty. It has been an art form, in which an original idea is conceived with a clear understanding of the technique to be used. The main objective in textile printing is the production of attractive designs with well defined boundaries made by the artistic arrangement of a motif or motifs in one or more colours. Thus, textile printing may be briefly described as the art of dyeing or colouration of localised areas on cloth or yarn, so that a design is produced in one or more colours on a white or coloured ground.

Printing is the second method of adding colour to fabric. The printing of textile materials is the application of colour according to a predetermined design comments Gohl and Vilensky (1987). Due to the recent development in Science and Technology,

many improvements have been made in the field of dyeing and printing. Hence at present, various methods of printing such as block, roller, duplex, direct, discharge, resist, warp, melange, or vigoreus, and screen printing are carried out.

Screen printing, a method of decorating fabrics is of recent origin and has attained a considerable importance. According to, "The World Book Encyclopedia (1989), screen printing is a print making technique in which ink or paint is forced through a piece of silk on to paper or textile material. The most significant contribution of the century, to the textile printing development has been hand-screen printing, and its various mechanical derivatives. One or more colours are printed in a particular form to produce a single or multicolour design effect. This method of printing is applicable for printing sarees, curtains, draperies, hosiery materials, bags, emblem for institution and advertising banners.

The importance of colour in textiles and clothing cannot be under estimated. Colour is one of the most striking feature in apparel as well as in home furnishing items. The application of colour as adornment may actually predate the use of clothing. Colour is the most complex of the elements of design. From the earliest recorded history, man decorated the fabric surfaces of his environment with colourant, is obvious that fabric decoration has been a significant and dynamic force in man's cultural history.

"Dyeing is the process, in which the colouring material penetrates the fibres and become an integral part of their structure", says Wingate and Mohler (1984). There are different classes of dyes available such as vat, sulphur, direct, azoic, reactive, napthol and pigment dyes. Among them pigment dyes play a vital role in printing process.

According to Hollen et-al (1988), pigment colours are not truely dyes, but are of utmost importance in printing. Pigment printing is the oldest method used, which makes use of pigments. The use of insoluble pigments, which are mechanically bonded to the surface of the textile fibre by means of a film of synthetic resin or other bonding media. The printing is quick, simple and economical, pigment printing gives better and good results in cotton and khadi material.

Cotton is the most significant industrial and agricultural product in India. It is one of our traditional textiles and is more widely used, as apparel, uniform, furnishings and for various other purposes. It is well known for its easy availability and in expensiveness. Cotton is commonly preffered today, because of its wide range of variety and its capacity to satisfy the needs of the consumer.

Khadi cloth can be presumed to have been in vogue in India, since the spread of civilization. Ghandiji boldly put khadi, that is, hand-woven cloth from hand-spun yarn, as a

symbol not only for freedom movement but also for rejuvenation and the rural economy-Ganguli (1983).

Printing has always been a major means, to upgrade the aesthetic quality of textile materials. Usually kerosene or turpentine is used in pigment printing, depending upon their availability and cost. Any one of these two mineral oils used along with the binder paste, give surface uniformity while applying the printing paste.

Since no research finding has proved the cheaper and best solvent to be used in pigment printing, the investigator felt the need to study the effect of kerosene and turpentine in pigment printing, by varying the volumes of each of the mineral oils, selected.

The main objectives of the study are:

1. to compare the cost incurred by using turpentine and kerosene solvent on the selected fabric for printing.
2. to find out the suitable volume of solvent to be used for printing.
3. evaluation of the printed samples by visual inspection, fabric thickness, fabric weight, bursting strength and colour fastness.

REVIEW OF LITERATURE

II. REVIEW OF LITERATURE

The literature pertaining to this study are reviewed under the following headings:

A. Textile printing,

B. Methods of printing,

C. Screen printing,

D. Pigment colours in printing,

E. Techniques and mechanism of pigment printing and

F. Advantages of pigment printing.

A. Textile Printing:

Textiles offered a means of aesthetic expression and the making of utilitarian fabrics has been a concern of man for thousands of years. Throughout the centuries there has been a consistent development in both the structuring of fabrics and their designs. The beginning of the art of ornamenting textile fabrics, dated from the pre-historic period which forms the basis, for numerous trends in the field of dyeing and printing in recent years. India has got a very rich heritage in design and printing, says Maruthi (1983).

Vavala (1975) and Datye (1980) are of the opinion that printing is an ancient art and science. Delpierre (1987), says that the origin of the textile printing is to be found in the orient. Fabrics have been printed in India, since about 3,000 B.C. Robert (1987), reveals that before the end of the 18th century, direct printing of indigo became possible and then

other mordant dyes were discovered. Stuart and Robinson (1982), viewed that the printed textiles and blocks were first introduced from graves at Achmin, the ancient city of Panopolis in Upper Egypt, are some of the earliest, still in existence.

Basu (1964), states that the art of printing was originally introduced by the Hindus and the Chinese. Printing is generally done on plain ground and that is why it is commercially termed as "Calico printing".

Cockett (1964), states that printing in modern times have received considerable help from science and technology and has led to more pleasant conditions, even in those parts of the world, known as under-developed. Hafstetter (1987), tells that engraved wooden blocks and engraved copper plates, which have been invented in Ireland in 1752, were also used at present for printing. During 1810, a radial transformation took place in the means of production. The first to appear was the roller machine with its large central press roller around which, the engraved printing rolls rotated.

Wingate and Mohler (1984) felt that the printing of fabrics represents an important part of the textile industry. Printing is an art in which coloured designs are produced on fabric by printing with dyes in paste form or by positioning dyes on the fabric with specially designed machine states, Hollen et-al (1988).

Man has long been intrigued by the process of printing. Knecht and Fothergill (1972) are of the opinion that printing is used to signify the production by various means of coloured patterns or designs, upon all sorts of textile fabrics - cotton, wool, silk, jute, linen and various mixtures of these and other fibres. Joseph (1980) says that printing refers to coloured designs created by surface modifications through the application of dyes. Mehra et-al (1980) and Arora (1983) state that the textile printing can be envisaged as a technique of localised dyeing, where the colouring matter is applied only to restricted areas to obtain the design.

Wilson (1979) states that printing, is the application of colour to the surface of a textile, was for the most part a development of modern times. Cockett (1964) views that printing is a technique in which artist, engineer and chemist combine their various skills. "Printing remains the least expensive techniques of textiles and hence the most profitable and it is applicable on substrates that do not require previous dyeing", Comments Joshi (1982).

Miller (1984) defines printing as the application of colour in the form of a pattern to a fabric surface. The development of new dyes, chemicals and fabrics further diversified the scope of printing. As stated by Kosthy (1980) printing has always been a major means to upgrade the aesthetic quality of textile material.

B. Methods of Printing:

During the early period, the methods adopted for printing textiles were limited. But due to the recent development in the field of textiles, many improvements have been made in printing techniques. Blackshaw and Brightman (1961) are of the opinion that colour designs may be obtained by roller or machine printing, screen printing, block printing (Hand and fully mechanized) and by stencil printing.

Lyle (1976) and Corbman (1985) are of the opinion that, the methods adopted for printing textile material includes duplex, discharge, block, screen, roller, warps, photographs, resist and pigment printing.

Wingate (1958) reports that printing has been classified in to different methods like tie and dye, batik, mordant, wood block, flock, discharge, roller, stencil and screen printing. Labarthe (1975) tells that there are different methods of printing which produce beautiful textiles like block, stencilling resist, batik and screen printing.

Potter (1960) explains that new developments, discoveries and changes can be quickly applied through printing, to create new designs and colour in the fabric. Modi (1987) strongly stresses that the ever changing times improve increasing demands for improved aesthetic appeal of printed fabrics, putting the textile technologists and scientists under constant

pressure to upgrade the technology for better and superior fabrics. This is obtained by introducing printing techniques such as roller, block, stencil, screen, resist, discharge and madder.

Marsh (1982) includes that the technology of printing enables to produce sharp outlines that can be obtained by new techniques like screen, roller, photographic and madder printing, airbrushing, heat transfer, polychromatic or jet printing.

C. Screen Printing:

Screen printing includes:

1. History and development of screen printing
2. Styles in screen printing
3. Advantages of screen printing

Stuart and Robinson (1982) feel that screen printing is a simple, quick method of reproducing a design on fabric or paper, is a development of stencils. Carter and Crabtree (1988) are of the opinion that screen printing is a popular way of printing fabrics.

Blackshaw and Brightman (1961) viewed screen-printing as a method of printing based on the principle of the stencil, with the required design, reproduced on a tightly stretched screen of thin gauze silk which is fixed to a rectangular

wooden frame. The design is obtained by the formation of an impervious film on all parts of the screen except the areas corresponding to the pattern to be printed.

Kale (1976) states that, screen printing is really a development of stencil printing, where the letters and numbers are cut out of sheet and colour dabbed, through by means of a brush, which produces some quite attractive coloured patterns on the fabrics. According to Cockett (1964) screen printing has a big appeal because of the smaller capital outlays.

1. History and Development of Screen Printing

Screen printing, a method of decorating the fabrics, has attained considerable importance in the recent years. It is not really a printing process at all, but purely and simply an improved method of stencilling.

According to Clarke (1980) screen printing uses the same principles, as the ancient Chinese stencil print is historically the most recent method of printing textiles. Lyons in France, seem to have been the first city to industrialize the technique about 1900's. During this period many attempts were made in England but not until the 1920's that it began to develop the stature of an industry. By 1926 France, Swizerland, Germany, Great Britain and United states were all producing commercially successful screen print. More, recently, this traditional hand operation was

revolutionized by the invention of a Swiss machine which prints the screens automatically.

According to Miles (1981), the paper stencilling in the form of a woven silk fabric was introduced in France in the mid-nineteenth century. For best results the support fabric stretched across a frame, the combination becoming known as a screen. The replacement of the paper stencil by a durable paint on the screen fabric soon followed. The invention of new machanized techniques, made the screen printing as leading printing method in the textile industry. The introduction of the synthetic fibre fabric like, nylon and polyester, are the new developments made to improve the quality of screen printing.

Shenai (1985) states that, screen printing made an impact on Lyons in France by 1850. In 1907 Samuel of Manchester took out a patent for screen printing process. John Pilsworths; an American undertook the production of screen printed stars, and stripes banners for the U.S. Army at extremely low cost in 1915. Not before 1926 did screen printing become industrially significant in Europe. Due to great demand for roller printing, increased cost and due to rapid fashion changes, the advantage of screen printing become all the more obvious. Equipment and technical accessories were improved in the mean time, enabling the screen printing technique to win a permanent place in textile printing.

According to Verla (1962), screen printing which started, so modestly in the early part of the twentieth century, has become one of the most important method of printing. One of the first improvement made in commercial printing was the use of tracks or rails to move the screen above fabric, stretched over along base table. This requires two people to operate the squeegee. Later, a wide sqeegee was developed which could be held by two persons. In modern times, the printing is now controlled by electrical devices. The squeegee, operated mechanically slides back and forth in grooves along the screen frame.

Gami (1982) states that in Japan the printing of cloth and crepe fabrics with stencils, reached a high level of technical and artistic perfection at an early period. The Yuze style consisted of cutting out lines or figures in paper or board sheets and then applying colour in these stencils with a brush. Later, it was modernized in to screens.

Kale (1976) are of the opinion that recent development in flat screen printing machine shows that the main emphasis is on reducing the number of operatives required in manual screen printing.

2. Styles in Screen Printing:

According to Hollen- et-al (1983), screen has been modernized by the use of flat, automatic and rotary screen Printing.

Corbman (1985) states that screen printing is done with the use of either flat or cylindrical screens. He also defines rotary screen printing as, a printing machine that utilizes seamless cylindrical screens made of metal foil, which was originally developed in Holland.

Labarthe (1979) opines that screen printing today is still done by hand for many fabric application but, automatic screen printing is possible with electronic controle over both the pattern selection and the dye to be used.

According to Wingate and Mohler (1984), screen printing methods are classified as hand screen printing, automatic screen printing, and rotary screen printing. Here the rotary screen printing is a combination of screen and roller printing. Kaufman and Johnston (1981) felt that, photographic screens produce any graphic art work which exhibit sharper and more intricate details.

According to Joshi (1982), screen printing is done on tables by the hand-screen printing, but now a days automatic screen printing machines have been developed which increases the production. According to Miles (1972), screen printing is carried out by hand and automatic screen printing method.

3. Advantages of Screen Printing:

The world book Encyclopedia (1989) states that, the silk-screen process is used commercially to print such items as bill boards illustrations, package labels and fabric design, so this printing is called as serigraphy.

Modi (1987), reveals that screen printing has low working pressure and hence brilliancy of prints are seen. Screen printing has satisfactory half tone printing, and has controlled colour application on the fabrics.

Brooks (1976), experesses that screen printing's special value lies in the fact that, it enables new patterns which can be produced quickly and without a large initial expense. Screen printing are sufficiently durable to print the comparitively short runs of fabrics which are required.

According to Corbman (1985), the chief advantages of screen printing are, that the colours can be provided in brighter, cleaner shades that are possible with roller printing, and the designs to be repeated can be much larger. The techniques also lends itself to experimental and creative designs, and any desired shapes of designs can be obtained.

Maruthi (1983) feels that in screen printing, the depth of the colour and registration of design are uniform and for bulk orders, this screen printing can be done economically.

According to Clarke (1980), in screen printing, pigment colours can be laid on in heavy layers to produce a handicraft effect. The screens are cheaply prepared, sufficiently durable and the results of screen printing can be just as pleasing and clear - as those obtained in roller printing. Fourteen to sixteen colours can be obtained. Its special value lies in the fact that it enables new patterns to be produced quickly and without a large initial expense.

According to Kale (1976), screen printing results in brightness, transparency, purity, richness, fall-on, half-tone effects are concerned and hence screen printing is superior to roller - printing.

D. Pigment Colours in Printing:

In every civilisation, from the stone age to the "silicon chipage", colour has played a very important role in human life. Colour not only gives a pleasant look to the substrate but also expresses emotions and ideas, comments Damodar (1990).

Colour has probably been a method of adornment for mankind, since prehistoric times. Pigments extracted from roots and herbs, coloured muds, and other sources have been greatly used in those period. Colour is an important economic factor in todays textile industry, comments Labarthe (1975).

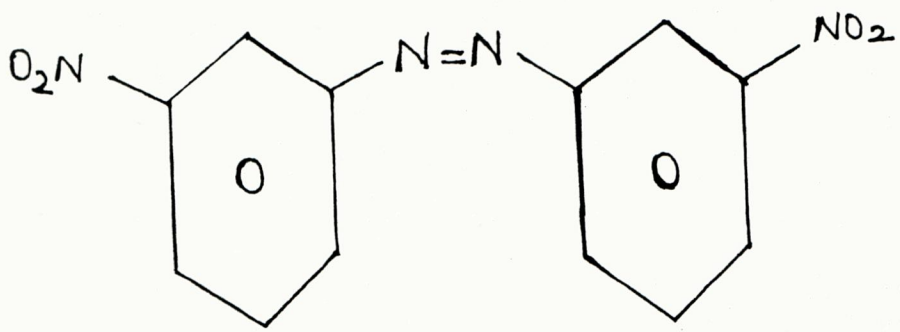
Hollen, et-al (1988), view that colours have always been important in textiles. Until 1856, natural dyes and pigments were used as colouring agents. These were obtained from plants, insects, and minerals. During world War I, when trade with Germany was cut off, that a dye industry was developed in U.S., many dyes and pigments have been developed so that today there are hundred of colours available for selection..

Gami (1982) explains that, pigment dyes are suitable for all kinds of fibres. It has a simple and quick working procedure. Final shade is immediately visible after printing. Joseph (1980) feels that pigment colours are attached to fibres or fabric by means of some type of adhesive resin or bonding agent. The pigment colours are relatively permanent but their durability is directly related to the durability of the binding agent.

Corbman (1985), is of the opinion that pigment colours, are not truely dyes, but are of utmost importance in printing These colours are fixed to the fibre by means of resin that are very resistant to laundering or dry cleaning. Blackshaw and Brightman (1961) defines pigment as, substance in particulate form which is applied to bodies by mechanical incorporation, by chemical precipitation, or by coating, to modify their colour and light scattering properties. It is a substance (white or coloured) which is in-soluble in the vehicle in which it is mixed.

Ash and Dyson (1972), state that pigment colours are insoluble colours which can be dispersed to a colloidal degree of fineness and in that state can enter the fibre, be fixed with it and gives outstanding fastness to light and washing. Kale (1976) feels that, pigment dyes are exactly the same as the one employed by the artists in painting, and includes a number of highly coloured substances both from mineral and vegetable source. They are insoluble in water and in vegetable source. Varghese (1982) defines that, pigment dyes are insoluble molecular aggregates, with hardly any substantivity towards the substrate to which they are applied.

According to Smith and Block (1982) the structures of typical inorganic and organic pigments are shown below.



PIGMENT ORGANGE

E. Technique and Mechanism of Pigment Printing:

Pigment printing is of recent development which has attracted interest of the processes. It originated in America and is known as the Aridye process. This new printing used, pigment dyes, which belongs to vat variety and hence insoluble in water and are very fast to light - Bogle (1977).

Blaum (1981) states that, during the past 15-20 years pigment printing has gained a strong position in the textile finishing field, being one of the most important techniques of printing. Miles (1971) feels that, co-polymer dispersions, with provision for cross-linking after printing are used to bind the pigments in a tough, flexible film around the individual fibres. Lyle (1977) states that, pigment printing differs from other methods of printing, in that the colours are produced by finely ground insoluble pigments instead of dyes and is called "emulsion printing" because the pigment is dispersed in an emulsion of water and oil with a suitable resin binder. The agent that binds the colours to the fabric is the thermosetting resin in pigment emulsion system.

Gharia, et-al (1990), felt that for pigment printing, however, polymers are not very useful, as with such products. The residue left behind after drying causes dullness and stiffness. The oil-in-water type emulsions give best results, as the constituents vapourise leaving no residue. Corbman (1985), is

of the opinion that, pigment printing is the old method of printing , inwhich the pigment, is mixed with an adhesive and thus fastened it to the fabric which produces permanent and excellent effect.

Khanna (1987) states that, pigment colour printing in aqueous phase is possible by the use of proper synthetic thickners. Pigment colour printing was the most popular means of printing. Johnston and Kaufman (1981) state that pigment printing is a method in which, pigments are not dissolved in application processes but remain solid particles that are attached to fibres with resin binders.

ATIRA technical digest (1981), Gutjahr (1981), Dixit et-al (1974), and David (1974) are of the opinion that, basic pigment print pastes consists of pigments, binder and thickner, the pigment supplies colouration, the binder holds the pigment onto the fabric and produces good fastness properties, and the thickner is necessary to keep the binder and pigment in place where the paste is deposited.

According to Gohl and Vilensky (1987), the general theory of printing explains the interaction on steaming between the dye, fibre, water, thickner and hydrocarbon solvent, by forces of repulsion are developed between the dye molecules and the constituents of the printing paste and forces of attraction are developed between the dye molecules and the fibres of the textile material to be printed.

F. Advantages of Pigment Printing:

According to Gutjahr (1981), a good quality pigment print is charactericed by

- brilliancy and high colour values relative to pigment concentration in the paste.
- minimum stiffening in the handle of the textiles.
- Generally acceptable fastness properties.

Shenai (1985) is of the opinion that,pigment printing exhibit good fastness to light, washing, glas-fading, chlorine, alkaline peroxide, perspiration, solvents and especially to abrasion, and the cost is favourable and they satisfy a particular colour requirement and are very brilliant. Green (1972) states that pigment printing exhibit true tint and give stiffness to the fabric.

Johnston and Kaufman (1981) feels that pigment printing possess a light - coloured design on a dark ground, if they are sufficiently opaque. Varghese (1982) comments that pigment printing of textiles is popular all over the world as it offers several advantages over other styles of printing. These include brilliant prints with high light fastness, ease of application, certainty in colour matching, flexibility with respect to applicability to natural and synthetic fibres and avoiding of the final wash off and thus completely eliminating any effluent disposal problems.

According to Bogle (1977), Aridye process have excellent fastness to washing and supplement excellent fastness to light, pessifixation and other harmful influences. Tortora (1982) feels, that printing of pigment dyes, with the help of synthetic binder, has opened a new era in textile printing for they can match the artists, colour and are fast to colour. Corbman (1985), states that pigment printing is simple and best method of printing any textile materials.

EXPERIMENTAL PROCEDURE

III. EXPERIMENTAL PROCEDURE

The experimental procedure adopted for this study comprises of the following steps:

A. Selection of the material.

B. Selection of the design.

C. Selection of the dye.

D. Selection of the printing method.

E. Preparation of the screen.

F. Preparation of fabric for printing.

G. Preparation of the binder and printing paste.

H. Nomen clature of samples.

I. Actual printing

J. Evaluation of the printed samples.

K. Evaluation of the cost of solvents in printing.

A. Selection of the material:

The material selected was khadi cotton. Jain (1983) says, "Khadi was never a mere piece of cloth. More was woven into it, hand spun cotton yarn". According to Pandit Rao (1983), Khadi cotton has a predominant place and it is an insignificant item in the textile products, of India. Khadi, nowadays is given an immense importance and, it is used in apparel, as well as in furnishing.

Since khadi material is easily available and is durable, it has been used for preparing bags for our institutions. Hence the investigator selected khadi cotton for printing. For comparitive purpose cotton poplin material too was selected.

According to American Home Economic Association (1961), cotton poplin is a fine, closely woven fabric with slight horizontal ribs, and is widely used for both apparel and furnishing items. Although poplin is a costly material, it is durable and gives best result in printing. Hence the investigator selected khadi cotton and poplin material. Details about the materials are given in (Appendix-I).

B. Selection of the design:

Miles (1981) views that, the first pre-requisite for a good printed fabric is a well - drawn design. According to Joshi (1982), designing textiles has been an ancient art. Textile design have not only the aesthetic value but the economic value too.

The design selected by the investigator was Avinashilingam Deemed University's emblem. This emblem is simple and compact and with the basic elements in it. One of the requirements of this University is to have proper sized emblem of the University to be used in bags and banners. Hence the investigator selected Avinashilingam Deemed University's emblem, as the design for this study (Appendix-II).

C. Selection of the dyes and colour:

The success of printing,mainly depends upon the type of dyes used. According to the "The World Book of Encyclopedia" (1989), pigment is a finely powdered, coloured substance that gives its colour to another material when mixed with the material or applied over its surface in a thin layer.

Stuart and Robinson (1982) are of the opinion that, pigments are based on organic colouring matter,that is insoluble in water and has to be attached to the fibre by the use of resinous binders which are fixed by heat. Pigment dyes are most convenient and a wide range of colours are available. Pigments are suitable for all kinds of fabrics.

The recent advancement in the field of textile printing, makes use of pigments. Pigments are commonly used in printing units at Tirupur and hence the investigator selected pigment dyes for printing. Moreover it gives best result for printing on cotton materials.

The colour selected by the investigator in pigment was blue - to suit the uniform colour of Avinashilingam Deemed University.

D. Selection of the Printing method:

Wingate and Mohler (1984) suggest that, when a design called for delicate shading, the process originally employed to produce the pattern was screen printing method. According to Maruthi (1983) "In screen printing, the depth of the colour and registration of design are uniform".

American Fabric Magazine (1972) indicates that, from the economical point of view, screen printing does not require large investment because the run can be shorter especially in the hand-operation. Screen-printing technique is applicable to all kinds of materials.

Hence the investigator selected the hand-screen printing method. The design selected was small and can be easily printed by the use of hand-screen printing technique. Moreover the screens could be used for easy printing of the emblem at any required time.

E. Preparation of the screen:

According to Clarke (1973), screens are generally made of silk and screen frames are made either of wood or metal. Labarthe (1979) says that, screens today is generally of nylon or something of silk or a fine metal.

The screen was made of wooden frames. Nylon material was stretched over the wooden frame and pasted on sides with

exact tension. Then the screen was coated with a photo layer which consisted of polyvenyl alcohol and bichromate in a dark room and dried. The positive of the design was placed on the glass topped cabinet in a fixed position. The dry sensitised screen was then carefully placed on the negative and adjusted to correct registration of the design. Through photographic method the design was transferred to the screen. The light sensitive solution on the design areas was in a dissolved form, whereas the exposed areas were hardened. The screen was then placed in the tank of soft water and gently shaked. This allowed the light sensitive solution to swell. The screen was then washed with warm water for about ten minutes.

After the screen was dried, the paint was applied by brush as continuous film on the upperside of the gauze. Immediately after application, it was wiped from the designed area from the inverse side, with a cloth pad wetted in turpentine or thinner. This was done to clear the designed area containing the paint.

F. Preparation of Fabric for Printing:

According to Stuart and Robinson (1982), the fabric to be printed should be well - washed to remove any dressing, rinsed thoroughly and ironed flat. Shah (1984) defines that desizing is the method, which is carried out before the material is printed. It removes the sizing from the grey cloth.

Both khadi and polin materials required desizing process since they contain lot of starch, which prevents the penetration of the printing paste. Hence the material was desized, dried, ironed and made ready for printing.

G. Preparation of the Binder and Printing Paste:

According to Teli (1990), the success in screen printing depends on the amount of paste applied, as well as the spread of paste on the surface and into the structure of the textile materials.

Binder and fixers play important role in pigment printing in achieving optimum fastness properties. During earlier stages of development, SLN binder is used in pigment printing for the basic paste. This SLN binder is stronger and helps to fix the colour on the material. To this binder kerosene or turpentine oil is used, which in turn helps the binder to spread equally on the material. To this basic paste pigment colour, which was mixed with water, fixer CCL were added and the paste was made ready for printing.

The recipes used for preparing the printing pastes are given below:

1. Recipe No. 1 (Based on Kerosene)

SLN	..	1 litre
Urea	..	½ kg.
Water	..	½ litre
Kerosene oil	..	8, 12, 16 litres
Pigment colour (Blue)	..	25 gms.
Fixer CCL	..	5 ml.

2. Recipe No. 2 (Based on turpentine)

SLN	..	1 litre
Urea	..	½ kg.
Water	..	½ litre
Turpentine oil	..	8, 12, 16 litres
Pigment colour (Blue)	..	25 gms.
Fixer CCL	..	5 ml.

Here, only the volumes of kerosene and turpentine oil were varied, while all other ingredients were kept in the same level. Hence six different pastes were prepared, three from kerosene and three from turpentine oil.

H. Nomenclature of samples:

About 12 metres of cloth was purchased in both khadi cotton, and poplin from the local shop. The colour of the material was yellow. About half metre of cloth was cut from each material and kept aside as original. The remaining was cut into six equal bits and was subjected to printing operation, using kerosene and turpentine in 8, 12, and 16 litres respectively. The samples treated were named according to the type of material and the volume of oil used in printing processes. Original samples were cut from each printed sample and kept aside.

The nomenclature of the sample is presented in Table I.

TABLE I

NOMENCLATURE OF THE SAMPLES

Sl. No.	Material	Name of the samples					
		Kerosene in litre			Turpentine in litre		
		8	12	16	8	12	16
1.	Khadi (K)	KK8	KK12	KK16	KT8	KT12	KT16
2.	Poplin (P)	PK8	PK12	PK16	PT8	PT12	PT16

I. Actual Printing:

The actual printing was carried out on the respective samples using the prepared paste, following screen printing techniques, the university emblem was printed on khadi and poplin materials. The sample is spread over a padded table and screen was placed over the cloth. The printing paste was poured into the screen and with the help of a squeegee, the paste was forced through the design. The printing was continued in the same manner covering the entire sample surface. Then the sample was allowed to dry in the shade. Similarly, by using the other five prepared volume of printing pastes, the printing process was carried out, on the other samples. The printed samples are shown in (Appendix III). The printing process is shown in Plate No.1

PLATE - I.

SCREEN - PRINTING.

J. Evaluation of the printed samples:

The printed samples were evaluated both subjectively and objectively using the following tests.

1. Visual Inspection
2. Performance tests
3. Colour fastness tests

1. Visual Inspection:

A panel of 20 post graduate students specialising in the field of Textiles and Clothing were selected as the judges for visually assessing the printed samples. The performa used for the visual inspection is given in Appendix IV. The major aspects taken into consideration for visual inspection included:

a. Appearance
b. Brilliancy of colour
c. Texture
d. Uniformity of print

2. Performance tests:

The performance tests included the following:-

a. Fabric thickness
b. Fabric weight
c. Bursting strength

a. Fabric thickness:

Thickness is defined as the distance between two parallel surfaces, while exerting a specified pressure on a material, Skinkle (1949) and Lomax (1956) feel that the fabric thickness

test is used to find out its density in connection with such property as air permiability, water permiability and thermal conductivity. Lyle (1977) expresses that fabric thickness is the distance between the upper and lower surface of the material measured under specific pressure.

According to Booth (1970) and ASTM standards (1975), thickness of a textile material is the distance between two parallel surface while exerting a specified pressure on the material.

The Hungarian Thickness Tester (Plate-II) was used to determine the thickness of the material. The thickness tester had broad anvil upon which a presser foot is pressed by a spring. The original sample was placed on the anvil without any tension or crease and the presser foot was lowered on to the sample by releasing the raising lever very slowly and allowed to rest upon the sample for two seconds at two kgs.pressure. Each division of the dial read o.o1mm. The dial reading indicated the thickness of the material in thousands of an inch between the anvil and the pressure foot. The dial reading was recorded. Ten readings were taken from different parts of the same material. The mean value of the ten readings was calculated and recorded. Similarly the experiment was repeated using different printed samples and the readings were recorded and the mean value was found out for each sample. Students' "t-test" was used to statistically analyse the data.

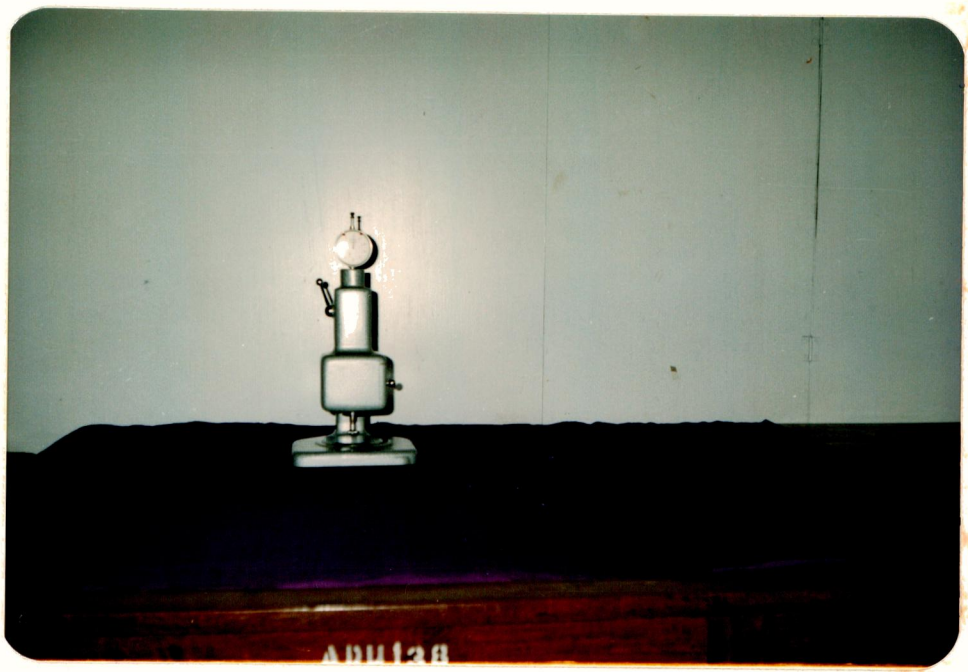


PLATE - II

THICKNESS TESTER.

b. Fabric Weight:

According to Skinkle (1972) and I.S.I. (1982), the fabric weight is determined by two methods - "weight per unit area" and "weight per unit length". As suggested by Booth (1970), the fabric weight can be determined by using a cloth Quardant Balance (Plate-III) which had a scale graduated in ounces per square yard. A template was, used to cut the samples, and the original sample was suspended on the hook of the balance and the corresponding reading was noted.

The experiment was repeated, 10 readings were taken from each sample. The mean value was found out in ounces per square yard, and then converted into grams per square metre.

c. Bursting strength:

Bursting strength is the maximum pressure applied to a circular specimen in distending it to rupture-ISI (1982).

Taylor (1972) is of the opinion that, the pressure acquired to burst the fabric is measured and termed as bursting strength of the fabric. This depends not only on the strength of the yarns, but also in a complicated way on the extensibilities of the yarns and cloth construction. Grover and Hamby (1969) define that, it is the ability of a material to resist and rupture by pressure.

The Eureka Brand Hydraulic Bursting Strength Tester (Plate -IV) was used. Four inches square samples were cut from different parts of printed emblem and as well as from

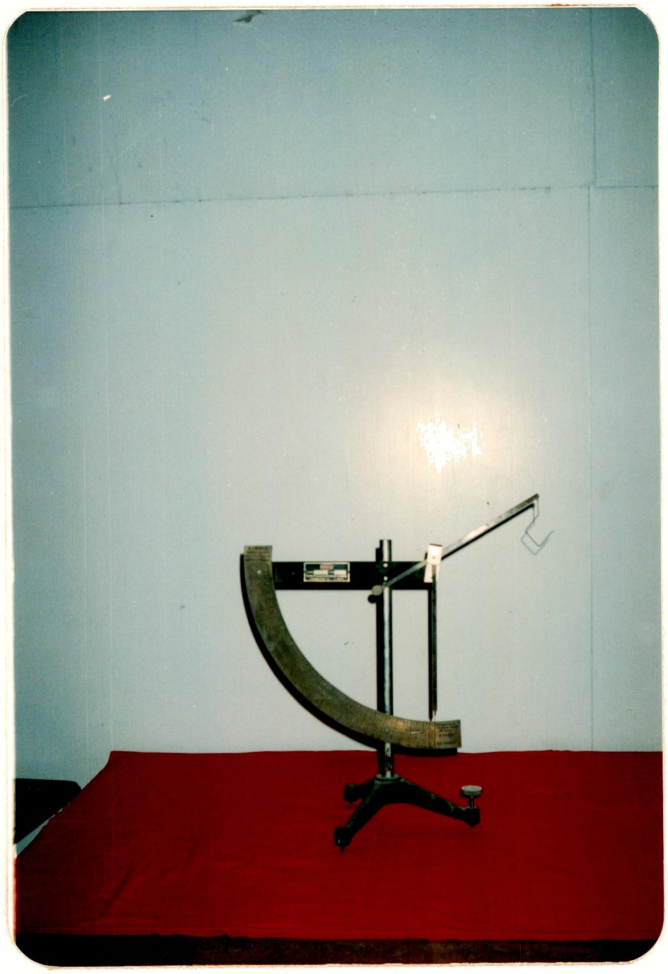


PLATE - III

CLOTH QUADRANT BALANCE

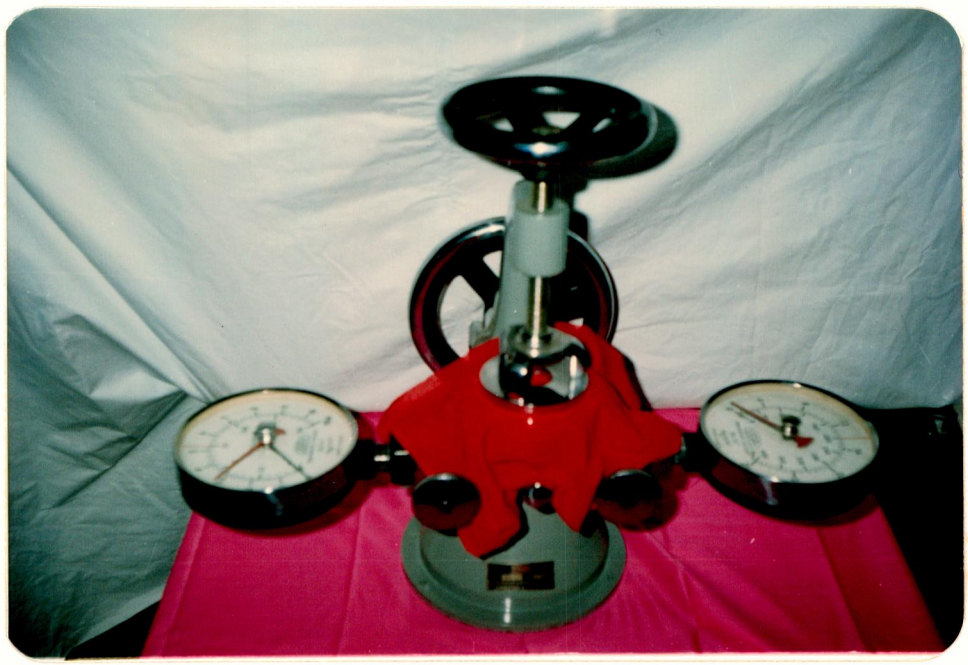


PLATE - IV

BURSTING STRENGTH TESTER.

original. It consisted of a device for holding the sample. The internal diameter of the clampings was three cms. The dial was caliberated in pounds per inch square and the kilograms per cm^2. The sample was mounted and pressure applied until the sample was broken. The reading of the sample was noted. Ten readings were taken from each sample and the mean value of the ten readings was calculated and recorded. The bursting strength of the two originals and 12 samples were found out separately. Students' "t-test" was used to satisfically analyse the data. A sample calculation is given in (Appendix-VI).

3. Colour Fastness Tests:

The Major performance characteristics of a dye is its ability to maintain its colour in normal use. This is knwon as colour fastness.

ASTM committee-12 (1987) states that, colour fastness test helps to determine whether the colour is fast to external conditions or not. The major factors affecting colourfastness are light, perspiration, cleansing methods, friction and atmospheric fumes - state Smith and Block (1982).

The American Association of Textile Chemists and Colourists (AATCC) has established standard terminology for rating colour fastness properties of fabrics and for evaluating colour staining and colour transfer in fabrics. The investigator followed the AATCC grey scale for the assessment

of colour change and staining of the printed samples.

The printed samples were tested for their,

a. Colour fastness to sunlight.
b. Colour fastness to printing (wet and dry),
c. Colour fastness to crocking (wet and dry).
d. Colour fastness to washing.

a. Colour Fastness to Sunlight:

A method suggested by Wingate (1984) was modified in such a way that, instead of exposing the same area for the entire length of time, for which the samples were exposed to light, the test was conducted as follows:

A specimen which consisted fo seven emblem was cut from each sample and covered with black chart paper on both the sides. Each emblem was marked from one to seven for exposing them to sunlight. The samples were exposed for a duration of eight hours from 9 am - 5 pm , and every day the area of expoture was increased by one section more than the previous day, that is, section one was exposed for first day and two on the second day and so on. Then the comparison was made with the original printed sample.

b. Colour fastness to wet and dry pressing:

I.S.I. Handbook of Textile Testing (1982) suggested two methods intended for evaluating colour fastness of textile fabrics when they are wet and dry.

A sample piece containing five emblems was taken. A white desized cotton material was attached with the printed sample, and pressed at medium temperature for about five seconds for dry pressing.

For wet pressing, the white material was wetted and excess water was squeezed out. Then the printed area was placed over and pressed for about 10 seconds with an iron having medium temperature.

Any stains on the white material was evaluated by using the AATCC grey scale and graded. Grey scale gradings are given in (Appendix-V).

c. Colour fastness to Crocking: (Wet and Dry)

Crocking is defined as the colour transfer from one coloured textile material to another by rubbing, point out Wingate (1970) and Mohler (1984).

Phyllis (1982) suggested two tests one with dry rubbing cloth and another with the wet rubbing cloth for evaluating the colour fastness of textile materials.

'SASMIRA Crockmeter' was used (Plate V). It consisted of two metal blocks. The base block was stationary, while the upper block had a device to move to and fro on the base by means of a rotating handle. The upper block consisted of a finger knob to hold the white material with a ring. The size of the sample was cut into 5 x 5 cms.

For drycrocking, the printed sample was mounted on the base block. The while material was mounted on the rubber finger with a ring. The number of rubs to be given was standardised and fixed as ten. Each sample was given ten rubs. The white material was rubbed to and fro against the printed sample along a track of ten cms., with a pressure of 900 gms. on the finger.

For wet crocking, the printed area was wetted out slightly and clamped on to the finger. The colour change and colour transference if any was assessed by means of AATCC scale, the details are given in (Appendix-V).

d. Colour Fastness to washing:

Wingate (1976) opines that the best way to determine the fastness to laundering is actually to launder a fabric. I.S.I. (1982), suggests that a series of laundery tests to determine the amount in colour fading, shrinkage or change in other properties.

A specimen of about 30 x 30 cm. was cut from each sample and subjected to artificial dusting. In this method, fine dust from sand was sieved, by placing the printed material below the sieve. The amount of sand for each sample was taken as 100 gms. Then the dust was evenly incorporated into the fabric by gently spreading the dust with fingers and then the dust was withered away. The sample was then subjected to washing.

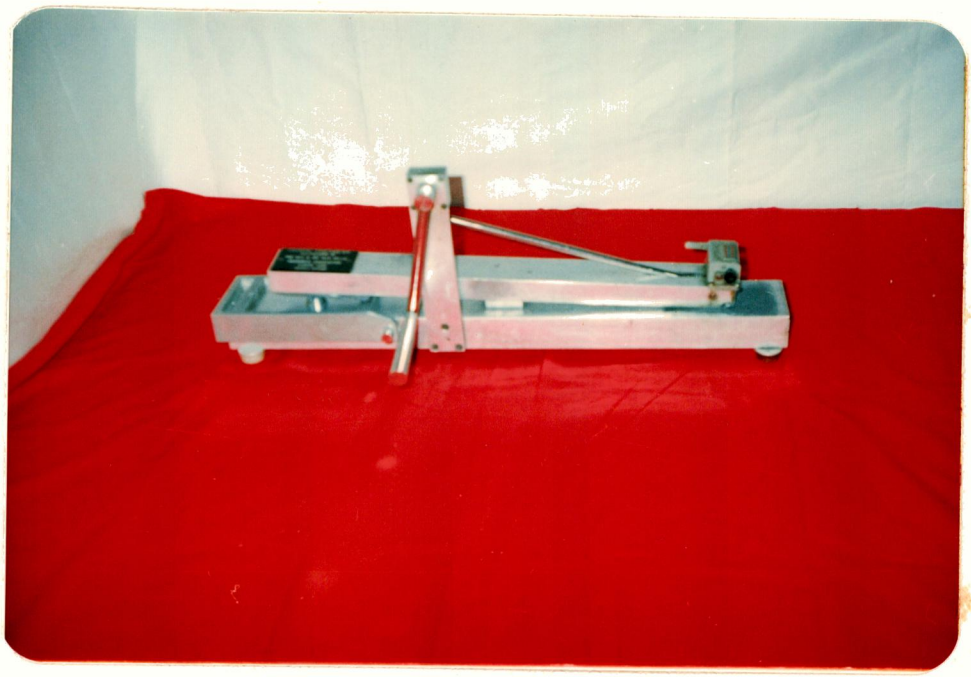


PLATE - V

CROCKMETER.

In the washing process, 5 grams of detergent powder was mixed in one litre of water, for each sample and the sample was kept in the soap solution for 5 minutes, and then gently washed by squeezing and rubbing. Then it was thoroughly rinsed in water and dried in shade. Similarly the experiment was repeated for twelve samples and ten washes were given for each sample. Any change is colour of the washed samples were evaluated visually by the investigator with the original sample, for brilliancy of colour, texture and appearance of the print.

K. Evaluation of the cost of solvents in printing:

The cost incurred by using kerosene and turpentine oil in printing, are evaluated and shown in (Appendix-VII).

RESULTS AND DISCUSSION

IV. RESULTS AND DISCUSSIONS

The results of the study are discussed under the following headings:

A. Visual Inspection.

B. Performance Tests.

C. Colourfastness Tests.

D. Evaluation of the cost of solvents in printing.

A. Visual Inspection:

The details of the visual inspection done are presented under the following headings:

1. Appearance of the print,
2. Colour of the print,
3. Texture of the fabric.
4. Uniformity of the print on the material.

1. Appearance of the print:

The details of the rating, regarding the appearance of the print is given in Table - II.

TABLE II

APPEARANCE OF THE PRINT.

Sl. No.	Sample Number	APPEARANCE			
		Very good	Good	Fair	Poor
		%	%	%	%
I	KHADI				
1	KK8	--	40	30	30
2	KK12	60	40	--	--
3	KK16	--	50	30	20
4	KT8	20	40	20	20
5	KT12	70	30	--	--
6	KT16	10	20	60	10
II	POPLIN				
7	PK8	10	20	60	10
8	PK12	60	40	--	--
9	PK16	10	60	20	10
10	PT8	20	30	30	20
11	PT12	60	30	10	--
12	PT16	20	20	40	20

From Table-II, it is clear that, the appearance of the printed khadi sample KK12, was rated as very good by 60 per cent of the judges and good by 40 per cent of judges, whereas sample KT12, printed with turpentine was rated as very good and good by 70 and 30 per cent of the judges respectively.

Among printed poplin material, sample PK12 was considered as very good and good by 60 and 40 per cent of the judges respectively, whereas sample PT12 was rated as very good and good by 60 and 30 per cent of the judges respectively.

In short, samples KK12, KT12, PK12 and PT12 were considered as better than the rest of the samples.

2. Colour of the print:

The results obtained regarding the colour of the print are shown in Table-III.

TABLE III

COLOUR OF THE PRINT

Sl. No.	Sample Number	COLOUR		
		Very bright	Bright	Dull
		%	%	%
I	KHADI			
1	KK8	10	80	10
2	KK12	70	30	--
3	KK16	10	60	30
4	KT8	20	50	30
5	KT12	30	70	--
6	KT16	10	50	40
II	POPLIN			
7	PK8	--	80	20
8	PK12	80	20	--
9	PK16	--	70	30
10	PT8	10	60	30
11	PT12	60	40	--
12	PT16	40	30	30

From Table-III, is is clear that sample KK12 was rated as very bright by 70 per cent of the judges and sample KT12 was rated as very bright and bright by 30 and 70 per cent of the judges respectively.

Among, the printed poplin material, sample PK12 was rated as very bright by 80 per cent of the judges and sample PT12 was rated as very bright by 60 per cent of the judges.

Evaluation proved that samples KK12, KT12, PK12 and PT12 were considered to be better as for colour of the print than the others.

3. Texture of the Material:

Regarding the texture of the printed material, the ratings obtained are shown in Table-IV.

TABLE IV

TEXTURE OF THE PRINTED MATERIAL

Sl. No.	Sample Number	TEXTURE		
		Smooth	Medium	Rough
		%	%	%
I	KHADI			
1	KK8	10	60	30
2	KK12	90	10	--
3	KK16	--	70	30
4	KT8	--	70	30
5	KT12	40	50	10
6	KT16	10	70	20
II	POPLIN			
7	PK8	20	70	10
8	PK12	70	30	--
9	PK16	20	50	30
10	PT8	--	100	--
11	PT12	50	40	10
12	PT16	40	50	10

Table-IV shows that, 90 per cent of the judges rated KK12 as smooth, whereas sample KT12 was rated as smooth and medium by 40 and 50 per cent of the judges respectively.

Among, the poplin printed samples, sample PK12 was rated as smooth by 70 per cent of the judges, whereas sample PT12 was rated as smooth by 50 per cent of the judges.

As for the texture of the printed material, sample KK12, KT12, PK12 and PT12 were found to be better than the others.

4. Uniformity of print:

Regarding the uniformity of print, the ratings obtained are shown in Table - V.

TABLE V

UNIFORMITY OF PRINT

Sl. No.	Sample Number	Uniformity of Print	
		Even %	Uneven %
I	KHADI		
1	KK8	90	10
2	KK12	100	--
3	KK16	100	--
4	KT8	100	--
5	KT12	100	--
6	KT16	50	50
II	POPLIN		
7	PK8	100	--
8	PK12	100	--
9	PK16	80	20
10	PT8	100	--
11	PT12	100	--
12	PT16	70	30

From Table-V, it is clear that samples KK12, KK16, KT8, KT12, were rated as even by cent per cent of the judges.

Among the poplin printed materials, samples PK8, PK12, PT8 and PT12 were rated as even by cent per cent of the judges.

The evaluation proved that among the khadi material where kerosene is used as solvent in printing, sample KK12 was better than KK8 and KK16 in all respect.

In the case of turpentine, used as solvent in printing sample KT12 was considered as better than samples KT8 and KT16.

As for poplin material where kerosene is used as solvent, sample PK12 was rated as better than the other two samples PK8 and PK16.

In the case of turpentine used as solvent in printing, sample PT12 was found to be better than the other two samples PT8 and PT16.

B) Performance Tests

1. Fabric Thickness
2. Fabric Weight
3. Bursting strength

1. Fabric Thickness:

The thickness of the khadi samples are represented in Table-VI and also in Figure-I.

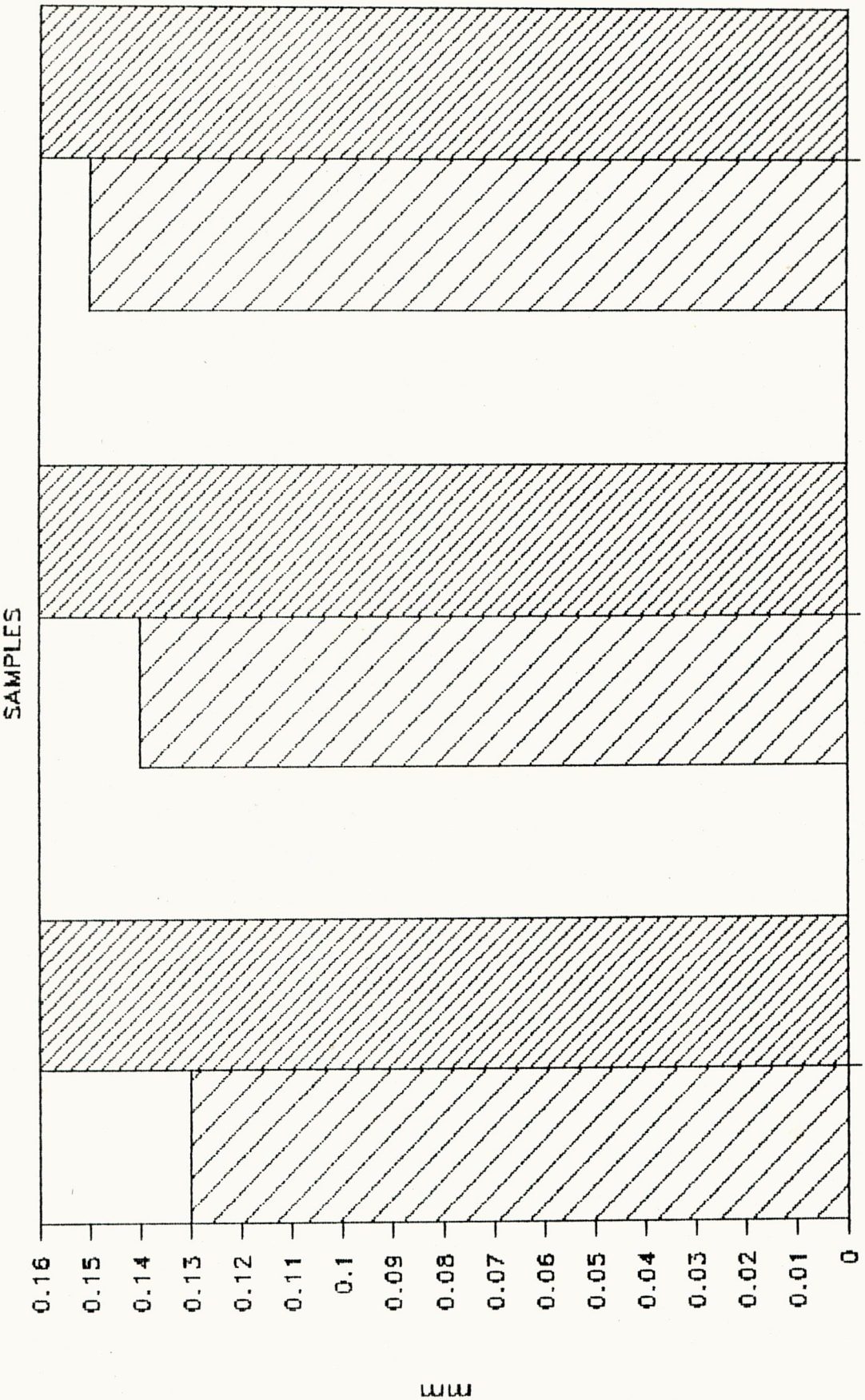
TABLE VI

FABRIC THICKNESS OF THE ORIGINAL & PRINTED KHADI SAMPLES

S.No.	Samples	Mean Value in mm.	Gain or loss over original in mm.	Percentage gain or loss over original	Samples compared	't' value
1	K	0.14	--	--		
2	KK8	0.13	-0.01	7.14	KK8 Vs KK12	1.72
3	KK12	0.14	0	0	KK12 Vs KK16	1.24
4	KK16	0.15	0.01	7.14	KK8 Vs KK16	3.38**
5	KT8	0.16	0.02	14.29	KT8 Vs KT12	0
6	KT12	0.16	0.02	14.29	KT12 Vs KT16	0
7	KT16	0.16	0.02	14.29	KT8 Vs KT16	0
					KK8 Vs KT8	8.36**
					KK12 Vs KT12	3.19**
					KK16 Vs KT16	1.49

Key : ** - Significant at 1% level.

FIG.I FABRIC THICKNESS OF THE KHADI



It is clear from the above table, that the thickness of all most all khadi samples were increased by .01 to .02mm except samples KK8 and KK12.

"t-value" between samples revealed that KK8 and KK16, KK8 and KT8, and KK12 and KT12 were significant at 1 per cent level.

The thickness of the poplin samples are represented in Table-VII and also in figure-II.

TABLE VII

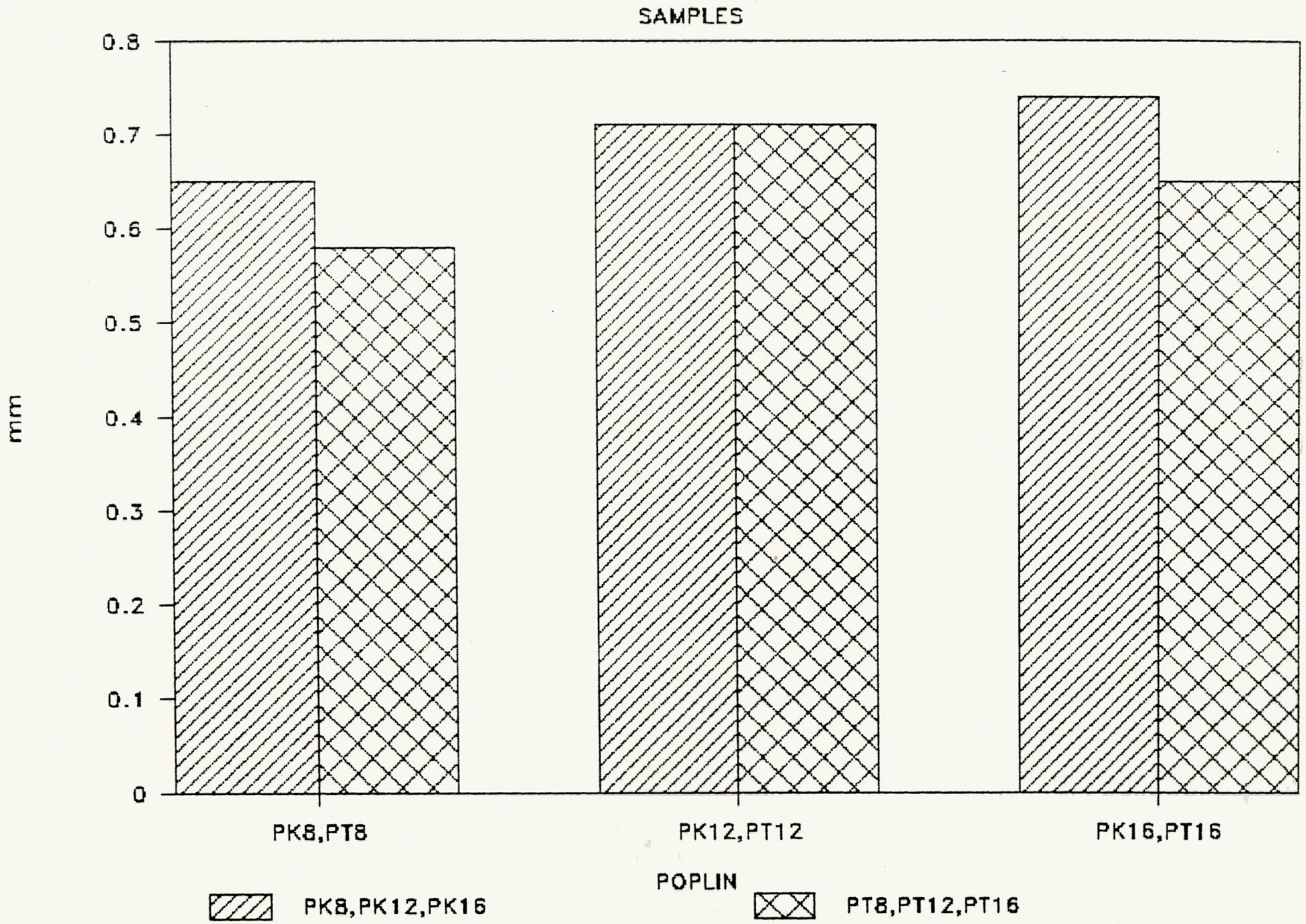
FABRIC THICKNESS OF THE ORIGINAL AND PRINTED POPLIN SAMPLES

S.No.	Samples	Mean Value in mm.	Gain or loss over original in mm.	Percentage gain or loss over original	Samples Compared	"t-Value"
1	P	0.72	--	--	--	--
2	PK8	0.65	-0.07	3.72	PK8 Vs PK12	1.41
3	PK12	0.71	-0.01	1.39	PK12 Vs PK16	0.704
4	PK16	0.74	0.02	2.78	PK8 Vs PK16	3.65**
5	PT8	0.58	-0.14	19.44	PT8 Vs PT12	4.13**
6	PT12	0.71	-0.01	1.39	PT12 Vs PT16	2.23*
7	PT16	0.65	-0.07	3.72	PT8 Vs PT16	2.60*
					PK8 Vs PT8	2.60*
					PK12 Vs PT12	0
					PK16 Vs PT16	3.65*

Key : ** - Significant at 1% level

* - Significant at 5% level

FIG.II FABRIC THICKNESS OF THE POPLIN



Fabric thickness of poplin samples showed a decrease over original, except in sample PK16. The decrease over original was ranging from .01mm to .14mm.

Statistical analysis proved that PK8 Vs PK16 and PT8 Vs PT12 were significant at 1 per cent level. PT12 Vs PT16, PT8 and PT16, PK8 Vs PT8, and PK16 Vs PT16 were found to be significant at 5 per cent level.

2. Fabric Weight:

The fabric weight of Khadi and Poplin samples are given in the Table VIII and figures-III and IV.

TABLE VIII

FABRIC WEIGHT OF THE ORIGINAL AND PRINTED SAMPLES

S.No.	Materials	Samples	Near value in OZ/Square yard
I	KHADI	K	3.6
1		KK8	3.66
2		KK12	3.77
3		KK16	3.5
4		KT8	4
5		KT12	4.09
6		KT16	4.1
II	POPLIN	P	3.3
7		PK8	3.3
8		PK12	3.43
9		PK16	3.36
10		PT8	3.22
11		PT12	3.45
12		PT16	3.43

It is clear from table VIII that, there is increase in weight in all samples except KK16 as for khadi material is concerned.

FIG.III FABRIC WEIGHT OF THE KHADI

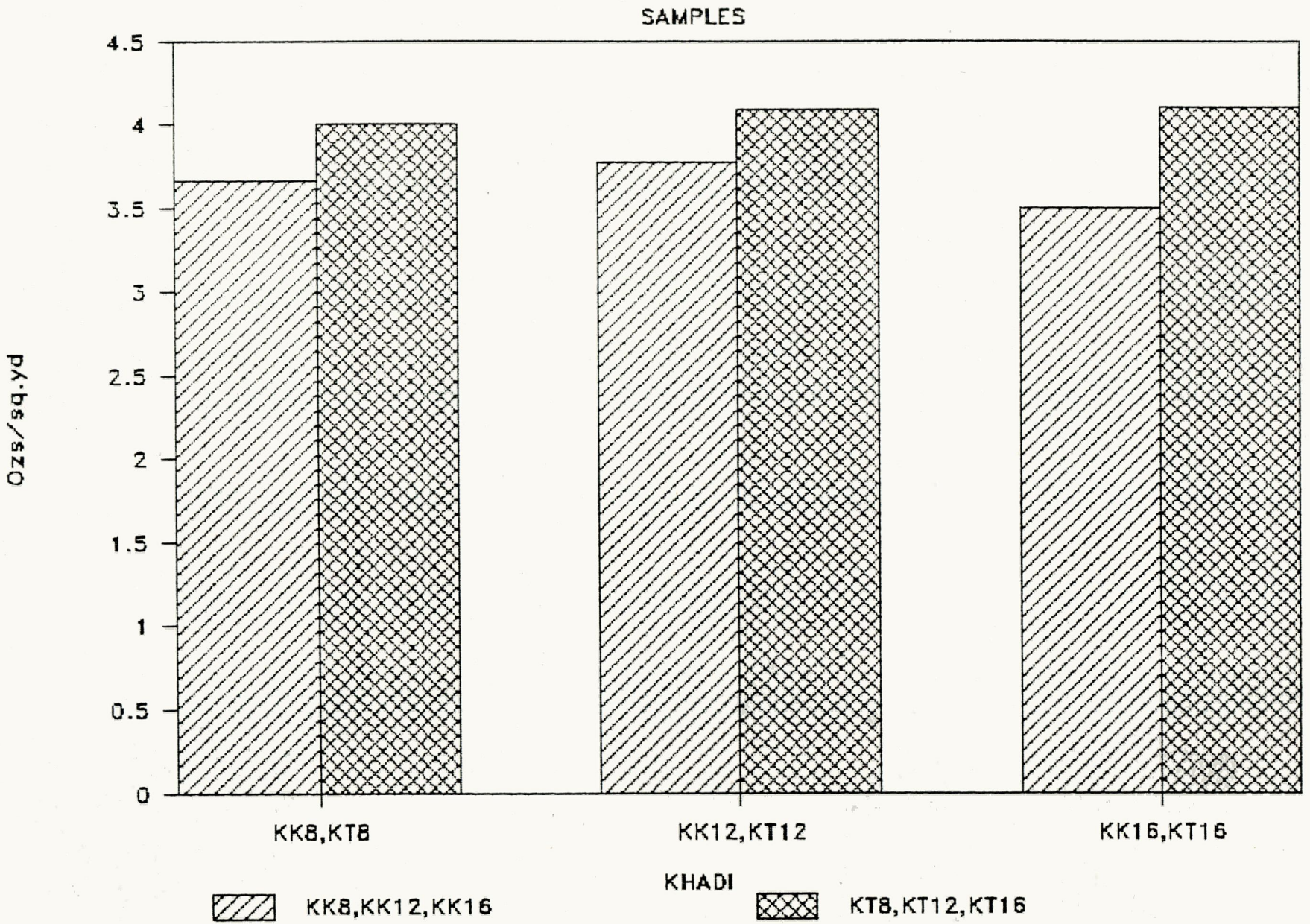
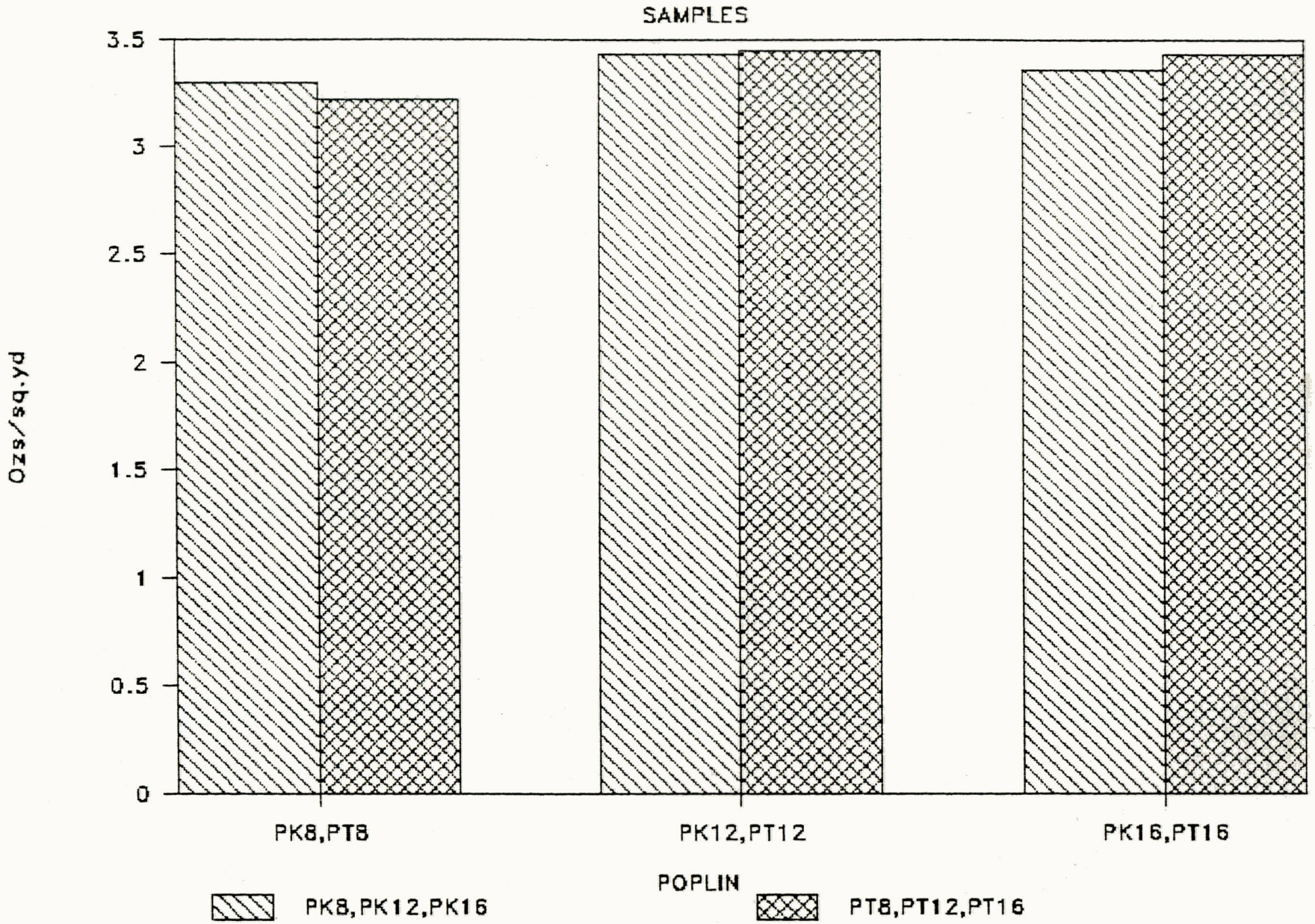


FIG.IV FABRIC WEIGHT OF THE POPLIN



Poplin too shows that, there is increase in weight in all samples except PK8 and PT8.

Hence, it is understood that, the increase in volume of kerosene or turpentine has only limited effect on the weight of the samples.

3. Bursting strength:

The bursting strength of the khadi printed samples are represented in the Tables IX and also in Figure-V

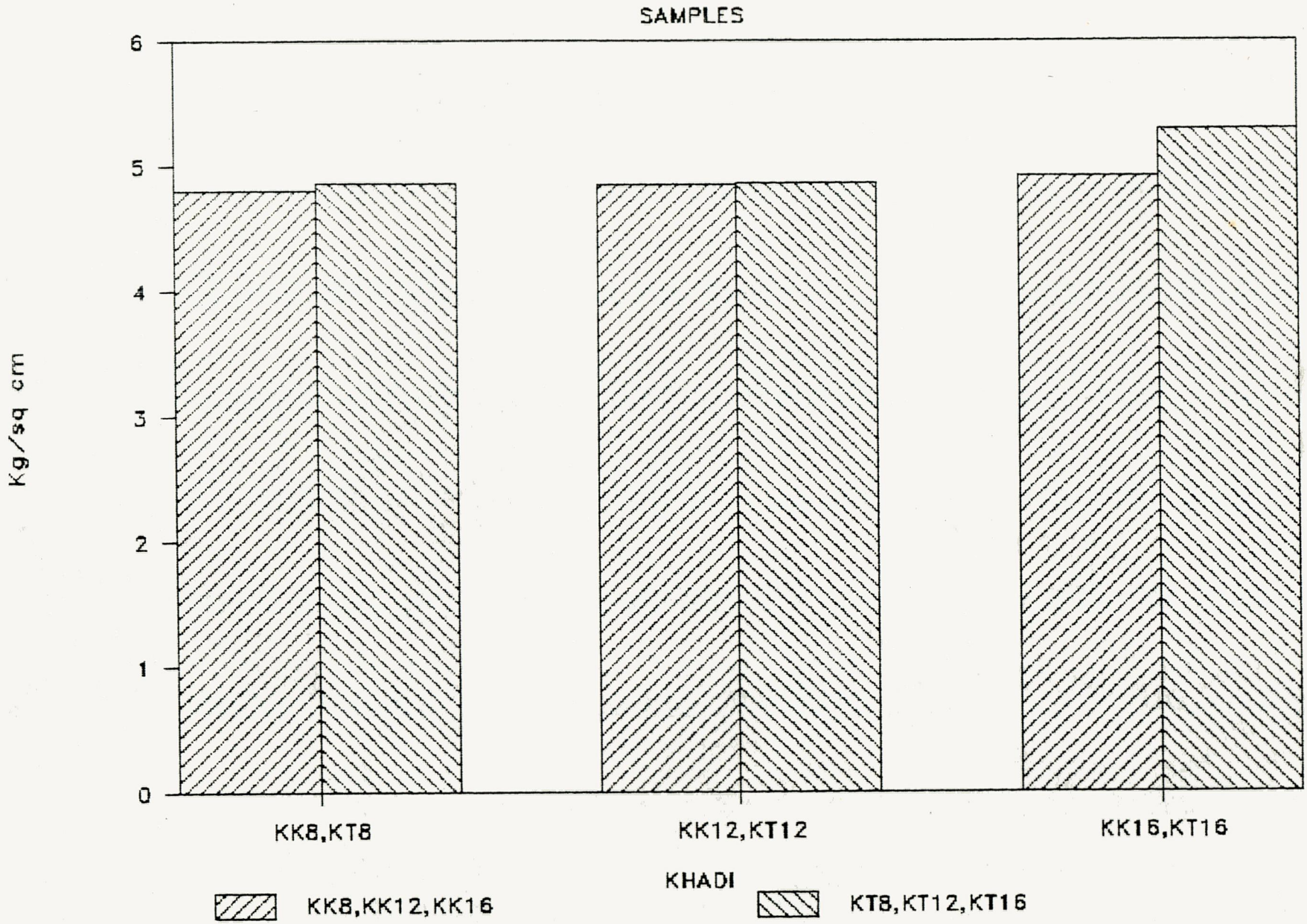
TABLE IX

BURSTING STRENGTH OF THE ORIGINAL AND PRINTED KHADI SAMPLES

Sl. No.	Samples	Mean Value in mm	Gain or loss over original in mm	Percentage gain or loss over original	Samples compared			"t-Value"
1.	K	5.1						
2.	KK8	4.8	0.3	5.88	KK8	Vs	KK12	0.209
3.	KK12	4.85	0.25	4.90	KK12	Vs	KK16	0.39
4.	KK16	4.91	0.19	3.73	KK8	Vs	KK16	0.63
5.	KT8	4.86	0.24	4.71	KT8	Vs	KT12	0
6.	KT12	4.86	0.24	4.71	KT12	Vs	KT16	2.91*
7.	KT16	5.29	0.19	3.73	KT8	Vs	KT16	2.91*
					KK8	Vs	KT8	0.28
					KK12	Vs	KT12	0.066
					KK16	Vs	KT16	2.57*

Key: * Significant at 5% level

FIG.V BURSTING STRENGTH OF THE KHADI



Regarding the bursting strength of khadi samples, it is clear from table IX and figure V, that sample KT16 shows an increase by o.19 mm, whereas all other samples had decreased, and the decrease was found to range from 0.1 to 0.3 mm.

Statistical "t-value" between samples revealed that samples KT12 Vs KT16, KT8 Vs KT16 and KK16 Vs KT16 weresignificant at 5 per cent level.

The bursting strength of the poplin samples are represented in the Table X and figure-VI.

TABLE X

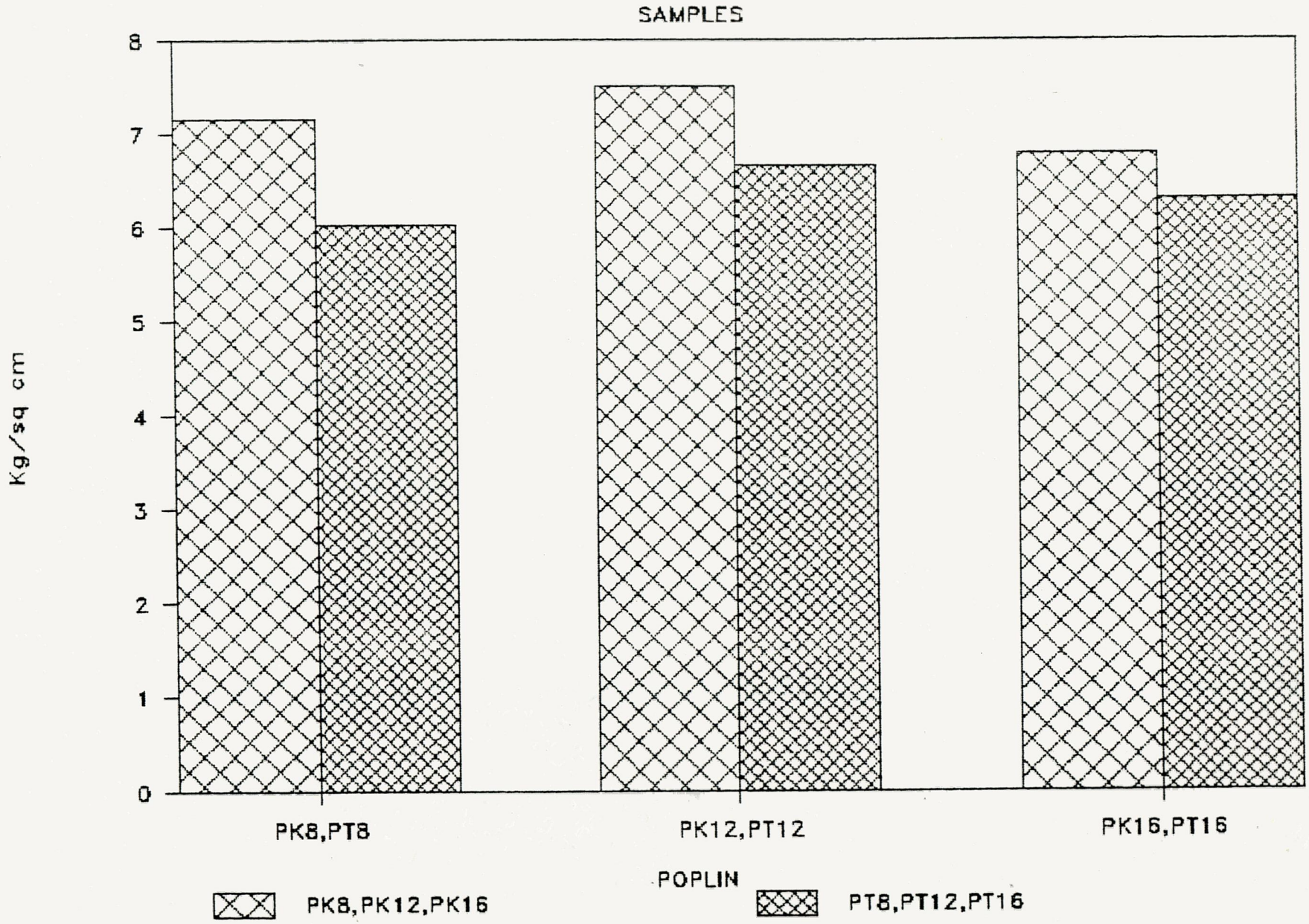
BURSTING STRENGTH OF THE ORIGINAL AND PRINTED POPLIN SAMPLES

Sl. No.	Samples	Mean Value in mm	Gain or loss over Original	Percentage gain or loss over original	Samples compared	"t-Value"
1.	P	6.6				
2.	PK8	7.15	0.55	3.33	PK8 Vs PK12	1.815
3.	PK12	7.5	0.9	13.64	PK12 Vs PK16	3.92**
4.	PK16	6.78	0.18	2.724	PK8 Vs PK16	1.964
5.	PT8	6.03	-0.57	-3.64	PT8 Vs PT12	3.29**
6.	PT12	6.65	0.05	7.76	PT12 Vs PT16	1.773
7.	PT16	6.3	-0.3	-4.55	PT8 Vs PT16	2.74*
					PK8 Vs PT8	7.35**
					PK12 Vs PT12	3.791**
					PK16 Vs PT16	3.24**

Key: * Significant at 5% level.

** Significant at 1% level.

FIG.VI BURSTING STRENGTH OF THE POPLIN



Bursting strength of the printed poplin samples shows that, all most all the samples were increased by 0.05 to 0.9 mm except samples PT8 and PT16.

The "t-value" between the samples revealed that samples PT8 Vs PT16 was significant at 5 per cent level. The "t-value" between samples PK12 Vs PK16, PT8 Vs PT12, PK8 Vs PT8, PT12 Vs PT12 and PK16 Vs PT16 were signifcant at 1 percent level.

c. COLOUR FASTNESS TESTS

1. Colour fastness to sunlight

when the printed samples after a week's exposure to sunlight were compared with that of the original printed sample, samples KK8,KK8, PK8 and PT8 were found to have good colour fastness whereas the prints on the other sample were found to have faded lightly.

Hence, it may be concluded that samples printed using kerosene and turpentine at 8 litres volume, as solvent in printing, were found to be more colourfast than the other samples.

2. Colour fastness to pressing:

The grades obtained by the printed samples for fastness to pressing is given in Table-XI.

TABLE XI

COLOUR FASTNESS TO PRESSING

S.No.	Material	Samples	Grading Obtained Colour Fastness to Dry	Grading Obtained Colour Fastness to Wet
I	KHADI			
1		KK8	5	5
2		KK12	5	4-5
3		KK16	5	4-5
4		KT8	5	5
5		KT12	5	4-5
6		KT16	5	4-5
II	POPLIN			
7		PK8	5	5
8		PK12	5	5
9		PK16	5	4-5
10		PT8	5	4-5
11		PT12	5	5
12		PT16	5	4-5

From Table-XI , it is understood that almost all the samples had good colour fastness to dry and wet pressing. This is obvious from the fact that, there was no staines on the white material.

3. Colour fastness to crocking:

The Table-XII deals with the grading for fastness to crocking of the printed samples.

TABLE XII

COLOUR FASTNESS TO CROCKING

S.No.	Materials	Samples	GRADING OBTAINED	
			Colour fastness to crocking	
			Dry	Wet
I	KHADI			
1		KK8	4	3-4
2		KK12	4	3-4
3		KK16	4	3-4
4		KT8	4	4
5		KT12	3-4	4
6		KT16	3-4	3-4
II	POPLIN			
7		PK8	4	3-4
8		PK12	4	3-4
9		PK16	4	3-4
10		PT8	4	4
11		PT12	4	4
12		PT16	3-4	3-4

From table-XII, it is understood that samples KK8, KK12 KK16 and KT8 were slightly stained while KT12 and KT16 were noticeably stained in dry crocking. In wet crocking, samples KK8, KK12, KK16 and KT16 were noticeably stained while KT8 and KT12 were stained lightly.

In poplin, almost all the samples were stained slightly in dry crocking. In wet crocking, most of the samples were noticeably stained, but sample PT8 stained slightly.

Hence from the above test, it shows that samples. KT8 and PT8 stained only slightly both in dry and wet conditions, when compared to other samples.

4. Colourfastness to washing:

When the washed printed samples were compared with the original printed sample, it was seen that samples KT8 and PT8 were highly colourfast than the rest of the samples.

Evaluation of the cost of solvents in printing:

For the different volume of solvents used, the cost have been worked out and are depicted in Table-XIII

TABLE XIII

COST OF SOLVENTS IN PRINTING

Sl.No	Name of the solvent	Volume of the solvent in litres	Volume of solvent used	Solvent cost in Rs. P.	Total* cost ofthe paste Rs. P.	Percentage of solvent cost over the total Rs. P.
I	Kerosence	8	1	8.00	16.09	49.72
		12	1½	12.00	20.09	59.73
		16	2	16.00	24.09	66.42
II	Turpentine	8	1	9.00	17.09	52.66
		12	1½	13.50	21.59	62.53
		16	2	18.00	26.09	68.99

*Total cost shown in appendix -VII

From table XIII, it is evident that as the volume of solvent increases, the cost also increases. The cost of the solvents used contributes to the major portion of the total cost which can be seen from the above tabulation.

The objective of the study is to compare the cost incurred by using kerosene and turpentine as solvents in printing. The percentage of solvent cost over the total, in the case of kerosene ranges between Rs.49.72 to Rs.66.42. In the case of turpentine, the same varies between Rs.52.66 to Rs.68.99. Thus, the cost of printing is less, when kerosene is used as solvent than, turpentine in pigment printing.

SUMMARY AND CONCLUSION

V- SUMMARY AND CONCLUSION

Textiles play a vital role in every man's life, which changes and improvements have contributed greatly to man's mobility, and to his conquest in the field of science and Technology. Man urges to decorate his clothing, and the fabrics of his environment, by means of "printing and dyeing" dates from the very earliest times.

Printing is a technique, in which surface designs are achieved by the application of colours or chemicals to the surface of the fabric, after the fabric has been woven or non-woven. pigment printing, a method of printing fabrics,plays a leading role, all over the world. In pigment printing, the paste consists of pigment (a colouring matter), binder, thickner resins and suitable solvent. This paste can be applied to the fabric by using any suitable printing techniques, usually the screen-printing method. The solvents that are commonly used are kerosene or turpentine, which gives surface or uniformity of the print.

This study was conducted to find out the effect of kerosene and turpentine oil in pigment printing, on cotton khadi and poplin material, under selected conditions.

The main-objectives of the study are:-

-to compare the cost incurred by using kerosene and turpentine solvent on the selected fabric for printing.

- to find out the suitable volume of solvent to be used for printing.

- Evaluation of the printed samples by visual inspection, performance tests and colourfastness tests.

First, the material was prepared for printing. Six different pastes were prepared, three from Kerosene named as K8, K12, and K16 and three from turpentine named as T8, T12, and T16, just by varying the volume of solvents alone. Then by using each paste, printing was carried out by hand-screen printing technique, on their respective samples, both in cotton khadi and poplin material. Then the samples were subjected to various tests, and evaluated.

The evaluation of the printed samples comprises of the following steps:-

A) Visual Inspection

B) Performance tests

C) Colourfastness Tests

D) Evaluation of the cost of the printed samples.

A) VISUAL INSPECTION:

Among the printed samples, samples printed with kerosene and turpentine with the volume of 12 litres were rated as very good in appearance, very bright in colour, smooth in texture and even in uniformity of print.

B) PERFORMANCE TEST:

1. Fabric Thickness

The thickness of almost all khadi samples were increased and in the case of poplin, samples, all the printed samples showed a decrease over the original samples.

2. Fabric Weight

The fabric weight of almost all the samples were increased except KK16 and PT8, Hence it could be concluded that the increase in volume of kerosene or turpentine has only limited effect on the weight of the samples.

3. Bursting strength

The strength of theprinted materials, in the case of both khadi andpoplin showed an increase in the strength of the material.

C) COLOURFASTNESS TESTS:

1. Colour fastness to sunlight test proved that, among the printed samples in both the khadi and poplin, material, samples printed with kerosene and turpentine at a volume of 8 litres were highly colourfast than the others.

2. Colour fastness to pressing test shows that almost all the samples were colourfast to both dry and wet pressing.

3. Colourfastness to crocking showed that samples KT8 and PT8 were better than the other samples.

4. Colourfastness to washing test proved that the samples printed with 8 litres Volume of Kerosene and turpentine were highly colourfast when compared with other samples.

D) EVALUATION OF THE COST OF THE PRINTED SAMPLE

Evaluation of the cost of the printed samples showed that, the samples printed with kerosene are more economical when compared to that of turpentine, in pigment printing.

CONCLUSION:

It may be concluded that, the samples printed, using 12 litres, Volume of kerosene or turpentine, were visually very good in appearance, very bright in colour, smooth in texture and even in uniformity of print. But all other tests proved that the samples printed using 8 litres Volume, were the best of the three.

As for the economy, it was felt that using kerosene is economical than using turpentine.

Hence Kerosene can be used both in 8 or 12 litres capacity as solvent in pigment printing in order to reduce the printing cost.

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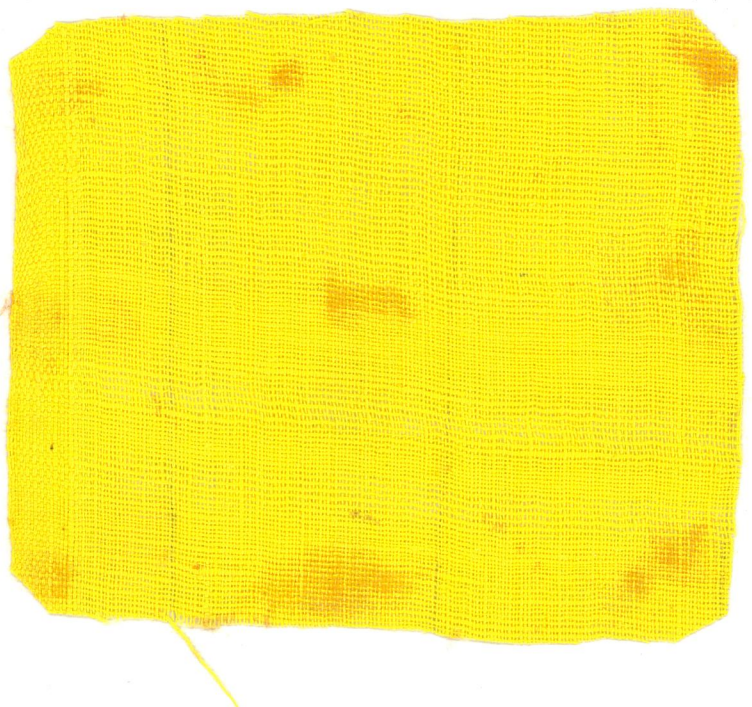
APPENDICES

APPENDIX – I.

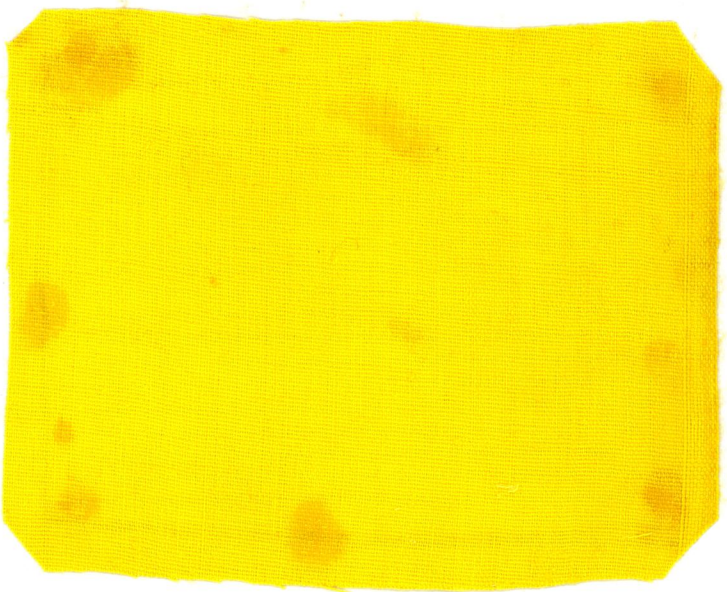
DETAILS OF THE SELECTED MATERIALS.



NAME OF THE MATERIAL – KHADI.

WIDTH OF THE MATERIAL – 34".

COST PER METRE – Rs. 16.00.



NAME OF THE MATERIAL - POPLIN

WIDTH OF THE MATERIAL - 34"

COST PER METRE - Rs: 11.50.

APPENDIX - II

SELECTED DESIGN.

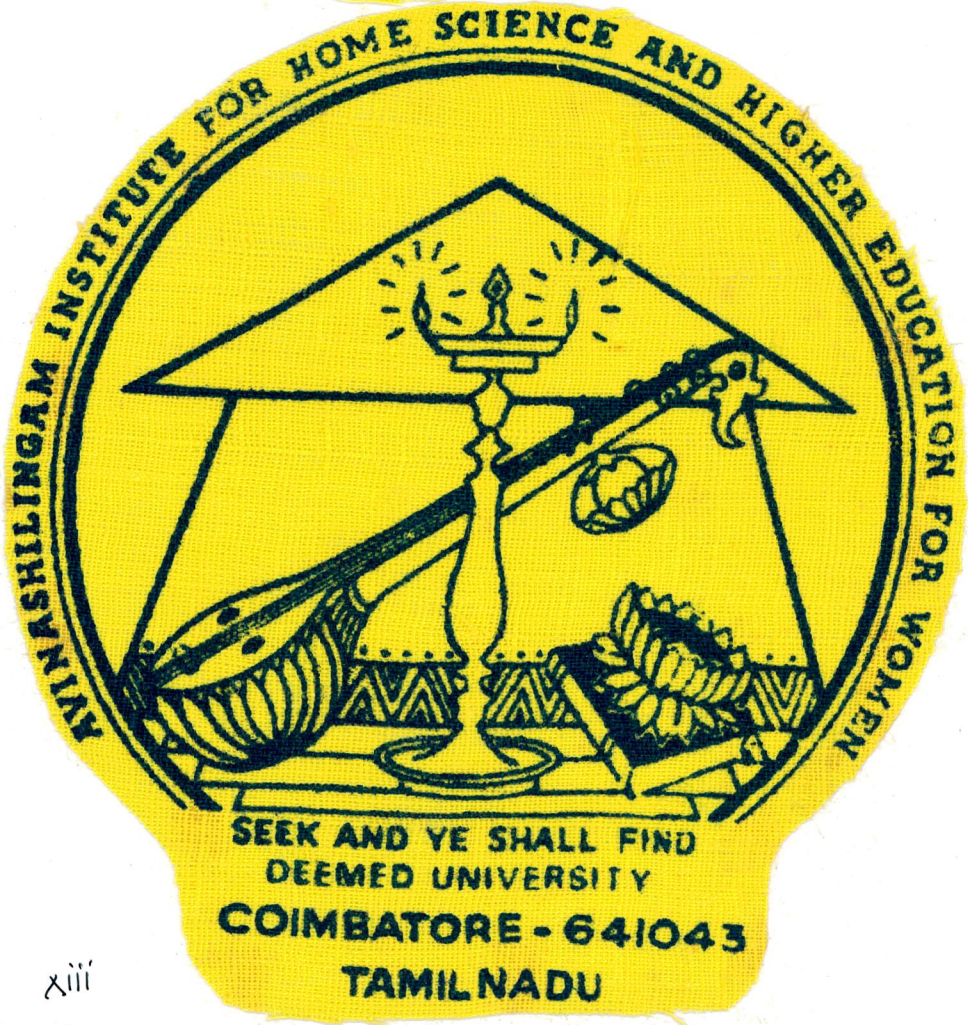
APPENDIX - III . PRINTED KHADI SAMPLES

KK8

KK12


AVINASHILINGAM INSTITUTE FOR HOME SCIENCE AND HIGHER EDUCATION FOR WOMEN
SEEK AND YE SHALL FIND
DEEMED UNIVERSITY
COIMBATORE - 641043
TAMILNADU

KK16


AVINASHILINGAM INSTITUTE FOR HOME SCIENCE AND HIGHER EDUCATION FOR WOMEN
SEEK AND YE SHALL FIND
DEEMED UNIVERSITY
COIMBATORE - 641043
TAMILNADU

KT8


AVINASHILINGAM INSTITUTE FOR HOME SCIENCE AND HIGHER EDUCATION FOR WOMEN
SEEK AND YE SHALL FIND
DEEMED UNIVERSITY
COIMBATORE - 641043
TAMILNADU

KT12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KT16

POPLIN SAMPLES

PK8

PK12


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TAMILNADU

PK16


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PT8


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PT12


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PT16

APPENDIX - IV

RATING SCALE USED TO EVALUATE THE PRINTED SAMPLES

Sl. No.	Sample No.	Appearance				Colour		Texture			Uniformity of print	
		Very good	Good	Fair	Poor	Very Bright	Bright	Dull	Smooth	Medium	Rough	Even	Uneven
1													
2													
3													
4													
5													
6													
7													
8													
9													
10													
11													
12													

APPENDIX - V

GREY SCALE USED TO EVALUATE THE PRINTED SAMPLES

The printed samples were rated using the AATCC grey-scale to measure the extent of colour staining. The grey ratings envisaged the following standards of colourfastness to pigment printing on khadi cotton and poplin under selected conditions. Nomenclature used for staining.

5	-	No staining
4	-	Slightly stained
3	-	Noticeably stained
2	-	Considerably stained
1	-	Much stained

APPENDIX VI

METHOD USED FOR STATISTICAL ANALYSIS

According to Gupta (1987), the "t-test" is based on the "t-distribution". The "t-distribution" is commonly called "student's t-distribution" (or) simply "student's distribution". The t-distribution is used when the sample size is 30 or less and the population standard deviation is unkown.

The t-table is the probability integral of t-distribution and the t-distribution has a different value for each degree of freedom if the calculated value of 't' is greater than the table value, it is said that the difference between the sample mean significant at that particular level. On the other hand, if the calculated t-value is less than the table value the difference is not significant.

$$t = \frac{\overline{X_1} - \overline{X_2}}{S} \times \sqrt{\frac{n1 \quad n2}{n1 + n2}}$$

Further,

$$S = \sqrt{\frac{n1 \quad s1^2 + n2 \quad s2^2}{n1 + n2 - 2}}$$

Where;

$\overline{X_1}$ = Mean of sample 1

$\overline{X_2}$ = Mean of sample 2

n1 = The size of the sample 1

n2 = The size of the sample 2

S = Combined standard deviation of sample 1 and 2

S1 = The standard deviation of sample 1

S2 = The standard deviation of sample 2

The sample of "t-test" for Bursting strength is shown (Samples KK12 vs KK16).

Whereas,

$\overline{X_1}$ = 7.5

$\overline{X_2}$ = 6.78

n1 = 10

n2 = 10

S1 = .40

S2 = .38

$$S = \sqrt{\frac{n1 \quad S1^2 + n2 \quad S2^2}{n1 + n2 - 2}}$$

$$= \sqrt{\frac{10\ (.16) + 10\ (.14)}{18}}$$

$$= \sqrt{\frac{1.6 + 1.4}{18}}$$

$$= \sqrt{\frac{3}{18}}$$

S = 0.41

$$t = \frac{\overline{X_1} - \overline{X_2}}{S} \times \sqrt{\frac{n1 \; n2}{n1 + n2}}$$

$$= \frac{7.5 - 6.78}{.41} \times \sqrt{\frac{10 \times 10}{10+10}}$$

$$= \frac{.72}{.41} \times \sqrt{5}$$

$$= \frac{.72}{.41} \times 2.23$$

$$t = 3.92$$

Now we see the table value of "t" of (n + n - 2) degree of freedom.

$$t = (n + n - 2)$$

$$= (10 + 10 - 2)$$

$$= 18$$

t 18 - 1% level

$$= 2.878$$

So the calculated 't' value (3.92) is greater than table 't' value (2.878) at 1 per cent level, hence the difference between the two samples was significant at 1 per cent level.

APPENDIX VII

EVALUATION OF THE COST OF SOLVENTS IN PRINTING

The amount of ingredient and cost presented below indicates the amount used for printing 4 metres of material respectively.

K8

SLN	116.6 gm	-	Rs. 7.00
Kerosene	1 litre	-	Rs. 8.00
Urea	33.3 gm.	-	Rs. 0.08
Fixer CCL	0.41 ml.	-	Rs. 0.05
Pigment Colour	3 gm.	-	Rs. 0.96
	K8	-	Rs.16.09

K12

SLN	116.6 gm	-	Rs. 7.00
Kerosene	1½ litre	-	Rs.12.00
Urea	33.3 gm	-	Rs. 0.08
Fixer CCL	0.4 ml	-	Rs. 0.05
Pigment Colour	3 gm	-	Rs. 0.96
			Rs.20.09

K16

SLN	116.6 gm	-	Rs. 7.00
Kerosene	2 litre	-	Rs.16.00
Urea	33.3 gm	-	Rs. 0.08
Fixer CCL	0.41 ml.	-	Rs. 0.05
Pigment Colour	3 gm	-	Rs. 0.96
	K16		Rs.24.09

T8

SLN	116.6 gm	-	Rs. 7.00
Turpentine	1 litre	-	Rs. 9.00
Urea	33.3 gm	-	Rs. 0.08
Fixer CCL	0.41 ml.	-	Rs. 0.05
Pigment Colour	3 gm	-	Rs. 0.96
	T8	-	Rs.17.09

T12

SLN	116.6 gm	-	Rs. 7.00
Turpentine	1½ litre	-	Rs.13.50
Urea	33.3 gm	-	Rs. 0.08
Fixer CCL	0.41 ml.	-	Rs. 0.05
Pigment Colour	3 gm	-	Rs. 0.96
	T12	-	Rs.21.59

T16

SLN	116.6 gm	-	Rs. 7.00
Turpentine	2 litre	-	Rs.18.00
Urea	33.3 gm	-	Rs. 0.08
Fixer CCL	0.41 ml	-	Rs. 0.05
Pigment Colour	3 gm	-	Rs. 0.96
		T16 -	Rs.26.09