AN EVALUATION OF THE QUALITATIVE CHARACTERISTICS OF PATTERN DYED FABRICS OF SMALL SCALE DYEING INDUSTRIES IN SOME PARTS OF NIGERIA.

BY

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DECLARATION

I hereby declare that this thesis has been written by me and that it is a record of my own research work. It has not been presented in any previous application for a higher degree. All quotations are indicated by quotation marks and the sources of information are specifically acknowledged by means of references.

Folasade Idowu Abanikannda
September, 1998

CERTIFICATION

The thesis entitled an evaluation of the qualitative characteristics of pattern dyed fabrics of small scale dyeing industries in some parts of Nigeria by Abanikannda, Folasade met the regulations governing the award of degree of Master of Arts of Ahmadu Bello University and is approved for its contribution to knowledge and literary presentation.

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ABSTRACT

The high aesthetic value of the pattern dyed fabrics of Nigeria's small scale dyeing industries is a fact with which the world at large is well acquainted. However, the level of their performance in relation to pre-determined end uses is not certain. The problem of this study therefore, is an investigation into the extent to which some parameters of quality namely; aesthetics, comfort and durability are either present or absent in this type of home - made textiles.

The purpose of this study is to: (a) identify and examine the raw materials, equipment and techniques employed in pattern dyeing in Nigeria; (b) find out both the producers and consumers' appraisal of the fabrics, performance level and to use standard laboratory facilities and methods to verify the information obtained; (c) determine the effect of quality and/or manipulation of raw materials on the fabrics performance and; (d) make recommendations based on the findings for future research.

This research is evaluative in nature, hence two research strategies were employed in the gathering of data. These are; the field survey and the experimental method. During the field survey samples were obtained from the dyers, sellers and users of the fabric. Alongside the collection of samples, information about adequate or deficient quality parameters was obtained through interviews and participant observation. The samples were then subjected to testing using the facilities and methods stipulated by the International Standard Organisation (ISO). The assessment of results was also done in accordance with the ISO specifications.

The information gathered from the field was to a large extent, confirmed by the laboratory tests. 'Colour fastness' an aspect of fabric aesthetic performance was found to be of major concern to the consumers. The test confirmed the fact that the fabrics have Colour fastness problems and that only

a little effort Is required on the part of the craftsmen to remedy the situation. Other prominent deficiencies observed were poor crease recovery, abrasion resistance and dimensional stability. On the other hand, both the water and air permeability values of the fabrics were generally high. The tensile strength was also generally high.

The result of this study shows that the fabrics possess characteristics which qualified their quality to be ranked as good. Furthermore, the fabrics have the potential to rank higher than most contemporary fabrics with identical construction patterns and decoration procedures if the recommendations at the end of the study are considered and acted upon. Finally, the study reveals the fact that all the performance parameters considered either adequate or deficient in the fabric as an apparel wear can actually be manipulated to adapt the pattern dyed fabrics to many more varied end uses than are presently known.

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CHAPTER 1

INTRODUCTION

1.1 Background of the Study

Nigeria, a country situated on the west coast of Africa is a base of various handcrafts which constitute the bulk of the nation's small scale industries. Products of the pattern dyeing crafts happen to be one of the most popular in both production and consumption within and outside the country.

The importance of textile crafts as a means of boosting the Nigerian economy cannot be over emphasised. According to Fagg (1971), the Yoruba are the finest practitioners of pattern dyeing which they call 'adire'. The main centres of adire dyeing are at Abeokuta, Ibadan and Oshogbo but it is practised almost universally by the Yoruba wherever they are found. Other Nigerians include the Hausa, the Tiv and the Nupe. Today however, virtually all the diverse cultural groups in Nigeria are actively engaged in the craft either on an individual basis or in small groups of two or more. As a result of the popularity of the craft as a vocation among many Nigerians, the markets have become flooded with fabrics with a wide variety of patterns and colours.

In Nigeria, traditional fabrics abound on the one hand while various foreign made fabrics from all parts of the world compete in an attempt to dominate the domestic home market. Sotade (1994), observes that as each day passes, local textiles and fashion designers are coming out with new innovations to cut a 'haute couture' from our local fabrics both for local and international consumption. Many of them have highlighted their creativity by designing local fabrics into styles that will appeal to the taste of fashion

conscious Nigerians. International styles are now being popularised using local fabrcis.

Inspite of all these breakthroughs, it is not uncommon to see high cadre of Nigerians on the television screen or at important functions wearing apparels made outside Nigeria while they preach that others should buy Nigerian goods. The reasons for this situation are not far fetched. Studies such as that of Akinyemi (1993) have revealed that much as Nigerians would love to patronise locally produced textiles, the quality (especially durability) have often been major limitations. As observed by Baker (1975) one of the nature and causes of product failure (lack of acceptance in the market) is product defects. Hence, the performance of any fabric to be selected is given serious consideration before payment can be made on it. It is the general impression among Ni gerians that a good quality fabric must be durable (Okeke, 1982)

How qualitative are the dyed fabrics of the small scale dyeing industries in Nigeria? The answer to this question is what this study hopes to provide at the end of its scientific research. The result of this study will hopefully serve as a morale booster to the textile craftsmen. Furthermore, it will bring about notable improvements in the products which will in turn bring about better marketability.

1.2 Statement of the Problem

The high aesthetic value of the pattern dyed fabrics of Nigeria's small scale dyeing industries is a fact with which the world at large is already well acquainted. The extent of their performance in relation to pre-determined end-uses however, remains a debatable issue. The problem of this study therefore, is the investigation into the extent to which certain predetermined performance

characteristics are either absent or present in the pattern dyed fabrics of small scale dyeing industries in some parts of Nigeria.

1.3 Purpose of the Study

1. To identify the raw materials and equipment used in pattern dyeing by small scale dyeing industries in some parts of Nigeria.
2. To examine the techniques of pattern making and dyeing.
3. To assemble information about the properties of pattern dyed fabrics which are considered adequate or deficient by the consumers.
4. To verify with standard laboratory facilities and methods, the adequacy or deficiency of pre-determined parameters of quality.
5. To determine the extent to which the inherent nature of raw materials, their mode of construction, decoration or finishing affect fabric performance.
6. To find out the relationship between the standard Organisation of Nigeria (SON) and the small scale dyeing industries in Nigeria.
7. To make recommendations based on the findings to the craftmen, the consumers, the governmental bodies and the general public.

1.4 Research Questions

1. What raw materials and equipment are used in pattern dyeing?
2. What are the various techniques of pattern making and dyeing?
3. What are the parameters of quality in pattern dyed fabrics?
4. To what extent are the parameters of quality namely; colour fastness to light, washing, rubbing, perspiration and hot pressing, crease resistance, air and water permeability, abrasion resistance, dimensional stability and tensile strength present or absent in the pattern dyed fabrics of small scale dyeing industries in Nigeria?

5. Does the nature/quality of raw material or the way they are manipulated have any effect on the performance of the tested fabrics?
6. What is the relationship between standard organization of Nigeria (SON) and the small scale dyeing industries in Nigeria?

1.5 The Scope of the Study

The study was confined to the pattern dyed fabrics of small scale dyeing industries in some parts of Nigeria which include Abeokuta, Oshogbo, Ibadan and Kaduna. This is because the information required can best be obtained from the specified scope. Any other category of decorated fabrics are not considered in this study. The focus of investigation was on selected aspects of durability, comfort and aesthetic values of the fabrics.

1.6 The Limitations of the Study

The study was subjected to all the limitations recognised in the collection of data through interviews and laboratory testing. Some of them are:

1. The fact that interviewees release only the information they choose.
2. The fact that the laboratory equipment and attendants were made available to the researcher only at such times when their services were not engaged by the staff and students of the Quality Control and Testing Laboratory.
3. The irregularities in electricity supply as well as the development of faults by some testing equipment which led to interruptions and some alterations in the organisation of the research (i.e. the number of samples per test had to be reduced from 10 to 5)

1.7 Basic Assumptions

The Study has been based on the following assumptions:-

1. That the samples collected are true representations of the target population and that the methodology adopted for the study is appropriate enough to provide the required information.
2. That the methodology of the study can be replicated by future researchers for similar studies.
3. That the study will contribute significantly towards the improvement and subsequent standardization of the pattern dyed fabrics of small scale dyeing industries in Nigeria.

1.8 Significance of the Study

Clothing or fabrics are very much part of living experience of mankind. Our survival and existence depend very much on adequate clothing. Next to food and shelter, clothing is the next imperative in terms of human needs. Hence, this study touches the life of every Nigerian (Adeyemi, 1986) Consequently, this study should have great educational, economic and socio-cultural significance.

1.8.1 Educational Significance

A major problem in the teaching of textile education in Nigeria is the dearth of teaching materials. As such, textile education is still at an elementary stage which needs to be structured and developed (Oguntona, 1986). This study represents one of the efforts geared towards combating the scarcity of literature materials in the discipline. As Grillo (1989) emphasised, the role of Nigerian educational institutions must be particularly to provide literature and

well researched materials to correct existing distortions in order to redirect the character and trend of art developments along paths that reflect our real achievements and preserve our cultural heritage.

In most of the previous research, focus and emphasis have been on production. Most of such researches concluded by recommending a study of this nature. Current investigations however reveal that apparently little scientific research has been conducted in the problem area (within the specified scope). This study will furnish the textile craftsmen with information on their present levels of performance with a view to making them quality conscious. Furthermore, it will enlighten the general public on the correct selection of pattern dyed fabrics for specific end uses in order to ensure maximum satisfaction for their money's worth.

1.8.2. Economic Significance

The role of textile crafts within the context of self reliance cannot be over emphasised. This has been clearly demonstrated by thousands of Nigerian textile craftsmen who are both self-employed and employers of labour. The craft constitutes a viable investment with sizeable returns in foreign exchange and reduced unemployment rate. Self reliance is very imperative in a country as Nigeria where economic recession has made labour supply to exceed demand. In view of this, the textile crafts deserve to be kept alive. This study represents a significant contribution towards keeping the craft alive.

This study will promote the rational use of textile raw materials and contribute positively to the growth of the Nigerian economy. One of the easiest means through which a country can become economically prosperous is the effective utilisation of her natural resources. For several decades, the pattern dyeing craft has served as one of the means for the utilisation of textile raw

materials in Nigeria. Polakoff (1980) observes that African fabrics were crafted by a people who made remarkable use of all that was around them. Investigations into the quality of products will in the long run lead to maximum yield on raw material investment.

The result of this study can serve as an advertisement strategy and consequently boost the marketability of the pattern dyed fabrics. The performance potentials and limitations having being highlighted, craftsmen will be able to improve on the quality of their products. Better quality products will gain the attention of many people who have made cheap manufactured clothing of western style to be their everyday wear.

1.8.3.Socio-Cultural Significance

Although Nigeria cannot claim monopoly of the pattern dyeing craft, it has contributed immensely to the development and improvement of this type of art (Oguntona, 1986). This study will serve as a contribution towards developing the craft. The need for development was stressed by Fadairo (1983) who noted that part of the methods by which we could maintain our uniqueness and identity is through the development of our culture. Given the tremendous progress the nation has made in many spheres of human endeavours, it becomes obvious that the current level of attention paid to cultural development is incompatible with the needs of the country. Therefore, one of the significance of research is that it helps to highlight what aspects of culture require development and how.

Another significance of the study is that it will bring about the consciousness of people to a meaningful perception and appreciation of the arts, which will in turn, lead to active and sympathetic involvement by all and sundry. Eicher (1976) observed that Africans often took their textile craft

products for granted and did not appreciate them as treasures. Invitations to art exhibitions are not honoured and homes and offices do not regard works of art as integral parts of furniture. In fact, it is not unusual that Nigerian artists have had to be recognised and proclaimed by the outside world before being embraced by their own people. Ironically, the Nigerian textile designers have been rated among the best in the history of the profession (Fosu, 1985). Hence, there is need to increase awareness about our culture and promote appreciation for it, as no country develops without a full appreciation of its culture (Fadairo, 1983).

Pattern dyed fabrics have served and will continue to serve as artefacts. Poor quality fabrics however, cannot satisfactorily attain the status of artefacts. Polakoff (1980) regrets that the complete and accurate documentation of African fabrics are made very difficult due to their perishable nature. The situation, he said, can be remedied by the co-ordinated efforts of craft centres, museums, technical trade schools, designers and manufacturers. Only then can the beauty of this aspect of African heritage be preserved for the on-coming generation. The proper documentation of our cultural heritage can be effected through research - an aspect of which is represented by this study.

1.9 Definition of Terms

Some special words occured in this study: Their definitions have been provided in accordance with how they are used in the context of this study.

PATTERN DYED FABRICS: Decorated fabrics which are produced by the use of any resist medium to prevent the penetration of dye liquor into pre-determined areas of the fabrics. These are generally known as 'adire' among the Yoruba people.

RESIST: Any medium such as strings, wax or starch which is used to bind or block some parts of a fabric in order to prevent dye penetration during subsequent dyeing.

BATIK: A term universally used to describe the process whereby a substance is applied to predetermined areas of a fabric for the purpose of resisting subsequent dyeing . The dye resisting substance most commonly associated with batik is hot wax.

TIE AND DYE: A resist technique whereby, the fabric is tied or stitched in such a way as to prevent the penetration of dye liquor into the tied areas.

PASTE RESIST: A resist technique whereby, natural gums or starches are applied to pre-determined areas of a fabric to form a pattern which will resist dye penetration and retain the colour of the fabric.

VAT DYES: A class of dye which has got outstanding fastness on cotton fabrics and is generally adopted for use by the Nigerian textile craftsmen.

POPLIN: A durable plain weave fabric having fine cross ribs produced by employing warp yarns that are considered finer than the filling yarns.

CHINA POPLIN: A plain woven white fabric which is a blend of 35% cotton and 65% polyester imported from the republic of China.

GUINEA BROCADE: A popular cotton fabric which has patterns incorporated into its structure during the weaving process.

QUALITY CONTROL: A venture in which the degree of excellence of the properties of a product are checked and regulated (if found necessary).

TEXTILE TESTING: Experiments which are carried out in the laboratory in order to find out the extent to which certain properties are either present or absent in textile materials.

STANDARD TESTS: Uniform and recognised system of test methods used for the measurement and evaluation of the several aspects of fabric performance by the international standard organizations.

CONDITIONING: The keeping of fabric samples for a specified period of time under specified climatic conditions so as to bring the material humidity close to that stipulated by the International Standard organisation.

GREY SCALE: A set of shades ranging from black, through greys to white which serve as the standard for assessing and rating the degree of fading or staining of fabrics.

1.10 Summary

Chapter one represents an introduction to the study. It stated the problem to be studied and outlined the purpose of the study. Next are the research questions to which the study intends to obtain answers from which the conclusion for the study can be drawn. The scope, limitation and basic assumptions of the study were also stated. The significance of the study and definition of terms were all discussed. The chapter was concluded with a brief summary.

CHAPTER 2
REVIEW OF RELATED LITERATURE

2.1 Introduction

The remarkable prominence gained by the pattern dyed fabrics of Nigeria both in the local and international markets has equally increased the rate at which its performance level (quality) is being questioned. Publications which focus on this topic of study are very rare. However, there exists a considerable body of literature related in one way or the other to the topic. These will be reviewed with regards to substance and methodology of the research being conducted under appropriate sub-headings.

2.2 The Handcrafted Textiles of Nigeria

The handcrafted textiles of Nigeria are of three types: (a) Those which bear a structural design (b) Those which bear a surface design and (c) Those with a combination of both designs.

Structural designs are those that are built into the fabric during the construction process. This is achieved by the manipulation of different colours, sizes, or textures of yarns to achieve a variety of patterns ranging from very simple to complex. The handwoven fabrics produced by some ethnic groups in Nigeria are typical examples of structural design.

Surface designs are imparted unto a fabric surface after the construction process must have been completed. The decorating medium (or colourant) is usually in form of an ink or paste, which may or may not be diluted with an appropriate solvent or extender. The colourant may be applied to a plain fabric or to a fabric which had certain parts tied, stitched, waxed or starched to resist the dye and form a pattern. The Yoruba 'adire' is a typical

example of surface design. The focus of this study will be on the pattern dyed fabrics (adire) of small scale dyeing industries in some parts of Nigeria.

2.2.1 Pattern dyeing in Nigeria - A review

Much of Africa's history is known only orally, hence no one knows when or where the pattern dyeing technique began in Africa (Polakoff, 1980). Nevertheless, the fact that pattern dyeing is an age old tradition in Nigeria is undisputable. In the South-Western part of Nigeria, large earthenware dye pots are a characteristic feature of most compounds inhabited by the Yoruba people who have perfected the technique to an everyday art form (Fagg, 1971). Investigation (survey research) reveals that until recently, the skill was being passed down from the older to the younger members of the family. The age of some of the women who are still actively engaged in the art especially in the towns of Abeokuta and Oshogbo are a proof of this. Recently however, more people are receiving the training through the apprenticeship system and/or formal education (Shinkafi, 1995; Osatuyi, 1995). The chief dyeing centres in the southern part of the country are Abeokuta, Oshogbo, Ibadan, Ede and Oyo.

In the middle belt region of Nigeria, the Tiv and Nupe do some bits of pattern dyeing while in Northern region, the dyeing industry is widespread in Kano, Sokoto, Zaria, Kaduna, Maiduguri and Katsina (Eicher, 1976). In this region, the patterns are usually less elaborate and the dyeing is carried out by men. The reason for the exclusive participation of males was traced by Oguntona, (1986) to the religious beliefs of the predominantly Islamic people of the North which forbid the public appearance of young married women. In places like Kaduna, large metal drums and earthenware pots are now being used in areas where dyeing pits are absent.

Raw Materials and Equipment: Resources for handcrafted textiles are plentiful in Nigeria and include cotton, silk and a range of dyes (Eicher, 1976). Records from the 1850s indicated that dyed and woven cotton were the main products of Kano and that cotton was found growing in many neighbouring villages. Stanfield (1971) observed that the early adire were dyed on handspun and handwoven cotton materials. This is no longer the case today as a good percentage out of the 135 textile mills in Nigeria are actively engaged in the spinning and weaving of cotton to produce a variety of woven and finished fabrics (Oguntona, 1994). These have taken over from the hand-processed cotton and gained prominence in use all over the country.

For several centuries, the natural dye 'indigo' has been the most common and popular source of colour throughout West-Africa (Polakoff, 1980). Stanfield (1971) observed that any visitor seeing a Yoruba market for the first time was usually impressed by the blueness of the scene. Most of the people wear indigo blue garments and on closer observation, many of these are seen to be made from the traditional adire cloths. By the 1960s however, the scene had begun to change. Commercial colour-fast dyes in colours other than indigo were being introduced and adire fabrics became available in a wider colour range (Eicher, 1976). As a result of competition from dyes of other shades, classes and brands, the dyeing of fabrics with natural indigo is greatly on the decline. This has paved way for synthetic dyes which according to Oguntona, (1986) have a wider range of usage and satifies most people's taste for colourful outfits.

Virtually every household object has the potential of being manipulated skillfully to produce an infinite variety of patterns on fabrics prior to dyeing (Gibbs, 1973). Early resist patterns were usually tied or stitched with raffia. This is why the products are popularly known as 'adire' which literally means "to

take, to tie and to dye" (Polakoff, 1980). Other pliable materials such as cotton threads, nylon threads, twines, wire chords, leather/cloth strips and polythene sheets among others are being used to tie or stitch the fabrics using a needle of suitable size. Sometimes, pebbles, seedgrains, wooden planks or any other object may be enclosed in the ties to create other interesting patterns.

Stanfield (1971) observed that the introduction of the use of starch as a resist agent greatly improved the possibility of the designers. This is applied to fabric by the use of stencils, matchsticks, broomsticks, midrib of quills, combs, or brushes. The commonly used starch is that which is extracted from cassava. The 'Kampala' fabrics - another Nigerian name for batik (wax resist technique) became popular during the civil war (1967 - 1969) (Oguntona, 1986). Today, the craftsmen make use of the micro-crystalline wax, the bees wax and the candle wax to produce Kampala. The wax is applied either with the use of a brush, a wooden block on which a design has been carved or any found object.

The type of dye receptable used vary from craftsmen to craftsmen and from locality to locality. Oguntona (1986) observes that in Northern Nigeria, dyeing was being carried out in large communal deep pits (Marina) two or three metres deep which are cemented right from the bottom to the top. Nowadays in places like Kaduna, large metal drums and the earthenware pots are being used in areas where dyeing pits are absent. In South-Western Nigeria (Yorubaland in particular), large earthenware pots with covers are used for dyeing (Stanfield, 1971). However, the use of these are gradually being replaced by the use of large metal drums and plastic bowls.

Adire designs and materials: The different types of adire have their peculiar characteristics. As in other crafts, the materials with their

limitations (and possibilities) form the basis for the designs (Stanfield, 1971). In the tie-dye method, tyeing the cloth in preparation for dyeing may be done in many ways. When raffia is used to tie a pattern on the cloth before it is dyed, it is known as adire 'oniko' (Eicher, 1976). Sometimes, small pebbles, seedgrains or even finger tips are tucked under the cloth, the raffia is then pulled and tied firmly round the spot and knotted to form a design which is called adire 'eleso' (Oguntona, 1986). Some fascinating effects evolve by sheer manipulating of the cloth, such as by plaiting, ruching, folding, twisting, sewing, knotting and stitching. When the pattern is stitched with a needle and thread, whether by hand or sewing machine, the method is called 'alabere' (Eicher, 1976). When the fabric is folded, given a hard twist in string form and tied, it is known as 'Elelo'. Adire 'oni didi' results when a length of cloth is tied into knots. A diagnonally pleated design called 'sabada' was popular in the 1960's. The binding of a part of the fabric in tied cloths actually suggests the design (Stanfield, 1971).

The second method of resist dying is called 'adire eleko' by the Yorubas. This involves printing or painting on to the fabric with starch made from cassava flour. The introduction of the use of starch as a resist agent, greatly increased the possibilities of the designers. Stanfield (1971) noted that to prepare starch paste, a little cassava flour is mixed with water until it is smooth. More water is added and the mixture is boiled until it is the consistency of 'pap'. It is stirred while boiling and a small piece of copper sulphate added to help the starch keep fresh longer. The mixture is then strained through a cotton cloth to ensure that it is perfectly lump free. For a longer shelf life, Oguntona (1986) recommends the dissolving of some alum and candlewax in boiling water prior to pouring in the starch. The mixture is

then kept in a cool place. There are two methods for applying starch: stencil method and freehand method. (Eicher, 1976).

Stenciled patterns are produced by making use of metal foils. To produce a stencil, designs are made on a piece of metal and marked with a pen. The metal is then placed on wood and the design is chiseled or cut with a suitable tool. The stencil is placed in position on a piece of outstretched cloth and the starch applied through it with a semi-circular piece of pliable material. The starch is pressed into the fabric and any surplus is scraped back into the bowl which stay beside the craftsman on the table. The stencil is then lifted and replaced and the process repeated until the cloth is covered. A comb may be used to produced parallel lines in the pattern, by holding it at right angles to the cloth and dragging it through a stretch of printed starch (Stanfield, 1971). Contemporary craftsmen have adopted a number of other suitable materials for use as stencils. Cardboard sheets, straw boards, paper containers and other thick types of paper which when cut are waxed or painted to impart strength, old carpets and painted plywood have all become handy.

Freehand patterns are produced by dipping a hen's feather, match stick or broom stick into the starch paste and then drawing with it on the cloth. The basic lines of the design are made by folding the new cloth. An accidental blob of starch is lifted off the cloth with the pointed edge of a knife. The printed cloth is then carefully lifted over a bamboo pole to dry (Stanfield, 1971) or laid flat to dry in the sun (Oguntona, 1986). To remove the cloth, from the floor after printing, a stick longer than the width of cloth is passed under it in the centre and then lifted up. The drying of the cloth takes one day or more.

The third method of resisting dye is the 'kampala style' or batik' a contemporary resist technique. In this method, the cloth is spread on the floor or on the table while melted wax is applied (Oguntona, 1986). Both the

materials and methods used for the application of the wax to the cloth varies from craftsman to craftsman. Also, the method allows for a great deal of improvisation of tools. Brushes (coarse or fine), brooms, synthetic foams and metal objects among many other objects can be used to apply wax to the fabric by splashing, spraying, drawing, painting, dropping or stamping. The more recent technique of block printing of wax is daily gaining a wider acceptance especially in the towns of Abeokuta and Kaduna. In this technique, simple or intricate designs cut in relief pattern on wood and mounted on a base with a handle are used for stamping melted wax on cloth. The most striking feature of fabrics produced by this technique is the regularity of the patterns.

The Preparation of Dyebath: In the first half of the 20th century, patterned fabrics were being dyed with the use of dye obtained from the indigo plant in Nigeria. The young leaves of the indigo plant (called 'elu' by the Yorubas) are picked, pounded and moulded into balls and dried in the sun (Polakoff, 1980). Mordant water which is prepared by a special process is poured over broken indigo balls in a pot and left to stand for about three days while stirring occasionally. As the water is absorbed by the cloth during the dyeing process, more of the mordant water is added. The cloths are squeezed gently and dipped repeatedly depending on the strength of the dye and the depth of colour desired. Fabrics patterned with starch are gently folded into plaits and dipped one side after the other to avoid peeling off of the starch.

In contemporary dyebath preparation the craftmen use both method and materials that are quite different from the indigo processes. According to Eicher (1976), one of the reasons for the popularity and wider acceptance of adire in the 1960s was the introduction of commercial colourfast dyes in

colours other than indigo. Virtually all the new dyes are synthetic dyes and investigation reveals that up till now, the synthetic vat dyes are still by far the most popular in Nigeria out of the numerous other classes of dye available. To achieve effective dyeing, vat dyes have to be blended with caustic soda (NaOH) and sodium hydrosulphite ($Na_2S_2O_4$) (Oguntona, 1986). In recognition of this fact, some Yoruba women now use caustic soda to make their (indigo) dye solution alkaline (Eicher, 1976). In a similar observation, Oke (1971) noted that the traditional method is being gradually abandoned and caustic soda is being added to the indigo cake and water which is then allowed to ferment for two or three days. Oguntona (1986) reports the discovery that the absence of a reducing agent in the recipe of the local dyers accounts for the long period of dyeing and the poor results obtained when the natural indigo is used alone. He observed that the commonest and most useful reducing agent is sodium hydrosulphite ($Na_2S_2O_4$). As far back as 1971, attempts have been made at the University of Ife (now Obafemi Awolowo University) Chemistry Department to improve colour-fastness by reducing the local indigo blue to indigo white using sodium hydrosulphite.

Vat dyes are commercially available in the form of liquids, easily dispersible powders or granules. The latter two are more popular in use by Nigerian craftsmen. Being insoluble in water, Vat dyes require solubilisation before they can be applied to fibre. The solubilisation is called 'vatting and this involves reduction of the insoluble vat dye with sodium hydrosulphite (hydros) and caustic soda (Nkeonye, 1993). The proportion of each of the chemicals to be added to any given quantity of dye varies very much from craftsman to craftsman. Likewise the method of combining the dyestuff, the chemicals and the water. Oguntona (1986), recommends dissolving the dye with warm water in one container, dissolving the chemicals with warm water in another

container, pouring the dye solution into the required volume of cold water and pouring in, the dissolved chemicals. As for some other craftsmen the three dry ingredients which must have been well blended with a dry spoon in a dry container are stirred into the required volume of water with a wooden stick. Metal spoons or containers are seldom used in the mixing process due to the corrosive action of caustic soda.

Some vat dyes require hot-dyeing while others require cold-dyeing; the latter types are used for batik work, but either types can be used in tie-dyeing. However, the hot-water dyes can be mixed with a third of the required volume of hot water and then diluted after vatting with the remaining two-third (cold) water when batik or adire eleko is to be dyed.

The Vatting Process: In order to dye vat dyestuffs on cotton, it is necessary to first convert them to a form in which they are soluble in water and possess affinity for cotton fibre. This conversion is brought about by a chemical reaction involving a certain part of the dyestuff molecule that is common to all vat dyestuffs. This particular part of the molecule is reduced by means of sodium hydrosulphite (hydros) into the form of an organic acid which is then neutralised with sodium hydroxide (causic soda) to form a salt which is soluble in water and has affinity for cotton. The actual solubility varies from dyestuff to dyestuff and may necessitate variations in the quantities of hydrosulphite and caustic soda used to dissolve the dyestuff in preparation for dyeing (Clarke, 1973).

The process of converting the insoluble vat dyestuff into the soluble compound used for dyeing is called vatting and the solution so produced is called a vat. The reduced or vatted dyestuff is often referred to as leuco compound. Owing to the chemical changes that takes place during the vatting

of the dyestuff, the colour of the vat or leuco product may be very different from that of the original dyestuff.

Vatting is done for 5 minutes, after which the fabric to be dyed is immersed in the dyebath (Nkeonye, 1993). The dyer wears a pair of rubber gloves to prevent damage to the fingers due to the corrosive action of caustic soda.

The dyeing process: Dyeing is the process whereby, the soluble reduced dye is absorbed by the fibres (Gokhale & Shah, 1981). On entry into the dyebath the fabric is agitated (or moved about) thoroughly for the first 5 minutes. Stirring continues for the next 5 minutes but less frequently. After the first 10 minutes, stirring is done once in a while until the required duration of dyeing is reached. Dyeing times vary from 10 -45 minutes, the depth of shade obtainable increa sing with time of dyeing (Nkeonye, 1993). Oguntona (1986) even recommended 60 minutes. In the case of batik dyeing, thorough agitation may be done if the crackle effects are desired in the wax patterns, otherwise, the fabric is turned around very gently as in the case of adire eleko to avoid upsetting the wax . Table salt is sometimes stirred into the dyebath to aid dye exhaustion (complete absorption of dye by the cloth).

The oxidation process: The dyed cloths are never rinsed immediately. Rather they are removed from the bath and hung on bamboo poles to drip dry. After the heavy dripping, the fabrics are spread out to allow the occurence of oxidation. Oxidation is the conversion of the dye which has been absorbed by the fibres back to the insoluble form (Gokhale & Shah, 1981). It is the process which allows the reduced (solubilised) vat dye to go back to the original insoluble vat colour inside the fibre (Nkeonye, 1993). There are two possible methods through which the regeneration of the insoluble pigment inside the fibre (oxidation) can be brought about; either chemically

through the use of oxidising agents such as peroxides or dichromate or by the use of the oxygen in the air (Oke, 1971; Oguntona, 1986). The latter is cheap and simple and it is commonly used by the small scale dyers (Eicher, 1976).

Oxidation takes place for about 10 to 30 minutes, depending on the thickness of the material. A dyed cloth looses some of its colour if it is rinsed before oxidation is allowed to take place. Likewise, premature oxidation in the dyebath (due to the use of a smaller container or less liquor ratio than is required) can give rise to patchy/uneven dyeing.

Finishing Treatments: Both Oguntona (1986) and Nkeonye (1993) talked about treating the dyed cloth in a solution of boiling detergent for 15 minutes. However, this is seldom done by the Nigerian dyers. In fact, in the case of Indigo dyeing, dyed cloths are never rinsed. (Stanfield, 1971; Eicher, 1976; Polakoff, 1980). In dyeing other than indigo dyeing, the cloths are rinsed after oxidation must have been completed.

Tie and dye fabrics are untied or unstitched after drip drying to allow oxidation to take place. After thorough drying, adire eleko designs are hung over a bamboo pole and soaked with water. Buckets of water are thrown over the hanging cloth and a sharp edged bamboo stick is used to scrap the wet starch downwards unto the ground below (Stanfield, 1971, Oguntona 1986). Wax is removed from batik fabrics by boiling in hot water and then rinsing in cold water.

Traditional dyed cloths are prepared for sale by a special finishing process which involves beating the fabric with mallets (Oguntona, 1986). Surprisingly, this remains the practice in many towns and villages where electric or charcoal pressing irons are available at affordable prices. Perhaps the persistence in the use of beating is due to the relatively higher sheen which

is produced on the fabric after beating when compared with ironing (Anderson - Bauer, 1980).

Marketing of Pattern dyed Fabrics: Oguntona (1986) observed that although the practice of pattern dyeing is confined to certain ethnic groups in both the north and south of the country, the markets for the finished products extends far and wide beyond the borders of Nigeria. A similar observation was reported by Sotade, (1994); (Shinkafi); 1995; and Osatuyi, (1995.)

2.3 Variability of Quality

Quality, according to the Websters New International Dictionary, is the most general term which applies to that which is predictable of anything as one of its characteristics, properties or attributes. Going by this definition, colour, texture, shape and so forth can be termed attributes or properties of fabrics. The oxford English dictionary defines quality as the degree of excellence possessed by a thing. In this study therefore, an analysis of fabric quality depicts an attempt to verify the degree of excellence possessed by the various attributes which constitute the pattern dyed fabrics.

The raw materials for textile processing are not perfectly uniform. This lack of perfect uniformity prevents the turning out of identical products. Hence, the textile man is well aware of variations in his products (Enrick, 1980). To buttress this point, Oguntona (1994) asserts that it is a hard fact that no two articles are ever perfectly alike, no matter how similar they may appear or whatever the standardisation. This variability of quality, Murphy et al (1960) notes, is perhaps the most striking feature of textile material whether raw fibre or finished cloth and it is responsible for many of the technical problems. In the same vein, variation in textile construction or decoration process, gives rise to

the turning out of products of varying qualities. Standardisation of raw material requirements as well as production or decoration processes are therefore desirable. This can be achieved through the system which has come to be identified as 'quality control'.

2.4 Why Quality Control?

Control is defined by the Websters New International Dictionary as the exercising, restraining or directing of influence over something. Hence quality control is a medium to regulate the degree of excellence of the properties of a product (Oguntona, 1994).

Quality control is as old as industry itself. From the time man began to manufacture, there has been an interest in quality output. As far back as the middle ages, the medieval guilds insisted on a long period of training for medieval apprentices and required that those seeking to become master craftsmen offer evidence of their ability. Such rules were in part, aimed at the maintenance of quality (Shewart, 1931). This point is strengthened by Oguntona (1994) who opined that to claim that quality control is new to the textile industry would be a great disservice, because the fabrics of the ancients exhibit beauty in design, excellence in production and brilliance in colour, even to this day.

The need for quality control cannot be over emphasised. More and more consumers are expecting good performance and quality in their textile purchases (Lyle, 1977). This is not unexpected as directly or indirectly, both the consumer and the producer have to pay for faulty products (Noble, 1972). All the factors which help to ensure that the product produced is of the desired quality are covered by quality control which is a wide subject (Newbery Textiles Weekly, 1958) The wise expenditure of money and technology in this

area can give extremely high returns in both profits and reputation (Noble, 1972). Lyle (1977) observed that consumers are often at a loss to properly evaluate a garment or household item unless the performance information is given on a label. Where the consumers are not literate enough to understand the meaning of test results, they depend on the reputation of the manufacturer where the merchandise is purchased.

It is common knowledge that most consumer items are manufactured not to last long because of style changes (Hansen, 1963). In a 1993 study, Akinyemi revealed that many Nigerians prefer locally produced garments in this present day of economic depression in the country because they are cheaper than the imported ones. She observed that however, the doubts surrounding the quality of these products have caused major set-backs in their markertability. One often hears consumers saying this is "Ijebu made", "Igbo made", or "Okrika made" (local parlance which depict poor quality goods) when referring to goods which are sold as of high quality and unfortunately turn out to be a deception by the supplier or manufacturer (Muniru, 1983). Nowadays, virtually every good produced in Nigeria is so stigmatised. Akinyele (1983) noted that a situation where low quality goods abound in a country encourages smuggling, which in no small measure retards the economy. This is the exact situation in Nigeria today.

Proffering a solution, Igbani (1983) suggested that the most effective method for checking smuggling was through the improvement of the quality of locally produced goods. He is supported by Onwubiya (1982) who emphasises that the usefulness of quality control in pulling the industry out its present predicament should not be under estimated.

Quality control activities include inspecting and testing of products. Inspection employs whatever methods are essential to adequately evaluate the

product's quality level (Feigenbaum, 1961) for without reliable values provided by the quality control programme, any effort to alter quality or cost will amount to tampering with the unknown.

2.5 Features of the Quality Control Scheme

2.5.1 The aspects of quality to be controlled.

In a 1963 study, Hansen highlighted three broad aspects of quality in the operation of a business. They are; (a) Quality of design (ingenuity or creativity) (b) Quality of conformance to design (Standardisation) and (c) Quality of performance (Utilisation).

Ashner (1992), defines quality of design as the degree to which the collection of attributes, properties and characteristics (like the tensile strength, colour etc.) together will fulfill the purpose required by, or agreed with the customer, when implemented or embodied fully. A feature of most quality control schemes is that they are intended to maintain standards already established on the basis of experience (WIRA, 1974). Conformance quality or manufacturing quality is concerned with how well the manufactured products conform to the original design requirements. Hence quality is measured as a departure from the compliance and not as a failure to fulfill the purpose (Ashner, 1992). Textile processes present the dual problem of quality regulation (adherence to a standard) and quality improvement (breakthrough to new levels of performance). Ashner 1992) reports that;

"Quality control in this circumstances revolves itself into accurate sampling, accurate measurement of the parameters concerned and sound statistical treatment of the results. Quality is then measured both in compliance in manufacture and also achievement of purpose".

The quality of performance, is the area of focus in this study. The product is put to work and how it performs is dependent upon both the quality of the design and the quality of conformance. It can be the best design possible, but poor conformance control can cause poor performance. Summarily, quality control here is the regulatory process through which we measure actual quality performance, compare it with standards and act on the difference.

2.5.2 The personnel involved in quality control

Hansen (1963), states that the control of quality is the responsibility of everyone in the enterprise. Whatever work is performed by a person or machine, the person doing the work or operating the machine is the one who can most effectively control quality or make useful information on quality available. Hansen is supported by Aig Imoukhuede (1987) who pointed out that the industrial designer of today is an artistic and technical co-ordinator, whose duty is also to summarise the various demands which a product has to meet, and come up with solutions in which social, political, technical and economic aspect to mention but a few are duly catered for.

The primary aim of the textile industry is to produce the best quality goods at the lowest cost while keeping within sight, the problem of manufacturing and the customers' satisfaction (Oguntona, 1994). Supporting this statement, Lyle (1976) reports that the textile and apparel industries are constantly striving to improve their products by enhancing performance and fashion appeal. Hence quality control is usually carried out by a group of people who form a team or organisation within or outside an industry. In modern times, factory inspection and research activities of professional

societies have all sought for years to assure the quality of output (Duncan, 1965).

The professional organisation which is responsible for the maintenance of quality in Nigeria is the Standard Organisation of Nigeria (S.O.N).

2.5.3 Steps in quality control

Feigenbaum (1961) and Charbonneau and Webster (1978) all agreed that quality control programmes can be carried out at any stage in the industrial circle and followed up by corrective action. Quality control activities (in order of precedence) involve; inspecting, sampling, testing, analysis of result, feedback and implementations based on findings.

Quality control activities usually begins with inspection which helps to reveal facts which give clues as to the next line of action. Noble (1972) believes that the information collected from fabric inspection will not only supply producers with an unbiased assessment of the magnitude and frequency of defects, it will also indicate the causes and sources of defects. Inspection can also involve the investigation of variations which leads to their elimination. Consequently, less faulty materials are produced, resulting in a direct financial gain due to reduction in the proportion of seconds and rejects (Oguntona, 1982). It was observed by a group of experts (Murphy et al, 1960), that due to the expense of testing, or the destructive nature of tests, we must usually be content with testing a limited number of individuals called 'sample' and assuming that what is true of the sample is also true of the population. Notwithstanding the fact that testing is laborious and expensive, there is a natural tendency which must be guarded against; to use samples which are smaller than are neccessary for the purpose at hand and so run the risks of drawing conclusions about the population that are seriously in error.

Testing is the process whereby the knowledge of Science and Engineering is applied to the measurement of the properties and characteristics of textile materials in order to enhance quality and quantity (Oguntona, 1994). It plays an important role in quality control as a management function. (Booth, 1968). Testing varies considerably; from free and immediate to slow and costly; from positive to conclusive to relative tendencies; from a normal part of production to requirements for specific codes or installations. On all levels, testing is on the upswing (Larsen, 1975). By far, the greatest labour cost of quality control is expended on routine testing, from fibre to fabrics. Handtests are however, simple, free and immediate. Some are conclusive (like those for fibre identification), others only raise further questions.

In textile testing for the control of quality, we select some attributes of a product, measure them and then make necessary regulations to the machinery if the measured attribute is below the desired degree of excellence (Booth, 1968). Noble (1972) believes that testing is better done at the point of production with consequent savings in time, frustration and expense.

According to Ashner (1992), test results are given sound statistical treatments to make them easily interpretable, and understandable, since according to Booth (1968), the testing of a product helps in the continual search for new knowledge. The need for sound result was stressed by Hansen (1963) who argues that quality control represents a business investment, which as any other investment, should show proper returns to justify its existence.

Feedback entails communicating the information generated at the end of testing to the system so that corrective action can be taken with minimum delay (Feigenbaum, 1961). Noble (1972) remarks that it is important that all

operatives are made to feel involved in the success of their efforts. They must be made aware of the consequences of defective processes, techniques or raw materials. They should be told of improvements in quality as well as defects. To achieve this end, it was suggested in 1977 by Lyle that students of textiles should be trained to develop an appreciation for the technology involved in producing satisfactory consumer products. Thus, the establishment and maintenance of a sound quality control procedure is necessary.

Tests results may be successfully applied in the following areas:-

Quality-tested programmes: Some manufacturers use testing and quality control programmes in their advertisement and promotion programmes. The objective is to produce an item that will satisfy consumers' requirements both in serviceability and price.

Analysing product failure: Testing helps to detect, analyse and correct certain errors. It shows how better, identical or poorer a product is, when compared with another.

Comparative testing: This is necessary in developing and improving a product. It makes comparison of two or more products from different or identical sources possible.

End-use performance: How an item is to be used must be considered in testing programmes because the consumer needs must be satisfied (Lyle, 1977).

Summarily, testing provides the background and data, while quality control applies the result (Oguntona, 1994).

2.6 Parameters of Quality In Pattern Dyed Fabrics

Ostrick (1951) believes that the salesman who handles textiles whether in the piece or in garment form is aware that most textile materials possess



Plate 3.1: The Microscal light fastness tester
(mode no 225) -
for testing colour fastness to light

Test procedure: The exposure cells in the light tester were all detached from the spring holder. The sample holder was then drawn out of the glass cell and the pieces were unscrewed, exposing the cardboard sample holders. Each sample was mounted on a cardboard (also 10.5cm x 5cm) by stapling and this was slipped in between the two metal sample holders which were then screwed tightly together.

Strips of about 2cm x 1.5cm in diameter were cut out of the blue wool fabrics and stapled unto one side of a cardboard, one above the other in the correct numerical order. The strips of specimen were stapled to the other side of the cardboard in the same manner. The cardboard with the strips was slipped in between the 2 holders and fastened to them as earlier described. The sample holders were all pushed back into their glass cases which were in turn mounted back in their respective positions in the light fastness tester. By turning a knob on the left hand side of the tester the 500 watts xenon bulb became aglow and the period of exposure was being indicated by the indicator connected to the unit.

After 48 hours of exposure, the light fastness tester was turned off and the cell units were all detached. The specimen holders were drawn out of the cells, and the nuts were loosened a little bit. Strips of black cardboard each of 1.5cm x 10.5cm in diameter were slipped in between the metal sample holders to cover one of the exposed portions of the fabric. The same thing was done for one portion of the 2 exposed rows of blue wool strips. All the holders were screwed back to firmness, pushed back into their cells, placed back in their positions in the light fastness tester which was then re-switched on for another 48 hours.

Method of Assessment: Each fabric specimen was taken out and the fading of the exposed area and its unexposed part was compared with that of the blue wool standard. A suitable grade with which it matches was established and this

grade expresses the light fastness of the particular specimen. Furthermore, the rate of fading in the portions exposed for 48 hours was compared with that of those exposed for 96 hours on each and every specimen.

3.5.2. Determination of colour fastness of fabrics to washing

Experiment 7: Colour fastness test

Purpose: To evaluate the fastness characteristics of fabric on repeated washing.

Apparatus: The high temperature dyer/wash wheel (plate 3.2)

Test specimen: 10cm x 4cm specimens (5 each) were cut out of each sample. Each was placed in between 2 fabrics (white and scoured) measuring 5cm x 4cm and the 3 pieces were stitched together leaving 5cm x 4cm exposed. According to the ISO, when a cotton specimen is to be washed, the white (composite) fabric should either be wool or polyester or rayon. In these tests, all the 3 types of composites were randomly used.

Test procedure: The ISO test no. 3 was adopted, since the pattern dyed fabrics are not likely to be washed at a temperature exceeding 60^0C and duration exceeding 30 minutes. The wash wheel temperature gauge was pre-set to 60^0C. The pots in the washwheel were all rinsed with distilled water before the specimens were placed one in each pot with 10 steel (washing balls). 100 ml of soap was poured into each wash pot. Different brands of soap such as omo, sunlight, lux, truck and soda were used one per round of washing in order to observe their differential effects on the fabrics. The concentration of the soap solution was 5gm/litre while that of the sodium carbonate was 2gm/litre. All the pots were screwed into place and the lid of the washwheel was lowered.

The samples were agitated (by rotation) for 30 minutes after which they were taken out, rinsed in distilled water and dried at room temperature in the drying chambers.



Plate 3.2: The laboratory washwheel -
for wash fastness testing.



Plate 3.3: The IWS viewing cabinet -
for the assessment of staining and fading

Method of assessment: Except for light fastness, colour fastness is expressed on a 1 to 5 scale with rating no. 1 representing the lowest fastness and rating no. 5 the highest. In each case, the fastness rating of the tested specimen is the number of the grey scale whose contrast approximates to the contrast between the untested (original) and the tested specimen (Nkeonye, 1993). The ratings are as follows:

Table 3.1: Degree of alteration in shade / strength

Class	Implication
5	Negligible / no change
4	Slightly changed
3	Noticeably changed
2	Considerably changed
1	Much changed

For the evaluation of stains on adjacent material, the staining scale is used. The scale also has five grades but inbetween the five grades are half ratings of 1/2, 2/3, 3/4 and 4/5. For example, a rating of 1/2 means that the stain when compared with the white fabric is not up to the contrast in rating no. 1 but it is more than the contrast in rating no. 2. The ratings are as follows:-

Table 3.2: Degree of crocking or staining of adjacent fabrics

Class	Implication
5	Negligible / no staining
4	Slightly stained
3	Noticeably stained
2	Considerably stained
1	Heavily stained

A part of each of the specimens was unstitched. Both the staining of the undyed fabrics and the loss or change of colour by the washed samples were then assessed using both the staining scale and the grey scale under a viewing cabinet (Plate 3.3)

3.5.3 Determination of fabric colourfastness to rubbing

Experiment 8: Colour fastness test

Purpose: To ascertain the resistance of fabric colour to a rubbing action

Apparatus: The type FD-17 staining tester (Plate 3.4)

Test specimen: Five specimens each 21cm x 6cm in dimension were cut out of both the warp and weft directions of each and every sample. With the template provided, an equal number (250 pieces) of scoured white cotton fabrics were cut out.

Test procedure: The upper plate of the staining tester was lifted up with the hand lever attached and the coloured specimen was placed on the flat bed. The white specimens were then fastened on the rubbing head using the rubber rings provided. The rubbing button was activated by pushing the start. After 10 strokes of the rubbing head, the movement automatically stopped. 50 rubs were chosen for the standard rubbing for the specimens, so the drive was reactivated by pushing the 'start' button 4 times. On the completion of 50 rubs, the specimen and the composite were removed and the procedure repeated for other specimens. The experiment was repeated using a moistened white composite to observe colour fastness to wet rubbing.

Method of assessment: The staining on the white composite fabric for each specimen was assessed by the grades of a staining scale. The change/loss of colour on the tested fabric was assessed by using the grey scale. Both were assessed within the viewing cabinet.



Plate 3.4: The METRIMPEX staining tester -
for testing colour fastness to rubbing.



Plate 3.5: the AATCC Perspirometer
(on the top right edge of the curing unit) -
for testing colour fastness to perspiration.

3.5.4 Determination of fabric colourfastness to perspiration

Experiment 9: Colourfastness test

Purpose: To assess the degree of colour change of a fabric due to perspiration

Apparatus: AATCC perspirometer, a drying chamber (Plate 3.5)

Test specimen: 5cm x 5cm specimens were cut out from both the dyed and undyed fabric samples. Each sample was placed in between two pieces of scoured white cotton and the three pieces were stitched together.

Test procedure: The perspiration solution was prepared as follows:

(i) Alkaline solution

5gm sodium chloride

25gm disodium hydrogen orthophosphate

0.5gm histidine mono-hydrochloride monohydrate

PH 8.0 with 0.1N sodium hydroxide

Liquor ratio 2:1

(ii) Acid solution

5gm sodium chloride

2.2gm sodium hydrogen orthophosphate

0.5gm histidine mono-hydrochloride moliyurate

PH 5.5 with 0.1N sodium hydroxide

Liquor ratio 20:1

The specimens were divided into two groups. One group of specimen was wetted (one specimen at a time) in the alkaline perspirant for 30 minutes. The specimens were squeezed to remove excess moisture and they were mounted one after the other on the glass plates of the perspirometer. The glass plates were held in place by means of two pieces of steel slabs which were tightly screwed. A weight of 4.5 kg was placed on the uppermost slab and the whole assembly was placed in an oven at a temperature of $37^0C \pm 2^0C$ for 4 hours .

The specimens were unstitched on one side and air dried at a temperature not greater than room temperature. The procedure was repeated using the remaining specimens and the acid solution.

Method of assessment: The stains on the composite fabrics as well as the loss of colour on the specimen were assessed using the staining scale and the grey scales respectively. The assessment was carried out in the viewing cabinet.

3.5.5 Determination of fabric colour fastness to hot pressing

Experiment 10: Colourfastness test

Purpose: To assess the degree of permanence of colour change as a result of hot pressing.

Apparatus: An energy regulated 30gm/cm^3 pressing iron.

Test specimen: 10cm x 4cm specimens were cut out from each fabric samples. An equal number of specimens 14cm x 4cm were cut out of undyed, bleached white cotton. The undyed (composite) specimens were all folded into 2 across their lengths. each coloured specimen was then placed in between a folded composite exposing a portion 3cm x 4cm in dimension .

Test procedure: (a) Dry pressing: Each specimen was placed on an ironing board. The iron was placed on a specimen at a time and moved to and fro for 15 seconds.

(b) Damp pressing: The coloured fabrics were wetted with water and thoroughly squeezed before being placed in-between the white composite. A specimen is placed on the ironing board and the iron was moved to and fro for 15 seconds.

Method of assessment: The colour change on each specimen was assessed immediately after pressing and then 4 hours later. The degrees of staining were assessed on the most heavily stained part of the white composites.

3.5.6 Determination of crease recovery properties of fabrics

Experiment 11: Crease recovery test

Purpose: To determine the rate of recovery of fabrics from creases after the removal of the creasing force.

Apparatus: The Shirley crease - recovery apparatus, a pair of forceps, a stop watch (plate 3.6).

Test Specimen: 5cm x 2.5cm specimens were cut out from both the warp and weft directions of each sample. 10 specimens (5 warp & 5 weft) were cut from each sample.

Test Procedure: The procedure adopted was that of BS 3086 of 1972 which conformed to the ISO/R 2313 TEXTILE FABRICS. Each specimen was creased by folding it in half, placing it in between two glass plates and adding a 2kg weight for 1 minute. The creased sample was then transferred by means of a pair of forceps to the fabric tclamp on the instrument for measuring the recovery angle (Plate 3.6) One edge of the specimen was clamped and the other edge was left free. The specimen was left to recover for one minute. At the end of the recovery time, the dial of the instrument was rotated to keep the free edge of the specimen in line with the knife edge. The crease recovery angle was then read off in degrees on the engraved scale.

Expression of result: The readings of both the warp and the weft values of each sample were taken and the mean value for each sample was obtained. The recovery angles of samples were then compared.

3.6 Comfort Properties of Fabrics

Selected tests for the evaluation of the comfort properties of the pattern dyed fabrics include:-

(a) Air permeability tests



Plate 3.6: The Shirley loading device, crease recovery tester, a whirling hygrometer and a timer for crease recovery testing.



Plate 3.7: The METERFEM air permeability tester

(b) Water permeability/repellence test

3.6.1 Determination of air permeability properties of fabrics

Experiment 12: Air permeability test

Purpose: To determine the rate of air flow through a specimen.

Apparatus: *The type FF - 12/a air permeability tester* (Plate 3.7)

Test specimen: Using the template provided, 10 specimens (5 warp, 5 weft) were cut out from each sample.

Test procedure: The test procedure was in conformity with the stipulations of WIRA as well as No. 10 TS 59 582 of the Shirley Institute. The motor switch was turned on. Using a suction head of cross sectional area $20cm^2$, the specimen was placed on top and fixed by the suction strainer when the lever was clamped down. The water pressure was set at 10mm. The needle valve was opened gradually while starting from the smallest range. Trials were made with the rotameters in order to ascertain which of the measuring range would accommodate the volume of the flowing air (only one rotameter tube was opened at a time). Once the appropriate tube was determined, the top was left opened until the pressure difference shown on the manometer reached the prescribed value.

The rate of air flow was read off the appropriate calibrated capillaries. The motor was stopped and another specimen was put over the suction head. The process was repeated with the entire fabric specimens of different weights, setts, finishes and decorations. The water pressure was then changed.

Expression of results: The average air permeability values for each category of sample were reported and an air permeability graph (see appendix 3) was plotted.

3.6.2 Determination of water repellency properties of fabrics

Experiment 13: Water repellency test

Purpose: To determine the resistance of fabric to wetting by water.

Apparatus: The AATCC spray tester, 250 ml beaker, a stop watch (Plate 3.8) and distilled water.

Test specimen: With the template provided, 10 specimens (5 warp, 5 weft) were cut from each sample.

Test procedure: The test procedure was in line with the AATCC test method 22 of 1967; A specimen was mounted on an embroidery hoop and placed to face uppermost on the hoop support with the warp parallel to the direction of the flow of water. 250ml of distilled water at a temperature of $20^0C \pm 2^0C$ was poured into the funnel quickly and steadily (for 30 seconds) to ensure a continuous flow of spraying once it has commenced. Immediately the spraying stopped, the specimen was tapped twice with a solid object with the fabric facing down in a horizontal position. The process was repeated for all the remaining specimens alternating the warp with the weft.

Method of Assessment: The specimens were assigned values using the AATCC STANDARD SPRAY TEST RATING chart (Appendix 4) provided. The mean rating for each sample was obtained and recorded.

3.7 Durability Properties of Fabrics

Selected tests for the evaluation of the durability properties of the pattern dyed fabrics under study are;

(a) Abrasion resistance;

(b) Dimensional stability and;

(c) Tensile strength



Plate 3.8: The AATCC Spray Tester -
for testing water repellency / permeability.



Plate 3.9: The exact weighing balance (electric) and
the Ohaus weighing balance (mechanical)

3.7.1 Determination of the abrasion resistance properties of fabrics

Experiment 14: Abrasion resistance test

Purpose: To determine the resistance of fabric surface to abrasive actions.

Apparatus: The universal cloth-wear testing machine type FF - 21 (Plate 3.10), the weighing balance (Plate 3.9) and a stop watch (Plate 3.6)

Test Specimen: 10 specimens were cut out of each sample using the template provided.

Test procedure: Each specimen was weighed and the weights were recorded. Specimens were placed in between 2 steel fabric clamps which have been positioned on the suction surface of the wear tester. The suction head helped to flatten the fabric and ease out creases. The steel clamps were tightly screwed together and then mounted on the cylindrical sample holder situated under the abrading surface. The abrading surface on top of which was a 9072kg (2,000 pounds) weight was lowered into contact with the specimen. The same process was repeated in mounting two more specimens on the 2 remaining abrading units. Each of the 3 abradants was pre-set to make either a circular or reciprocating or zig-zag movement on the specimen. The machine was switched on and abrasion was allowed to take place for five minutes after which the machine was switched off. The same process was then repeated for all other specimens.

Assessment of results: Each specimen was weighed to determine the weight loss after abrasion.

Expression of results: The average weight loss per minute was reported in percentage for each of the 10 specimens obtained from a sample thus;

$$\text{Average weight loss per minute} = \frac{X_1 - X_2 \times 100}{X_3}$$



Plate 3.10: The TBJ wear/abrasion tester -
for testing fabric abrasion resistance

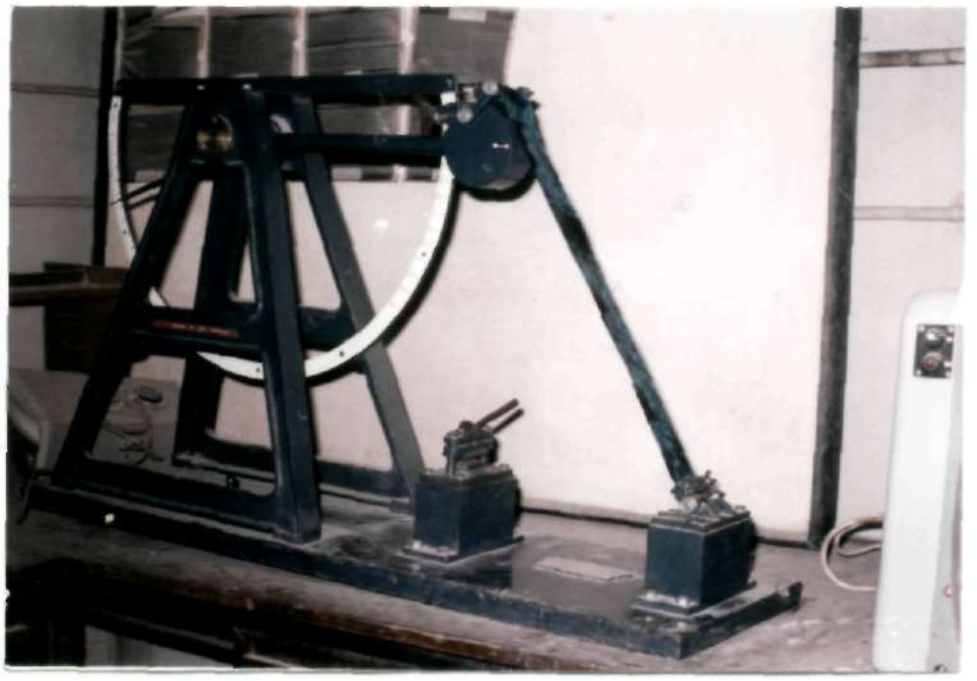


Plate 3.11: The ballistic tear tester
for testing the tensile strength of fabrics.

where X_1 = Initial weight

X_2 = Weight after abrasion

X_3 = Abrasion duration.

The mean of the 10 readings per sample was then obtained by adding all the 10 and dividing by 10 and then expressing the answer in percentage thus;

$$\frac{X_1 + X_2 + X_3 + X_4 + X_5 + X_6 + X_7 + X_8 + X_9 + X_{10}}{10} \%$$

where X = Average weight loss per minute per sample.

3.7.2 Determination of fabric dimensional stability properties.

Experiment 15: Soaking test

Purpose: To determine the effect of soaking in cold water on the dimensional stability of fabrics.

Apparatus: 10cm square, 2cm deep trays, a glass slab, and an absorbent cloth.

Test specimen: 10 specimens each 10cm square in dimension were cut out of each sample. Each specimen was marked with three pairs of datum lines 5cm from each edge in both the warp and weft direction, using indelible ink.

Test Procedure: The test procedure was in conformity with BS 4736 - 1971. The specimens were divided into two groups. Group one specimens were immersed and laid flat in 10cm square trays containing $1^1/_2$cm of water at room temperature. These were kept submerged for 2 hours. Group two specimens were treated the same way as group one was treated, the only exception being that the specimens were being gently agitated from time to time during the immersion in cold water. The specimens were removed after 2

hours, laid on a flat piece of glass and dabbed with an absorbent cloth to dry naturally. Having dried thoroughly, the distance between the datum lines were remeasured. The distance between the parallel edges of specimen were also measured. The difference between the new dimension and the initial dimension along both the warp and weft direction expresses the amount of shrinkage or relaxation that has taken place. The difference was then expressed as a percentage of the dimensions of both the agitated specimens and the undisturbed ones.

3.7.3 Determination of fabric tensile strength

Experiment 16: Tearing test

Purpose: To determine the tearing strength of a woven fabric

Apparatus: The Ballistic fabric strength tester

Test specimen: 10 specimens (5 warp and 5, weft) each 60cm x 5cm were cut out from each sample.

Test procedure: The test procedure was carried out in accordance with the BS 4253 of 1967. Each test specimen was fastened between the clamps on the pendulum bob and those on the base plate. The bob was then raised and held at a height on the tester. On releasing the bob, the weight fell breaking the specimen instantly and rising to a position on the graduated scale of the tester. The position was marked by a pointer.

Method of assessment: The distance along the quadrant scale represents the difference in height reached by the pendulum without breaking the sample, thus representing the loss of momentum or energy caused by the breakage, that is the work of rupture. The quadrant dial is calibrated so that this break can be read off in inches or pounds.

Expression of results: The value for each specimen was reported exactly as obtained (in inches) on the strength tester. The higher the value obtained, the greater the tensile strength of the specimen

3.8 Summary

Chapter 3 dealt with the methodology employed to obtain data for the study. The research design was elaborated upon and details of the laboratory tests were provided. The presentation and analysis of the data obtained will be the focus of the next chapter.

CHAPTER 4
RESEARCH FINDINGS AND ANALYSIS

4.1 Introduction

The data obtained from the field work as well as the results of the tests outlined and carried out in chapter three are presented and discussed in this chapter. The data gathered from the field work were based on the raw materials used for pattern dyeing, the procedures of pattern making and dyeing as well as the problems associated with the quality of the final outputs.

The laboratory test results are classified under fabric analysis (raw materials and constructional details) as well as under the three major parameters used for the evaluation of these fabrics, namely aesthetics, comfort and durability. All the collected data will be analysed in relation to the research objectives and questions earlier formulated.

4.2 Specific Findings from the Field Work

4.2.1 Pattern dyeing: Raw materials, equipment and procedure

Virtually all the raw materials required for pattern dyeing are available in Nigeria. Cotton which is processed into fabric grows abundantly in the Northern region. The abundance of spinning and weaving mills all over the country makes cotton to be readily available in different weaves such as poplin, shirting, guinea brocade and so forth. Poplin is turned out by textile mills either unbleached, bleached or bleached and dyed. The unbleached poplin comes out in a cream colour and it is usually thicker and heavier in weight than bleached poplin. It is usually called. 'Baft' and it comes in a wider breadth than bleached poplin (Plate 4.1) Bafts are usually soaked for several

FABRIC COMPOSITION



100% GREY COTTON (BAFT) IN PLAIN WEAVE



100% SCOURED COTTON IN PLAIN WEAVE



100% MERCERIZED COTTON IN BROCADE WEAVE



35% COTTON, 65% POLYESTER IN PLAIN WEAVE



100% VISCOSE RAYON IN TWILL WEAVE

Plate 4.1: FABRICS USED FOR PATTERN DYEING IN NIGERIA

hours in hot or cold water in order to increase their absorbency prior to dyeing.

Until recently, pattern dyeing was carried out almost solely on bleached white poplin which was popularly called 'Kaduna white' by the Yoruba dyers. This fabric is sometimes obtained coloured in bright red, yellow or blue from the industry. Also, there is 'gaskiya' - a mercerised and bleached white cotton fabric which has the narrowest width of all categories of fabrics used. This fabric is highly absorbent and it is generally used for highlighting sharp distinct patterns. It is preferred by dyers when dye is to be applied by splashing, dropping or brushing.

Efforts to adapt the pattern dyed fabrics to a wider range of usage led to the adoption of the guinea brocade fabrics as one of the fabrics for pattern dyeing (Plate 4.1) This fabrics has about the widest width and allows for many more varied styles of outfits to be sewn from adire. Furthermore, brocades enhance the patterns and colours imparted to them. Adire designs on guinea brocade have gained so much popularity all over Nigeria and is beginning to overshadow the use of poplin. Guinea brocade fabrics are marketed bleached (to white) or dyed in a plain colour.

Plate 4.1 shows a blend of 35% cotton and 65% polyester popularly called 'China' all over the country. The fabric is imported from the republic of China and it is used for a variety of purposes. This fabric brings out designs in subtle shades of colours. They are seldom used by dyers due to their relatively higher cost and lower absorbency. However, dyers sometimes use them on request by customers for specific end uses.

Another fabric which is used only occasionally for pattern dyeing is viscose rayon (Plate 4.1). Striped patterns in deep green brown and purple are

the designs commonly found on this fabric. They are sometimes produced by the Gambian dyers and sold through the agency of Nigerian adire sellers.

It was gathered from both the interviews and observation that natural indigo is now seldom used for dyeing. This is as a result of competition from dyes of a wider variety of shades which when combined with the right proportion of chemicals, are easier and faster to apply to fabrics. Furthermore, it was gathered that the vat dyes as a class, are the only ones which most Nigerian dyers are familiar with and are willing to continue using. Some of the dyers who are university or polytechnic graduates claim that they are aware of other classes of dyes. However, they have not adopted them for use due to their relative scarcity and the risks involved in trying a new product. Most dyers claim that they will rather stick to what is certain than 'gambling' with new products. They expressed their satisfaction with vat dyes which though very expensive, produce a variety of beautiful and fast shades of colours.

Wax is obtainable at crafts shops as well as retail chemical shops. The microcrystalline wax is available in form of large white slabs which are cut into smaller units at retail shops. Beeswax are sold in form of small dark brown segments. Candlewax and paraffin are sometimes used to achieve special effects in batik design. Wooden stamps which are used for wax application are also sold at craft shops. These come in different sizes bearing different designs. Sometimes, a dyer may sell his old stamps to obtain a new set with other patterns. Locally improvised 'tjantings' are also available in different sizes and shapes. The iron components are produced by the blacksmiths, attached to a wooden or bamboo handle and sent to various crafts shops for retailing.

Cassava starch which is used for producing adire 'eleko' is marketed in form of a white smelly powder by foodstuff sellers. It is abundant in the town of

Abeokuta. Cassava paste is applied mainly with the use of zinc stencils. The hand painted adire eleko described in chapter two are now almost extinct.

Virtually every pliable material is adopted in tying and stitching of fabrics. These include raphia, sewing thread, rubber thread, twines (cotton), crocheting thread, wires, strips of cloth, polythene and so forth. This method of designing actually allows for much improvisation and experimentation.

The data gathered from the field concerning pattern making and dyeing was consistent to a large extent with the information contained in the literature review (in chapter 2). However, some of the current trends in the craft which have not been properly documented will be discussed here.

The first striking feature of contemporary pattern dyed fabrics is the simplicity of the designs. Intricate patterns which require several days for completion are becoming a thing of the past. According to the craftsmen the demand from customers cannot be adequately met if the number of hours spent on each unit of fabric are not reduced. Hence simple but interesting designs are replacing the more intricate hand painted or meticulously tied adire oniko. Application of wax is now done almost exclusively with the faster stamping technique (Plate 4.1a) except when smaller units of fabric are involved. The methods of stitching and marbling are gradually replacing pleating and tying.

Also on the rise, is the combination of different resist techniques such as tying and stitching, tying and waxing, stitching and marbling and so forth. Efforts are no longer made to fill up every available space on the fabrics with a pattern. Rather, enough spaces are left around the patterns to form a background which enhances the beauty of the patterns after dyeing. Some times, fabrics are cut into desired outfits before being handed over to the



Plate 4.1a: Fabric being waxed with the stamping technique

pattern makers who will skillfully distribute the patterns on the fabric before handing it over to the dyer.

It was observed in most of the dyeing sheds visited that fabrics are seldom washed prior to resist application and in a few cases too, they were not wetted out prior to dyeing. Some of the pattern makers claim that it was not their duty to wash the cloths and if they have to do so, a lot of time will be wasted waiting for such cloths to dry especially if they are to be waxed or starched (for adire eleko). They also claimed that they did not have enough space in which to spread such cloths if washed, and that improper drying could lead to the growth of mildew on such fabrics if they are not patterned and dyed as soon as possible. Some of the dyers claimed that wetting out of fabrics was being ommitted to prevent shrinkage. They added that once the dyebath has been prepared with the correct concentration of chemicals and liquid, there was no need to be apprehensive about faulty dyeing.

One of the latest innovations in the pattern dyeing craft is the discharge dyeing. Discharge dyeing is the production of a pattern on a predyed cloth with a suitable reducing agent. A coloured discharge is one in which a new colour, unspoilt by the reducing agent is printed at once and at the same time, giving a coloured pattern on a pre dyed cloth. From observation, coloured discharge dyeings are mostly executed on factory dyed guinea brocade fabrics by the local dyers. A length of coloured brocade is folded, pleated, marbled or tied into a desired pattern. Having determined the areas for the discharge, the dyer goes ahead to prepare a boiling solution containing 5% wt/v sodium hydrosulphite, 1% wt/v sodium hydroxide (caustic soda) and the required quantity of dye (depending on the desired depth and the surface area for discharge). The areas for discharge are immersed in the boiling solution and the necessary reaction takes place. When the dyer is certain that the

required shade has been built up, he removes the fabric from the solution, allows it to drip for a while then spreads it out for oxidation to take place.

Discharge dyeing reverses the trend of the conventional building up of shades from light to dark. It enables a light bright colour to be obtained on a dark ground. Discharge dyed fabrics can be recognised by the sharp contrast between their colours, the brightness of the colours and the sharp and distinct designs which are usually surrounded by a white or cream coloured border (Plate 4.2) Generally, the designs look simpler than those on the regular pattern dyed fabrics.

The field survey reveals that all the dyers make use of vat dyes combined with sodium hydrosulphite ($Na_2S_2O_4$) popularly called 'powder' by dyers, sodium hydroxide (NaOH) called 'soda' and salt (optional) to prepare their dyebaths (Plate 4.2a). With the black dye, soda ash and a fixer (crisp yellow flakes) which is nicknamed cornflakes are used in combination. However, it was discovered that no common standard for determining the ratio of dyes to chemical to fabrics existed among the dyers. Most of them prepare their dyebaths using experience and sometimes trial and error - the products of which are released into the market with or without defects. Similarly, dyeing temperature and duration vary from craftsman to craftsman. Deeper shades are built up when the fabric spends a longer time in dyebath (Oguntona, 1986). Some of the dyers believe that there is no point leaving a fabric in the dyebath at the expense of other undyed ones when the required depth of shade has already been built up. They however fail to realise that whatever shade the fabric emerges with from the dyebath will be lightened when the fabric is finally finished and dried.

A common practice among most of the dyers observed is the use of the left over dye liquor from a dyeing operation to dissolve the dye/chemical

TIED & DYED	STITCHED & DYED	WAXED & DYED	MARBLED & DYED	DISCHARGED & DYED

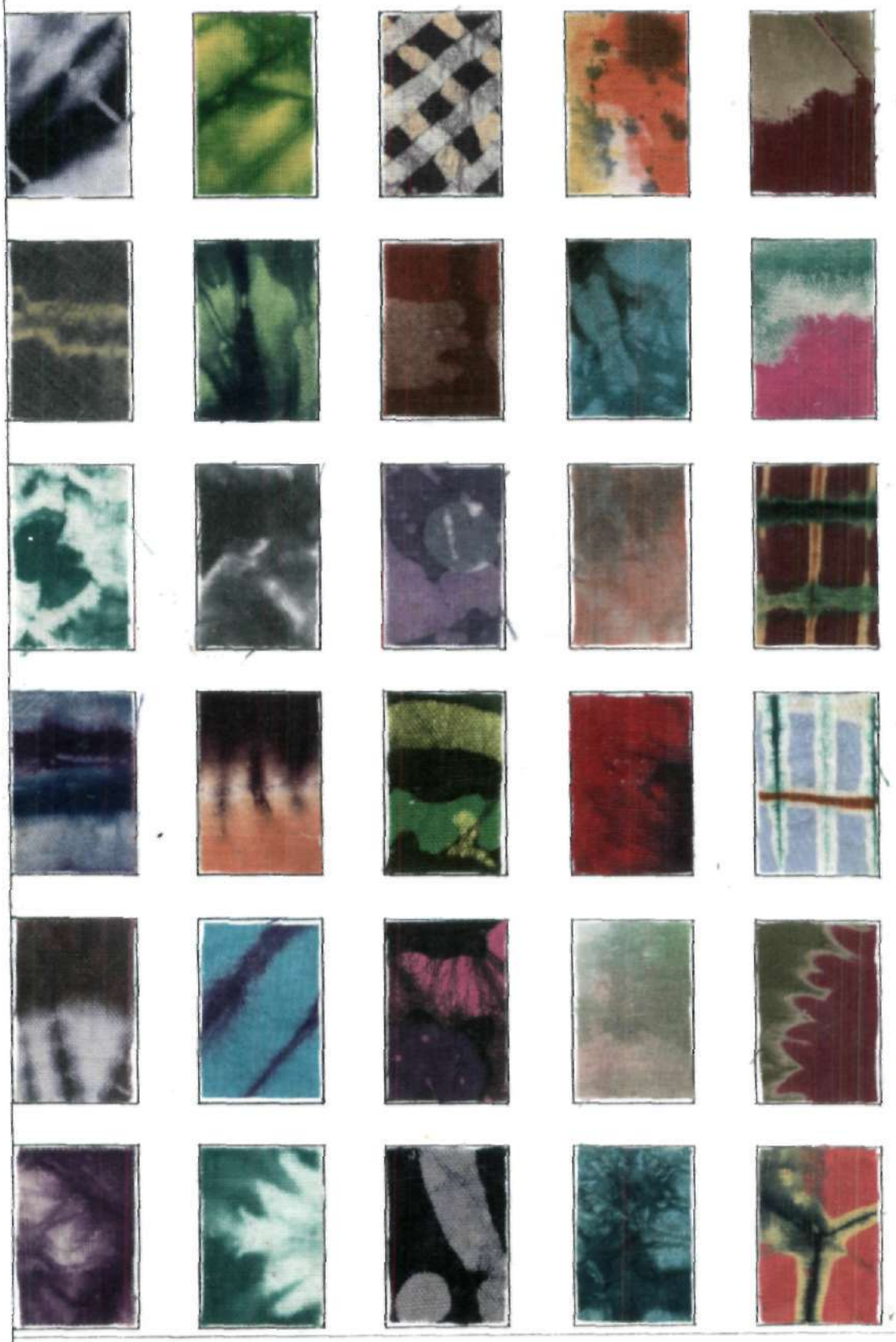


Plate 4.2 : ASSORTED PATTERN DYED FABRICS



Plate 4.2a: Fabrics tied with raffia to form different patterns
The pink fabric (at the extreme right) has been waxed in preparation for dyeing.



Plate 4.3a: The dyebath about to be prepared making use of different types of receptacles. Note the left over dye liquor in the foreground.

mixtures for subsequent dyeing. This practice helps to minimise wastage and produce potent dyebaths. However, the risk of having excessive caustic soda in the dyebath exists, since most of the dye would have been picked up by the dyed cloth, the hydrosulphite exhausted by long exposure leaving behind an alkaline concentration.

In most large dyeing compounds, there exists a strict division of labour. Some people specialise in applying the required resist to the fabric (Plate 4.1a) while there are those whose duty is to dye the fabric (Plate 4.4a). A dyer purchases bales of plain coloured fabrics, cuts them into units of predetermined dimensions and sends them to the pattern makers for patterning. The dyer collects her clothes from the pattern makers after paying for their services and then, dyes them into the desired shades of colours. Likewise pattern makers may also pay for professional dyers to dye their patterned cloths for them. Hence, most adire outlets were found to specialise in either of the two areas. Only in few cases were these two areas of specialisation (pattern making and dyeing) found to be present within a single enterprise.

After dyeing, oxidation and rinsing as described in chapter 2, fabrics are starched (plate 4.5a) using the cassava starch which is more economical than the packed laundry starch. A local version of laundry blue known as 'aro kiun' may be dissolved in hot water, sieved and blended with the starch paste to brighten up the fabric for sale. In some dyeing sheds, a few drops of kerosene are added to the final rinsing water. Dyers claim that this helps to prevent bacterial attack and enhance shelve life in the event of long storage.

The starched fabrics are dried either by hanging on long wooden or bamboo poles (Plate 4.5) or spreading them flat on the ground within a yard or along the motor roads. This practice is common in Abeokuta because of the



Plate 4.4a: Pattern - dyeing in progress.



Plate 4.5a: Starching the dyed fabrics.
Note the extended poles for drip drying and
spreading finished fabrics.

lack of sufficient space for spreading the hundreds of dyed cloths which are produced daily.

After drying, dyed fabrics are sent to the pounder (Oloolu) who imparts the final sheen (plate 4.6a) to them in preparation for the market.

Stanfield (1971) observed that the prices of adire varied according to the quality of the material on which they are made rather than on the quality of the craftsmanship. This remains the case today in the adire market. However nowadays, adire fabrics are cut prior to dyeing, bearing in mind the kind of outfits that are likely to be sewn from them. The length of such pieces vary from $2^1/_2$ yards to 5 yards except on special request by customers. Compared with the factory printed super prints and real wax, the prices of adire are still very reasonable. A 5 yard piece of adire on poplin fabric which is enough to sew a complete outfit for a woman costs N500 while a $4^1/_4$ yard piece on guinea brocade costs N600 from the sellers at Abeokuta. On the other hand, the prices per unit of 'super print and real wax fabrics which will suffice for a woman's complete outfit start from N500 and N1,000 respectively.

Adire fabrics are marketed by their producers through display at their sheds (Plate 4.6a & 4.7a) market stalls, gift shops/supermarkets, exhibitions, trade fairs and so forth.

4.2.2 Pattern dyed fabrics and the question of quality

Out of all the questions posed at the respondents by the researcher, the one that borders on quality was the most evaded and emotion provoking the craftsmen. Most dyers wanted customers to believe the best about their products. They argued that their sheds were not one of those which turned out defective products and boasted about their popularity and daily sales.



Plate 4.6a: Assorted pattern dyed fabrics at
Abeokuta, Ogun State.



Plate 4.7a: The researcher with Mrs Soetan
(One of the respondents) and
some of her products.

Attention was shifted to adire users who freely released useful information. A common question which is found on the lips of most prospective adire buyers is "will it (the colour of the fabric) wash off?" This shows that colourfastness of the fabric is of utmost importance to most of the consumers. The opinions of consumers on the colourfastness of the product were sought. Out of the 37 people interviewed, 41% believed that the fabrics are colourfast, 38% believe that they are not while 21% said they were not sure. Many respondents had facts and visual evidence to buttress their stands. Investigations reveal that few consumers realize that apart from washing, other agencies such as light, abrasion, perspiration and hot pressing have potentials of affecting fabric colour in a negative way. Some of the adire sellers said that they were aware of this fact and that it is in recognition of this fact that they fold up each fabric unit to a compact size and expose as little part of it as possible to rubbing and light. Others said that to prevent fading, they use only dim electric bulbs to light up their shops.

Both the makers and users of adire agreed that next to colourfastness, shrinkage is the greatest problem which has to be contended with. According to the dyers, bales of factory produced cotton fabric are bought, cut into predetermined length per unit, patterned with a resist and dyed. On the completion of dyeing, they discover that each unit of dyed fabric has decrease in length and such decrease often range from 5cm (≃ 2 inches) to 20cm (≃5 inches). The shrinkage notwithstanding, the fabrics are released into the market and sold at the normal price to unsuspecting buyers. Buyers claim that often, the extent of shrinkage is not discovered until the fabrics are taken to the tailor for sewing. Where it is impossible to return such a fabric, the buyer goes ahead to get it sewn and realises yet another shrinkage upon washing the cloth.

Shrinking is just one of the several ways in which dimensional instability can manifest on a fabric. Cotton fabrics are however more prone to shrinking and loss of shape. Buyers complain that the lower grades of guinea brocade shrink badly and loose shape after washing. This sometimes distorts symmetrical designs.

The draping characteristics of the fabrics were another area of interest to the respondents. Some of them were of the opinion that the pattern dyed fabrics would have gained a wider acceptance if their draping characteristics had been better off than they are at present. However, other respondents argue that draping becomes a problem only when excessive starch has been applied in finishing the cloth. Nevertheless majority of the respondents agreed that what the average working class Nigerian needs is a fabric which drapes well even without ironing. They pointed out that the hectic nature of a typical working day in most urban areas as well as the irregularities in electricity supply has made the 'wash and wear' fabrics to become the favourite wear of the bulk of the populace. They argue that this is the reason why the second-hand clothings of synthetic nature now sell like hot cake in most towns and villages.

All the respondents interviewed agreed that air permeability was an important factor which must not be over-looked in fabric selections especially when the hot humid weather of Nigeria is considered. Most of the respondents claimed that the relatively lighter weight and greater air permeability of pattern dyed fabrics account for their preference for them among other home-made fabrics. Pattern dyeing on some types of guinea brocade called 'oni air con' (air conditioned guinea brocade) by the Yorubas are generally preferred by consumers because of the spaces in between their weaves which allow greater air passage.

Similarly the ability of fabrics to absorb water was of great importance to the respondents. Some of them claimed that in spite of cheaper lightweight synthetic fabrics, they still prefer adire not only because of its design but also because of the comfort they experience while wearing them. They noted that the fabrics commonly used for adire absorb the moisture from perspiration and leave them feeling cool in a hot atmosphere.

Respondents believe that fabrics to be adopted as everyday apparel wear must possess a reasonable degree of tensile strength. The parts of a garment which are subjected to repeated flexing must be able to return to normal position without rupturing. Most respondents believe that the fabrics used for pattern dyeing perform fairly well in this wise.

Abrasion is another agency of wear which was pointed out by respondents as one of the major threats to the durability of pattern dyed fabrics while in use. It was gathered mainly through observation that the impact of abrasion were more noticeable on men's tops. This is most likely due to the fact that the tops have closer contact with the skin when compared with that of women (adire fabrics are usually made into free-lose garments by the women).

Asked whether they were aware of the existence of the SON (hitherto NSO). Most elderly craftsmen replied that they were aware of the NSO but had nothing to do with them since they were not smugglers. Some other respondents claimed that they were ignorant about SON's existence. It was the general impression among Nigerians in the 1970s and 80s that the duty of the NSO (now SON) was solely to confiscate smuggled and/or counterfeit goods. Hence, the NSO officials were often regarded with suspicion and hostility. The fact that most of these craftsmen are ignorant of the SON is an indication that

the SON has not been fulfilling its obligations towards the small scale industries as highlighted in chapter 2.

When contacted, the SON (Kaduna Zone) representative confirmed the fact that they have limited contact with small scale entrepreneurs. This, they claim, was due to the fact that most small scale productions were carried out indoors in random and unidentified locations which makes easy access by the NIS inspection team to be difficult. Hence, producers feel free to go ahead producing and releasing into the market both qualitative and defective products.

The SON representative mentioned that the SON still conducts factory inspections on a 3-monthly basis as in the past to all textile mills. The inspection team demands results of tests from factories and where no tests have been carried out, it takes up the responsibility.

4.3 Fabric Analysis

Table 1 shows the details of results obtained from the analysis of the fabric samples collected. The analysis was carried out following the standard procedure wherever possible. The details are classified under;

1. Fabric fibre content and constructional details
2. Class of fabric dye (on the sample)
3. Fabric sett
4. Fabric weight
5. Length and width of fabric

4.3.1 Fabric fibre content and constructional details

90% of the tested fabrics were constructed with 100% cotton yarns. This fact was established by the burning test whereby, the fabrics burnt quickly

Table 4.1 Results of fabric analysis

Sample No	Fabric dimensions		Weight (gm/m^2)	Fabric sett		Fabric fibre content	Class of dye used	Type of weave	Resist Technique
	Length (cm)	Width (cm)		Ends /cm	Picks /cm				
1	182.9	130.81	78.8	40	28	100% cotton	Vat	Brocade	Stitching
2	182.9	114.9	137.6	28	21	"	"	Plain	Waxing
3	43.18	129.5	99.6	52	14	"	"	Brocade	Tying
4	144.8	109	98	43	31	35% cotton 65% polyester	"	Plain	"
5	43	114	153.2	27	18	100 Cotton	"	"	Waxing
6	183	135	140.4	38	12	100% cotton	"	Brocade	"
7	86	114	153.2	26	21	"	"	Plain	Tying
8	183	113	108	43	29	35% Cotton 65% polyester	"	"	Waxing
9	91	36	152.8	27	22	100% Cotton	"	Plain(baft)	"
10	254	131	146.8	50	30	"	"	Brocade	Marbling
11	91	114	172.8	34	26	"	"	Plain	Waxing
12	91	112	138	24	19	"	"	"	Marbling
13	183	111	154	34	23	"	"	"	Waxing
14	91	36	150.4	29	21	"	"	" (baft)	Tying
15	76	41	150.8	49	30	"	"	Brocade	Stitching
16	46	56	143.6	25	21	"	"	Plain	"
17	42	46	200.4	25	21	"	"	"	Waxing
18	58	43	142.4	34	22	"	"	"	"

Table 4.1 (continued)

Sample No	Fabric dimensions		Weight (gm/m^2)	Fabric sett		Fabric fibre content	Class of dye used	Type of weave	Resist Technique
	Length (cm)	Width (cm)		Ends/cm	Picks/cm				
19	56	36	103.2	40	30	35% cotton 65% Polyester	Vat	Plain	Tying
20	36	25	140	40	26	"	"	"	Waxing
21	31	25	156	30	30	100% cotton	"	Brocade	Stitching
22	269	118	146.8	37	30	"	"	Plain	Waxing
23	24	85	187.6	30	18	100% cotton	"	"	"
24	179	113	165.6	35	22	"	"	"	Stitching
25	69	79	150	33	19	"	"	"	"
26	28	131	130.8	33	24	"	"	Brocade	"
27	25	130	131.6	42	25	"	"	"	"
28	23	20	210	29	26	"	"	Plain(baft)	Tying
29	46	56	139.2	26	20	"	"	Plain	"
30	46	23	181.2	50	32	"	"	Brocade	Stitching
31	182	130	150	46	17	"	"	"	Tying
32	153	132	141.2	46	17	"	"	"	Stitching
33	192	132	158.4	40	31	"	"	"	Waxing
34	91	20	180.2	28	22	"	"	Plain(baft)	Tying
35	46	25	138.2	48	19	"	"	Brocade	Stitching

Table 4.1 (Continued)

Sample No	Fabric dimensions		Weight (gm/m^2)	Fabric sett		Fabric fibre content	Class of dye used	Type of weave	Resist Technique
	Length (cm)	Width (cm)		Ends/cm	Picks/cm				
36	183	108	164.6	31	23	100% Cotton	Vat	Plain	Tying
37	183	117	174	36	27	"	"	"	Waxing
38	183	113	142.8	25	22	"	"	"	Stitching
39	137	89	146	30	23	"	"	"	Tying
40	121	90	162.4	26	20	"	"	"	Starching
41	183	130	144.6	40	14	"	"	Brocade	Waxing
42	239	133	142.4	43	17	"	"	"	
43	91	131	180.2	31	29	"	"	"	Tying
44	91	135	160.8	50	26	"	"	"	Stitching
45	91	131	154	48	29	"	"	"	"
46	46	132	152.4	47	18	"	"	"	"
47	25	133	144	50	33	"	"	"	Tying
48	97	114	100.6	42	30	35% Cotton 65%polyester	"	Plain	Marbling
49	38	131	150	51	32	100% Cotton	"	Brocade	Stitching
50	46	109	158.6	47	21	"	"	Brocade	Tying

gave a smell of burning paper and left behind a white ash. This confirms the information contained in the literature review as well as the one obtained from the field. 10% of the fabrics turned out to be a blend of 65% polyester and 35% cotton. Burning tests on these samples produced a black sooty flame with fabric melting and shrinking away from the flame. The residue was in form of a black and brittle mass.

All the tested fabrics were woven 66% in the plain weave and 44% in the brocade weaves. 32% of the fabrics were resisted with wax, 4% with starch and the remaining 64% were either tied or stitched or had both methods combined (Plate 4.2)

4.3.2 Class of fabric dye

The solubility tests reveal that all the samples were dyed with vat dyes. Although complete solubility was not achieved with the dyes on most of the samples while in the stripping solution, the change of the sample colours to those of their leuco compounds and the restoration of the original hues on exposure to air were proofs of the fact that they were dyed with vat dyes. This discovery confirms the fact that most of the dyers use only vat dyes for their dyeing operations.

The samples were obtained in different shades of colour and each was tested to confirm what class of dye it belongs to.

4.3.3 Fabric sett

The warp yarns were threaded from between 18 and 37 ends per centimeter (E/cm) while the weft were between 18 and 30 picks per centimetre (p/cm) in the plain woven samples. The bafts were threaded from between 27 and 29 E/cm while the weft yarns were threaded between 21 and 26 P/cm. The

polyester/cotton blend had warp yarns which range between 40 and 43 E/cm while the weft threads were between 29 and 31 P/cm The guinea brocade weaves had warp threads of between 30 and 52 E/cm and weft threads between 12 and 32P/cm

It was observed that the sett had significant effect on the fabric weights that is: fabrics with yarns lying closely weigh more than those with gaps in bewteen their yarns. The density of weaves or compactness of yarns in a fabric greatly influences so many other properties of the fabric such as air permeability, water permeability, abrasion resistance and so forth.

4.3.4. Fabric weight

The fabric weights ranged from between 78.8 - 210 grammes per metre square (gm/m^2). The lowest weight was recorded by sample 1 - a guinea brocade fabric while the highest was recorded on sample 28 a baft material. This weight range is in line with that of any dress fabric in normal use.

The NIS 144: 1981 stipulated that poplins should have a standard weight of $161 gm/m^2 \pm 3\%$ - that is a weight within the range of 156 and 166 gm/m^2 of all the poplins weighed, only 32% were in conformity with this standard.

The type of resist used was observed to have an impact on fabric weight. Samples which were dewaxed by ironing had higher weights due to the remnants of wax which were absorbed by the fibre. The dyers claim that this is sometimes done intentionally, especially when the fabric is to be used for furnishing.

4.3.5 Fabric dimension

The different types of fabric used for pattern dyeing are sold in standard widths and sometimes length. The plain woven samples (poplin) had widths ranging from 111cm (43.5 inches) to 117cm (46 inches) The widths of the guinea brocade were between 130cm (51 inches) and 135cm (53 inches). The polyester cotton blends had widths ranging from 109cm (43 inches) to 114cm (45 inches) Mercerised cotton had the smallest width , which ranged from 84.5cm (33.25 inches) and 90cm (35.5 inches)

The irregularities in the width of the fabrics are most likely due to shrinking of the fabrics either due to dyeing or washing. Sometimes, however, the irregularities may be due to technical faults from the production stage.

4.4 Aesthetic Evaluation of Fabrics

4.4.1 Colour fastness of fabrics to light

To determine the colour fastness properties of pattern dyed fabrics, an artificial light source; the microscal light fastness tester (500 watts) was used (Plate 3.1). The exposure took place for 96 hours. The results are presented in Table 4.2

The grading of the rate of fading after 48 hours are presented in column A while grading after 96 hours are presented in column B.

After 48 hours, no noticeable change took place in any of the samples. Nevertheless. one of the two exposed portions of each and every one of the samples were covered with a black card and exposure was continued for another 48 hours.

After 96 hours, the exposure operation was stopped and the samples were assessed once again. No noticeable change was observed on any of the samples, hence the samples were all rated as No. 8: outstanding light

Table 4.2: Test result of fabric colour fastness to light

Sample No	Grading of Fading[1]	
	A[2]	B[3]
1	8	8
2	8	8
3	8	8
4	8	8
5	8	8
6	8	8
7	8	8
8	8	8
9	8	8
10	8	8
11	8	8
12	8	8
13	8	8
14	8	8
15	8	8
16	8	8
17	8	8
18	8	8
19	8	8
20	8	8
21	8	8
22	8	8
23	8	8
24	8	8
25	8	8
26	8	8
27	8	8
28	8	3
29	8	8
30	8	8
31	8	8
32	8	8
33	8	8
34	8	8
35	8	8
36	8	8
37	8	8
38	8	8
39	8	8
40	8	8

Table 4.2: (Continued)

41	8	8
42	8	8
43	8	8
44	8	8
45	8	8
46	8	8
47	8	8
48	8	8
49	8	8
50	8	8

[1]Grading of Fading

Class	Interpretation
9 -	Superlative
8 -	Outstanding
7 -	Excellent
6 -	Very Good
5 -	Good
4 -	Fairly Good
3 -	Fair
2 -	Poor
1 -	Very Poor

- American Association of Textile Chemists and Colourists. (1977)

[2]A: Assessment after 48 hours

[3]B: Assessment after 96 hours

fastness. Furthermore, there was no visible difference between the appearance of the portions covered after 48 hours and those exposed for 96 hours.

The retention of the original shade/hue by the tested samples may be attributed to the fact that vat dyes possess the highest light and wash fastness property on cellulosic materials. Furthermore, an accelerated artificial light cannot quite replace natural sunlight both in composition and function. Hence it may not be impossible to have different results with other sources of light and/or methods of tests.

The NIS 27: 1973 (UDC 677:01 :535.68 : 628.93) recommends a minimum rating of 5 in the scale 1 -8 for the fabrics to qualify for the label 'fast to light'. Hence, the tested fabrics all possess excellent fastness to artificial light.

4.4.2 Colour Fastness of fabrics to washing

To determine the colour fastness of pattern dyed fabrics to washing, the laboratory washwheel (Plate 3.2) was used. The assessment of colour fastness of the tested samples was done using the staining scale for assessing staining and the grey scale for assessing fading under the IWS viewing cabinet (Plate 3.3.)

The results of the tests carried out to determine the colourfastness of samples to washing are presented in Table 4.3. On the table, the colours of the stains inflicted on each of the composite fabrics are specified since all the samples have more than one colour. Also, the degree of staining on each different (in fibre content) composite were specified alongside the degrees of change of colour or shade of the tested fabrics. On each of the tested samples, assessments of staining were made on both composites but the heavier stain was considered in the discussion of results.

Table 4.3: Test result of fabric colour fastness to washing[1]

Sample	Stain Colour	Composite Fabrics	Change of Colour Shade
1.	Ash	Cotton 4/5, Polyester 4	5
2.	Purple	Cotton 2/3, Polyester 3	ID
3.	Maroon	Cotton 4, Polyester 4/5	5Br
4.	Ash	Wool, 1/2, Polyester 3/4	4W
5.	Green	Cotton 3/4, Polyester 4	5Br
	Black	Cotton 3/4, Polyester 4/5	2D
6.	Brown	Cotton 4, Nylon 4/5	3D
7.	Purple	Cotton 4, Nylon 4	4W
	Orange	Cotton 4/5, Nylon 4/5	5
8.	Blue	Cotton 4/5, Polyester 4	4D
9.	Brown	Cotton 3/4, Polyester 4/5	4W
10.	Black	Cotton 2/3, Nylon 3/4	4D
	Turquoise blue	Cotton 3/4, Nylon 4	2D
11.	Orange	Cotton 4/5, Nylon 5	4W
12.	Red	Cotton 2, Polyester 3	5R, Br
13.	Purple	Cotton 4/5, Wool 5	5Br
14.	Purple	Cotton 4, Nylon 4/5	4Br
15.	Green	Cotton 4, Polyester 4/5	5G
16.	Green	Cotton 2/3, Nylon 3	5G
17.	Purple	Cotton 3/4, Nylon 4/5	3R
18.	Purple	Cotton 3/4, Polyester 4	4B
19.	Yellowish green	Cotton 4/5, Nylon 4/5	5Br
20.	Purple	Cotton 4, Nylon 4/5	4Br
21.	Purple	Cotton 2/3, Polyester 3/4	4R
	Orange	Cotton 4, Nylon 4/5	5
22	Green	Cotton 4/5, Nylon 4	5G
	Purple	Cotton 4, Nylon 4/5	5B
23	Black	Cotton 2, Wool 1/2	3D
			2W (Pink)
24	Purple	Cotton 2/3	5R
	Green	Cotton 4/5, Nylon 5	5Br
26	Dark blue	Cotton 3/4	4W

Table 4.3: (Continued)

	Lemon Green	Cotton 4/5	5
27.	Yellow	Cotton 3	4D
	Maroon	Cotton 1	3R
28.	Green	Cotton 3	5
29.	Green	Cotton 2/3	5Br
30.	Navy Blue	Cotton 2/3, Polyester 4/5	5Br
	Purple	Cotton 4/5, Polyester 5	5B
31	Pink	Cotton 4	3D
	Brown	Cotton 4/5	5Br
	Green	Cotton 3/4	5Br
32	Turquoise Blue	Cotton 3/4	4D
	Purple	Cotton 4	5
33.	Black	Cotton 3	5D
34.	Brown	Cotton 4/5	5
35	Orange	Cotton 3, Wool 3/4	5
36	Dark Blue	Cotton 4	4D
37	Indigo Blue	Cotton 2/3, Polyester 4	4W
38	Dark Blue	Cotton 2/3, Polyester 3	4D
39.	Maroon	Cotton 3, Wool 4	5Br
	Green	Cotton 4, Wool 4/5	5Br
40.	Blue	Cotton 1/2, Polyester 4/5	4W
41.	Green	Cotton 4/5	5Br
	Navy Blue	Cotton 4	5Br
42.	Olive Green	Cotton 4	4D
43.	Indigo Blue	Cotton 2	3W
	Reddish Purple	Cotton 4/5	5D
44.	Pink	Cotton 4/5, Polyester 5	4W
	Green	Cotton 3, Polyester 4	5
45.	Purple	Cotton 3/4	3D
	Green	Cotton 4	4D
46.	Navy Blue	Cotton 3	4
	Reddish Purple	Cotton 1/2	3D
47	Turquoise blue	Cotton 4	4W
	Purple	Cotton 4	5

Table 4.3: Continued

48.	Ash	Nylon 4/5, Polyester 5	5
	Orange	Nylon 4/5, Polyester 4/5	5
49.	Yellowish Green	Cotton 4/5	4W
	Maroon	Cotton 4	3D
50.	Navy Blue	Cotton 2/3	3D
	Red	Cotton 3	4D

[1]Washing was done with sunlight soap solution at 60^0C for 30 minutes in the laboratory wash wheel.

From the table, 10% of the composite fabrics attached to fabric specimens were considerably stained (i.e. from ratings nos. 1 to 2). 28% were noticeably stained (2/3 - 3/4) while 36% had slight or negligible stains. Changes occurred in the hues/intensities and/or shades of some of the washed samples. 7% were considerably changed (1 -2), 13% were noticeably changed (3) while there were slight or negligible changes (4 - 5) on 80%

It was observed on many samples that heavy bleeding during washing did not leave permanent heavy stains on composite fabrics. For example, in samples 4, 12 and 40, heavy bleeding which stained composite fabrics considerably only led to slight changes in the hues and shades of the tested fabric. Furthermore, samples 6, 14, 41, and 46 bled heavily during washing (the washing solutions were observed after washing) but left only slight stains on the composite fabrics. This situation may be a result of the use of excess dye as suggested by Nwaiwu (1990) in chapter 2. On the other hand, it may be due to the failure of dyers to carry out the 'soaping at boil' recommended by Oguntona (1986) and Nkeonye (1993) which helps to remove superfluous colour. Most dyers merely rinse lightly, starch and prepare their fabrics for sale. Hence, bleeding during washing (in a good number of cases) does not result in fading but a loss of excess colour, which if retained can give rise to crocking.

Bayei (1997) concludes from his own experience, that the soaping at boil is deliberately avoided by many dyers so as not to expose some of the flaws of the fabric (e.g. faulty dyeing) to prospective buyers. He hinted that some of the pattern dyers do not blend the dyeing ingredients in the right proportion either due to ignorance or in an attempt to economise what is available. As a result such dyers do not have the confidence to either give

CONTROL SAMPLE	WASHED SAMPLE	FIRST COMPOSITE	SECOND COMPOSITE
		COTTON	WOOL
		COTTON	NYLON
		COTTON	POLYESTER
		COTTON	VISCOSE RAYON
		COTTON	POLYESTER & COTTON BLEND

Plate 4.3 : FABRICS COLOUR FASTNESS TO WASHING

thorough rinsing or washing to the fabrics after dyeing before starching and displaying them for sale.

Bleeding and fading were more pronounced when the fabrics were washed with 'omo detergent' and the local 'soda' (a mixture of caustic soda and fat(respectively than when they were washed with other brands of soap (truck, lux & sunlight).

Of all the five composite fabrics used namely cotton, polyester, wool, viscose rayon and polyester cotton blends, stains were more noticeable and more permanent on the cotton fabrics (Plate 4.3) This implies that cotton fibres have the greatest affinity for vat dyes. Hence, care must be taken to prevent the contact of the dyed fabrics with white cotton fabrics when either or both are damp.

The N.I.S 02 : 1972 (UDC 677, 016. 474) recommends that to qualify for the label "fast to washing" a minimum rating of 3 in the scale 1 - 5 is required for the change in colour and a minimum rating of 4 in the scale 1 - 5 for staining. In view of this standard, the tested fabrics can be rated as having performed well. The results show that contrary to most people's fear, most of the dyed fabrics will retain a reasonable degree of aesthetic appeal in repeated washing.

4.4.3 Colour fastness of fabrics to rubbing

The tests to determine the colourfastness of pattern dyed fabrics to wet and dry rubbing were carried out with the use of the METRIMPEX staining tester (Plate 3.4) The results are presented in Table 4.4

In the wet state, 42% of the collection stained the composite fabric heavily (1 - 2), 50% stained the composites noticeably (2/3 - 3/4) while 8% stained the composites slightly (4 - 5). In the dry state, heavy stains (1-2) were

Table 4.4 Test results of fabric colour fastness to rubbing

Sample No	Grading of Stains[1]				Grading of fading[2]			
	Wet		Dry		Wet		Dry	
	A[3]	B[4]	A	B	A	B	A	B
1.	4/5	4	4/5	4/5	4	4	4	4
2.	2	2	4	3/4	3	3	3	3
3.	1/2	2	4/5	4/5	4	4	4	4
4.	1/2	1/2	3/4	3/4	3	3	3	3
5.	1	1	4	4	4	4	5	5
6	3	3	4/5	3/4	3	3	4Br	4Br
7	2/3	2/3	4/5	4	4	4	5	5
8	1/2	2	3	3	4	4	5	5
9	3	3	3/4	4	4	4	4	4
10	3	4	4/5	4/5	5	5	5	5
11	3/4	3	4/5	4/5	4	4	5	5
12	3	2	4/5	4/5	5	5	5	5
13	2	2/3	3/4	3/4	4	4	5	5
14	2/3	2	4/5	4/5	4	4	4	5
15	3/4	3/4	4/5	4/5	5	5	5	5
16	3	3/4	4	4	5	5	4	4
17	22	3	2/3	2	3	3	4	4
18	3/4	3	2/3	3	4	3	4	4
19	2	4	4	4/5	4	4	5	5
20	2	2	3	2/3	4	4	4	4
21	2/3	2	2/3	4	4	4	4	4
22	2	2	4	3	4	4	5	5
23	1/2	1/2	2/3	2/3	5	5	5	5
24	3	2	4	4	5	5	5	5
25	3	3/4	3	4	4	5	5	5
26	3	3/4	2/3	4	5	5	5	5
27	4	3/4	4	4/5	4	4	5	5
28	3	3/4	4/5	4/5	5	5	5	5
29	2/3	3	4	3/4	4	4	5	5
30	3	4	4	4/5	5	5	5	5
31	4	2	5	3/4	5	4	5Br	5Br
32	1	2	4/5	3	5	5	5Br	5Br
33	3	1/2	4/5	4	5	5	5Br	5Br
34	4	4	4	4/5	5	5	5	5
35	3	3/4	4	4	4	4	5	5
36	3/4	3	2	3/4	4	4	5	5
37	2	3	4	4	4	4	4	4
38	2/3	2/3	3	3	4	4	4	4

Table 4.4 (Continued)

39	3/4	3/4	4	4	5	5	5	5
40	2	1/2	2/3	3	4	4	5	5
41	4	4	4/5	4	5	5	5	5
42	3/4	3/4	4	4	5	5	4	4
43	2	1/2	3/4	3	3	3	4	4
44	2/3	3/4	4	3/4	4	4	5	5
45	3	3	4	4	4	4	4	4
46	2	1/2	3/4	3/4	3	3	3	3
47	3/4	3/4	4/5	4/5	5	5	5	5
48	4	4	5	4/5	5	5	5	5
49	3/4	3/4	4	4	4	4	4	4
50	2/3	3	4	3/4	4	4	4	4

[1]The staining scale was used for grading

[2]The grey scale was used

[3]Warpway direction

[4]Weftway direction

left on composite fabrics by 2% of the tested fabrics, noticeable stains (2/3 - 3/4) by 40% and slight/negligible stains (4-5) by 58%. This shows that staining is more pronounced in the wet state than in the dry state (plate 4.5) In majority of the samples, the degree of fading after wet or dry rubbing was minimal. After rubbing in the wet state, 14% of the samples faded noticeably (3) in the rubbed areas, while the remaining 86% showed slight or no fading (4-5). In the dry state rubbing, 4% of the samples faded noticeably (3) while all the remaining 96% exhibited slight or no fading.

As in the result of the wash fastness tests, the rate of fading as a result of rubbing did not depend on the rate of crocking. In spite of the fact that some samples (e.g. 23, 33, 12, 23, 24, 32, 33) left heavy stains on the composite fabrics, their original colours remained unchanged. The rubbed areas of some of the samples (e.g. 5, 6, 9. 33) rubbed in the dry state assumed a glossy appearance. The fabrics were all resisted with wax prior to dyeing, hence the gloss is most likely the result of the smoothening of the tiny particles of residual wax during the rubbing action.

There was no significant difference in the rate of crocking or change of colour between samples rubbed warpway and those rubbed weftway. (Plate 4.4). Heavier crocking was exhibited by fabrics which had most of their colours concentrated on the surface and not penetrating right through to their backs (Plate 4.5). This situation was common in fabrics which were folded, pleated or tied. The NIS 77 : 1978 (UDC 677.473.622) stated that to qualify for the label 'fast to rubbing' a minimum rating of 4 in the scale 1- 5 is required for both staining and change in colour. Hence it can be inferred from the results presented in Table 4.4 that the pattern dyed fabrics generally perform below standard when subjected to rubbing in the wet state.

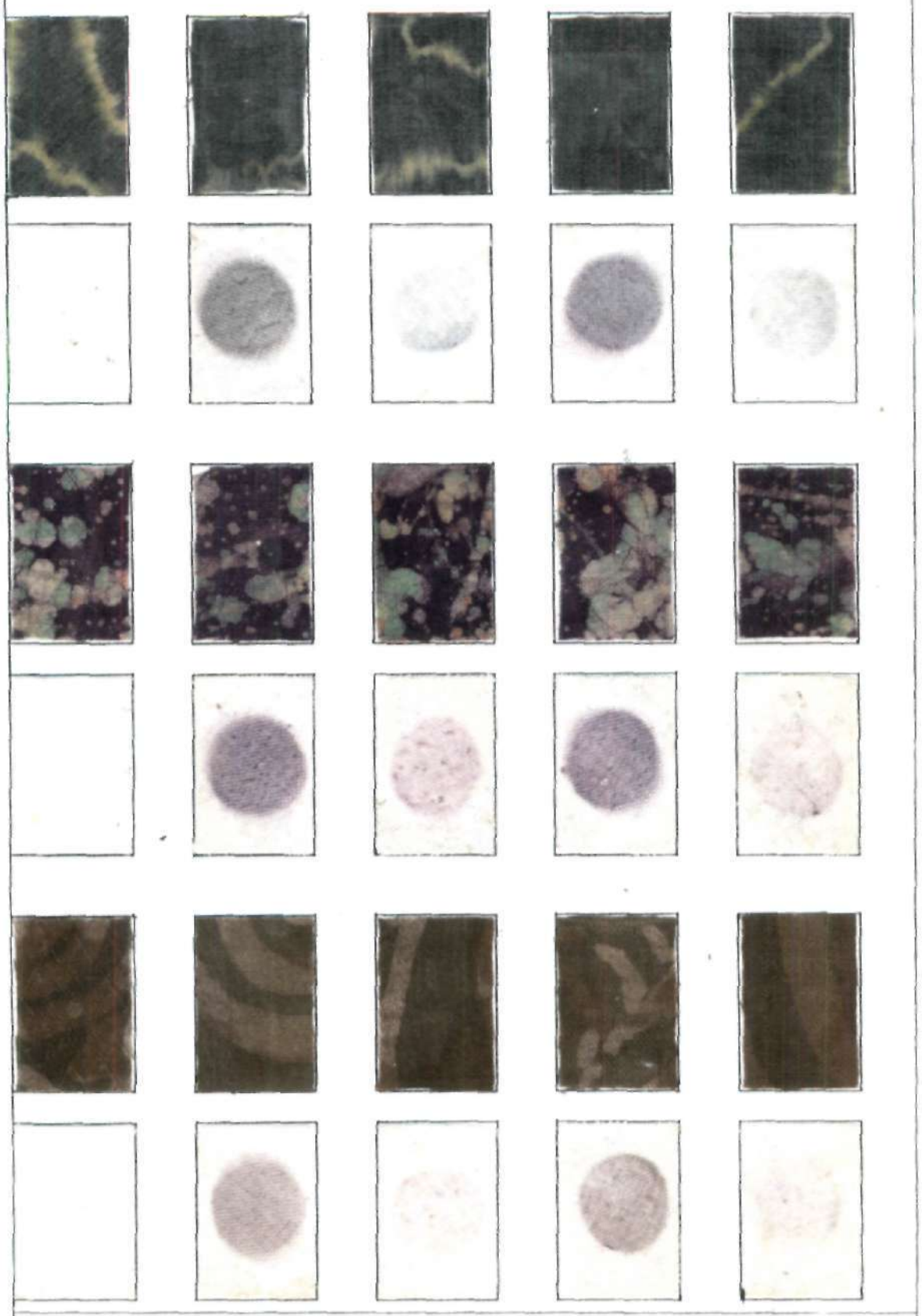


Plate 4.4: FABRICS COLOUR FASTNESS TO RUBBING

TIED/STITCHED SAMPLE		WAXED SAMPLE (BATIK)	
TECHNICAL FRONT	TECHNICAL BACK	TECHNICAL FRONT	TECHNICAL BACK

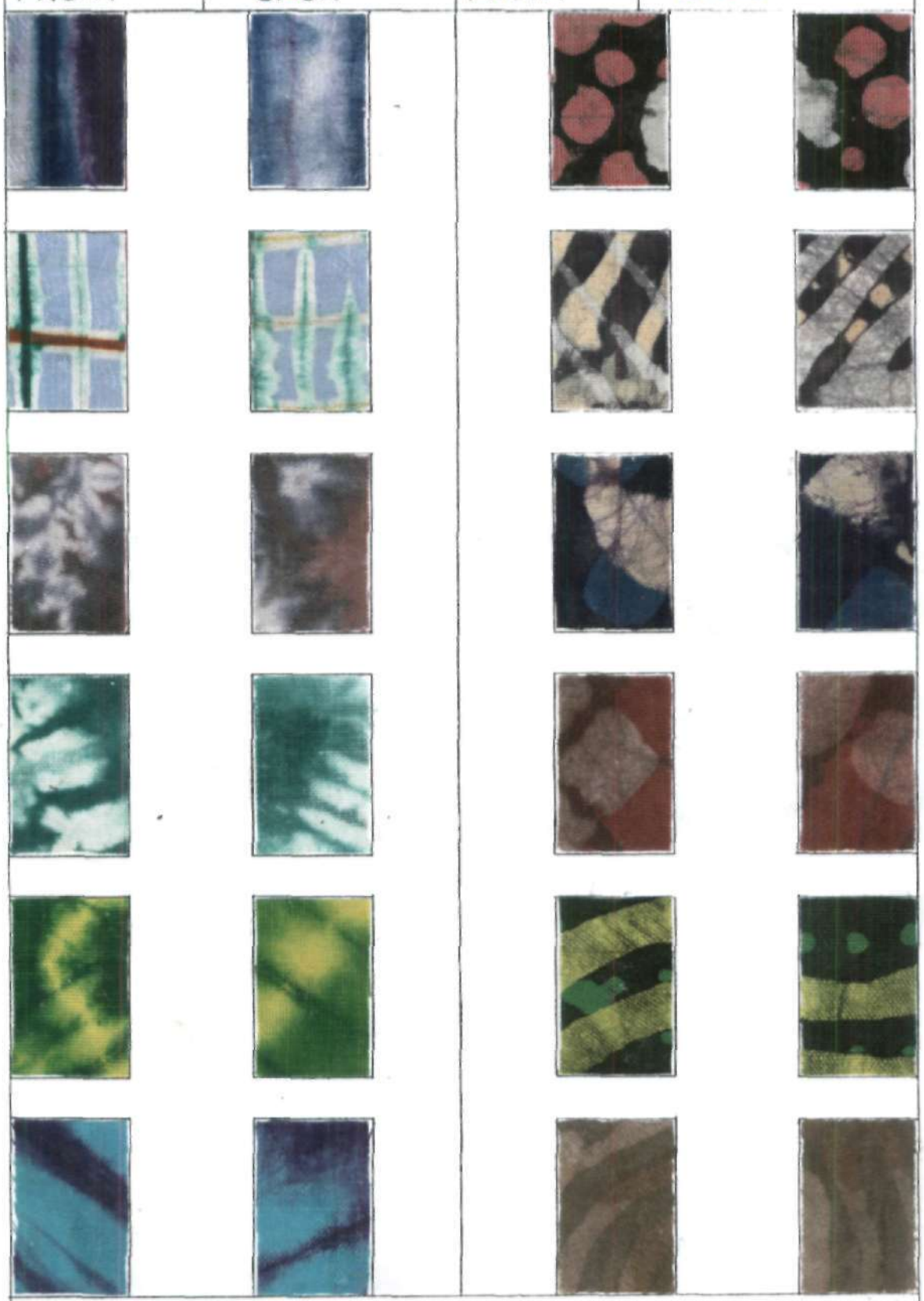


Plate 4.5 : DYE PENETRATION ON FABRIC SIDES

4.4.4 Colour fastness of fabrics to perspiration

The test to determine the colourfastness of pattern dyed fabrics to perspiration was carried out in the laboratory using the AATCC perspirometer (Plate 3.5) The results are presented in Table 4.5.

Out of all the samples treated in the acid solution, 2% left heavy stains (1-2) on the composite fabrics, 14% left noticeable stains (2/3- 3/4) while 84% left slight or negligible stains. In some cases (e.g. in sample 14, 18. 26 & 39,) a yellowing of the composite fabrics without visible stains from the colour of the fabric under tests were observed. As for the samples treated with the alkaline solution, 2% stained composite fabrics considerably (1-2), 12% stained composite fabrics noticeably 2/3-3/4) while 86% stained them slightly or negligibly (4-5). Most of the stains here were very faint and the colours observed did not usually correspond with that which is visible on the tested sample.

The change of colour of the samples after testing was minimal. Of the acid treated samples, 4% changed noticeably (3) while 96% showed slight or no change (4-5). Of the alkaline treated samples, noticeable change (3) took place in 2% while the remaining 98% exhibited only slight or no change. The changes which occurred affected the shades, intensities and hues of the fabrics in question. Change in shade occurred in samples 10, 17, 31, & 39 which become lighter, changes in intensity in sample 2, 23, 27, 40 (weaker) and 13 & 33 (brighter) and change in hue in samples 13, 21, 27, 35, & 46 which all became redder.

From the table, heavier stains were noted on the composite fabrics attached to acid treated samples than on the alkaline treated samples (Plate 4.6). There was no significant difference in the rate of bleeding or fading of fabrics cut warp way and those cut weftway.

Table 4.5: Result of fabric colour fastness to perspiration

Sample No	Grading of Stains[1]				Grading of Fadings[2]			
	Acid		Alkaline		Acid		Alkaline	
	A[3]	B[4]	A	B	A	B	A	B
1	5	5	5	5	5	5	5	5
2	4/5	5	4/5	5	4W	4W	5	4W
3	Red 4	Red 4	5	5	4	4	5	5
4	5	5	4/5	4/5	5	5	5	5
5	5	5	5	5	5	5	5	5
6	5	5	5	5	4D	4D	4D	4D
7	5	5	5	5	5	5	5	5
8	5	5	5	5	5	5	5	5
9	5	5	5	5	5	5	5	5
10	Tur. 3	Tur 3.	3/4	4	4	4	5	5
11	5	5	5	5	5	5	5	5
12	5	5	5	5	5	5	5	5
13	4/5	4/5	4/5	4/5	5R	5R	4Br	4Br
14	4	4/5	5	4	5	5	5	5
15	4/5	4/5	5	5	5	5	5	5
16	4/5	5	5	5	5	5	5	5
17	4/5	4	4/5	4/5	4	4	4	4
18	4/5	4/5	5	5	5	5	5	5
19	5	5	5	5	5	5	5	5
20	5	5	5	5	5	5	5	5
21	3/4	3/4	4	Purple 3	4R	4R	4R	4R
22	5	5	5	5	5	4R	4R	5
23	3/4	Black 3	4/5	4/5	4W	4W	5	5
24	5	5	5	5	5	5	5	5
25	5	5	5	5	5	5	5	5
26	4	4	4	5	5	5	5	5
27	Maroon	Maroon	2/3	2	3R	3R	4W	4W
28	5	5	5	5	5	5	5	5
29	4	4	4	4	5	4	5	5
30	4/5	4/5	4/5	4/5	5	5	5	5
31	3	4	4/5	3	4	4	4	4
32	Turq.3/4	Turq3/4	Turq.3/4	Turq.3/4	5	5	5	5
33	5	4/5	4	4/5	5Br	5Br	5Br	5Br
34	5	5	5	5	5	5	5	5
35	4	4	4/5	4/5	4R	4R	5	5
36	5	5	5	5	5	5	5	5
37	4/5	4/5	4/5	4/5	5	5	5	5
38	4	4	4/5	4/5	5	5	5	5

Table 4.5 (Continued)

39	4/5	4/5	4	4	5	5	4	4
40	4	4	4	4	4W	4W	4W	4W
41	4/5	4/5	5	5	5	5	5	5
42	5	5	5	5	5	5	5	5
43	5	5	5	5	5	5	5	5
44	4/5	4/5	4/5	4/5	5	5	5	5
45	5	5	5	5	5	5	5	5
46	Purple 3	Purple 2/3	3/4	3	3R	3R	3R	3R
47	4	4	3/4	3/4	5	5	5	5
48	5	5	5	5	5	5	5	5
49	4	4	4/5	4/5	5	5	5	5
50	3/4	3	4	4	5	5	5	5

[1]The staining scale was used for grading

[2]The grey scale was used

[3]Samples tested warpway

[4]Samples tested weftway.

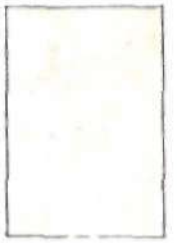
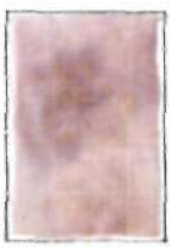
CONTROL SAMPLE	TESTED SAMPLE	ACID STAIN	ALKALINE STAIN
			
			
			
			
			

Plate 4.6 :FABRICS COLOUR FASTNESS TO PERSPIRATION

The NIS 51 : 75 (UDC 663.5) recommends a minimum rating of 4 (in both cases) in the scale 1-5 for piece dyed goods to qualify for the label 'fast to perspiration'. Therefore the tested fabrics can be said to posses a high degree of colourfastness to perspiration.

4.4.6 Colour fastness of fabrics to hot pressing

The result of tests carried out to determine the colour fastness of pattern dyed fabrics to hot pressing is presented in Table 4.6.

From the table, considerable degree of stains (1 - 2) were noticed on 4% of the composite fabrics hot pressed with samples in the damp state. Noticeable stains (2/3 - 3/4) on 10% while 86% had slight or negligible stains (4-5).

The degree of staining was lower in samples hot pressed in the dry state. Only 4% of the composite fabrics had noticeable stains (2/3 - 3/4) while all the remaining 96% had only slight or no staining.

Noticeable changes (3) occurred on the colours of 4% of fabric tested in the damp state, while slight or negligible changes (4-5) occurred on the remaining 96%. In samples hot-pressed in the dry state, noticeable changes of colour (3) occurred on 2% while slight or negligible change of colour (4-5) occurred on the remaining 98%. The changes were in form of change of shades, intensities or hues. Change of shade occurred on samples 5, 8 and 14 which became lighter, change of intensity on samples 2 (Duller) and 46 (weaker) and change of hue in samples 16, 17, 20, 28, 30, 32 (Bluer and samples 21 & 27 (Redder). However, when the samples were examined 4 hours after the hot pressing, their original hues were found to have been restored. Only samples 17 and 20 retained the new hue probably due to the presence of residual wax in them. The stains from these two samples were

Table 4.6: Test result of fabric colour fastness to hot - pressing

Sample No	Grading of Stains[1]				Gradings of fading[2]			
	Damp		Dry		Damp		Dry	
	A3	B4	A	B	A	B	A	B
1	5	5	5	5	5	5	5	5
2	5	5	5	5	3D	3D	4	5
3	4/5	4/5	5	5	5	5	5	5
4	4/5	4/5	5	5	5	4	5	4
5	5	5	5	5	4	4	4	4
6	4/5	4	5	5	4	4	5	5
7	5	5	5	5	5	5	5	5
8	5	5	5	5	4	4	4	4
9	5	5	5	5	5	5	5	5
10	5	5	5	5	4	4	4	4
11	5	5	5	5	5	5	5	5
12	5	5	5	5	4	4	5	5
13	5	5	5	5	5	5	5	5
14	4/5	4/5	5	5	5	5	5	5
15	4/5	4/5	5	5	5	5	5	5
16	5	5	5	5	5	5	5B	5B
17	5	5	3	3	5B	5B	5B	5B
18	5	5	5	5	4	4	5	5
19	5	5	5	5	5	5	5	5
20	3/4	3/4	2/3	2/3	5	5	5B	5B
21	5	5	5	5	4R	4R	5	5
22	5	5	5	5	5	5	5	5
23	5	5	5	5	5	5	5	5
24	5	5	5	5	5	5	5	5
25	5	5	5	5	5	5	5	5
26	5	5	5	5	5	5	5	5
27	2	2	5	5	4R	4R	5	5
28	5	5	5	5	5B	5B	5B	5B
29	5	5	5	5	5B	5B	5B	5B
30	Blue 3	Blue 3	5	5	5	5	5	5
31	Pink 3	Pink 3	5	5	5	5	5B (Green)	5B (Green)
32	4	4	5	5	5	5	5B (Green)	5B (Green)
33	4/5	4/5	5	5	5	5	5B (Green)	5B (Green)
34	5	5	5	5	5	5	5	5
35	2/3	2/3	5	5	5	5	5	5
36	5	5	5	5	5	5	5	5
37	4	4	4	4	5	5	5B (Purple)	5B (Purple)
38	4	4	5	5	5	5	5	5

Table 4.6 (Continued)

39	4/5	4/5	5	5	5	5	5	5
40	4	4	5	5	5	5	5	5
41	4/5	4/5	5	5	5	5	5	5
42	5	5	5	5	5	5	5	5
43	5	5	5	5	5	5	5	5
44	4/5	4/5	5	5	5	5	5	5
45	5	5	5	5	5	5	5	5
46	*Purple 2*	*Purple 2*	5	5	3W (purple)	3W (purple)	3W (purple	3W (purple)
47	4/5	4/5	5	5	5	5	5	5
48	4	4	5	4	5	5	5	5
49	4	4	5	4	5	5	5	5
50	Red3/4	Red 3	5	5	5	5	5	5

[1]The staining scale was used for grading

[2]The grey scale was used for grading

[3]Samples tested warpway

[4]Samples tested weftway

wax tinted with some greyish colour. This implies that fabrics which are dewaxed by ironing are better ironed apart to prevent staining.

The NIS 93 : 1983 (UDC : 677.06:535.6B) recommends that to qualify for the label 'fast to hot pressing', the change in colour and the staining of the adjacent white cotton cloth shall each be a minimum of 4 on the international grey scale. Considering the results presented in Table 4.6 therefore, it will be right to say that the pattern dyed fabrics possess excellent colour fastness when subjected to hot pressing both in the dry and damp state.

4.4.7 The crease recovery capability of fabrics

Tests to determine the ability of pattern dyed fabrics to recover from creases were carried out using the Shirley loading device and Shirley crease recovery tester (Plate 3.6). The results of the test are presented in Table 4.7.

The first column shows the recovery angles obtained in degrees per sample. The recovery angles are expressed as a percentage of 180^0 (the highest obtainable value) in the second column. The higher the percentage, the higher the fabric's rate of recovery from creases.

20% of the tested samples had relatively high recovery values (50% and above). These include samples 4, 8, 19, 29, 39, 40, 44, 47 and 48. The cotton polyester blends' recovery continued steadily during the stipulated recovery period (60 seconds). Heavily starched and beetled brocades (e.g. samples 10, 15, 26, 27, 32, 35, 46 and 49) recovered instantly upon the removal of the creasing load after which the rate of recovery became much slower giving relatively lower readings. Desized samples gave relatively higher readings than sized samples of identical fibre content and constructional details (e.g. samples 4 vs 19, 29 vs 36 etc.).

A slightly higher recovery rate was recorded in samples cut warpway than those cut weftway. We can infer from the results presented in Table 4.7,

Table 4.7: Result of fabric crease recovery test[1]

Sample No	Recovery angle (°)		Recovery angle (%)[1]	
	A[2]	B[3]	A	B
1	43	52	23.88	28.88
2	71	65	39.44	36.11
3	48	55	26.66	30.55
4	101	103	56.11	57.22
5	59	59	32.77	32.77
6	47	57	26.11	31.66
7	77	55	42.77	30.55
8	96	84	53.33	46.6
9	64	55	35.5	30.55
10	34	54	18.8	30
11	50	41	27.7	22.7
12	72	72	40	40
13	51	59	28.3	32.7
14	66	70	36.6	38.8
15	45	76	25	36.11
16	50	85	27.7	37.2
17	68	81	37.7	45
18	70	95	38.8	47.2
19	90	47	50	52.7
20	88	40	48.8	26.1
21	72	46	40	22.2
22	64	49	35.5	25.5
23	55	52	30.5	27.2
24	63	67	35	28.8
25	80	76	44.4	37.2
26	73	87	40.5	42.2
27	39	60	21.6	48.3
28	87	60	48.3	33.3
29	96	117	53.3	65
30	69	65	38.3	36.1
31	65	60	36.1	33.3

Table 4.7 (Continued)

32	62	55	34.4	30.5
33	80	65	44.4	36.1
34	62	75	34.4	41.6
35	53	61	29.4	33.8
36	78	65	43.3	36.1
37	58	79	32.3	43.8
38	73	92	40.5	51.1
39	93	101	51.55	56.1
40	84	96	46.6	53.3
41	60	67	33.3	37.2
42	64	71	35.5	39.4
43	74	72	41.1	40
44	94	99	52.2	55
45	87	102	48.33	65
46	89	84	49.4	56.6
47	73	104	40.5	57.7
48	108	117	60	65
49	59	77	32.7	42.7
50	82	86	45.5	47.7

[1]Recovery angle in percentage $= \frac{\theta}{180} \times 100$ where θ = the crease recovery angle

E.g crease recovery angle (in percentage) of sample one

$= \frac{43 \times 100}{180} = 23.88\%$

[2]Warpway direction
[3]Weftway direction

that the pattern dyed fabrics are generally produced from fabrics whose ability to recover from creases can be rated as medium. Hence, to maintain the appearance of dyed fabrics at their best, ironing after washing is highly recommended.

4.5 Evaluation of Fabric's Comfort Characteristics

4.5.1 The air permeability potentials of fabrics

Tests to determine the ability of fabric to allow the passage of air through it was carried out using the METEFEM air permeability tester (Plate 3.7). The results of the tests are presented in Table 4.8.

The table shows the readings obtained from the air permeability tester at varying pressure heads of water. The results indicate that all the tested fabrics possess a reasonable degree of air permeability ranging from 475 litres/hour to 8,000 liters/hour. As the standard for dress wear is 10mm water pressure (Adeniran, 1983) and the highest obtainable volume of air on the tester is 8,000 cm^3, the readings obtained from the test can be rated as ranging between medium and very high.

The highest air permeability value was exhibited by sample 27 which gave a reading of 8,000cm3 at 10mm water head, sample 27 is a guinea brocade fabric with a sett of 42 E/cm and 25 P/cm. The yarns are thin and the fabric was not starched. Sample 20 recorded the lowest air permeability by giving a reading of 475cm^3 at 10mm waterhead. Sample 20 is a blend of cotton and polyester which has a sett of 40 E/cm and 26 P/cm and was dewaxed by hot pressing. The table shows that for 8,000cm^3 of air to be passed through sample 20, the pressure head has to be increased gradually from 10mm to 40mm waterhead. Hence, the lesser the effort (represented by the water head) required, the higher the air permeability.

Table 4.8: Air permeability test results

Sample No	Pressure head of water (mm)							Remarks
	10	15	20	25	30	35	40	
1	7,950	-	-	-	-	-	-	Relatively low sett, S.I.E.P.[1]
2	3,500	5,150	6,815	8,000	-	-	-	
3	7,975	-	-	-	-	-	-	
4	2,700	3,850	6,100	8,000	-	-	-	Cotton/Polyester blend
5	3,675	5,475	7,100	8,000	-	-	-	
6	2,700	4,900	5,680	7,980	-	-	-	
7	5,880	8,000	-	-	-	-	-	
8	2,200	3,750	5,825	7,950	-	-	-	Cotton/Polyester blend
9	1,200	2,900	4,460	6,315	8,000	-	-	Extensively waxed
10	4,300	8,000	-	-	-	-	-	S. I. E. P.
11	720	1,960	3,100	4,865	6,350	7,125	8,000	High sett
12	6,140	8,000	-	-	-	-	-	
13	970	1,875	3,560	5,415	7,920	-	-	High sett
14	2,825	3,650	5,380	7,100	8,000	-	-	Baft
15	3,700	6,250	8,000	-	-	-	-	S.I.E.P.
16	6,525	8,000	-	-	-	-	-	Obtained Unstarched
17	530	1,120	3,000	4,140	5,351	6,260	8,000	Contains wax
18	2,950	4,560	6,080	7,900	-	-	-	
19	2,850	4,620	7,000	8,000	-	-	-	Cotton/Polyester blend
20	475	1,025	2,390	3,070	4,650	5,800	7,980	Cotton /Polyester blend
21	2,550	3,300	4,270	6,000	7,020	8,000	-	
22	720	1,580	3,600	5,020	6,275	7,900	-	High sett
23	800	2,100	4,350	6,225	8,000	-	-	
24	750	1,800	3,125	4,850	6,575	7,960	-	High sett
25	4,850	7,925	-	-	-	-	-	
26	3,500	6,200	8,000	-	-	-	-	

Table 4.8 (Continued)

27	8,000	-	-	-	-	-	-	S.I.E.P
28	2,575	4,880	5,870	7,250	8,000	-	-	Baft
29	6,700	8,000	-	-	-	-	-	
30	2,500	4,500	5,500	6,500	7,500	8,000	-	
31	6,960	8,000	-	-	-	-	-	
32	4,000	6,550	8,000	-	-	-	-	
33	7,850	-	-	-	-	-	-	S.I.E.P.
34	3,000	5,200	6,175	7,225	8,000	-	-	Baft
35	7,040	8,000	-	-	-	-	-	S.I.E.P.
36	4,800	8,000	-	-	-	-	-	
37	780	1,660	3,000	5,000	6,340	8,000	-	High sett
38	6,000	8,000	-	-	-	-	-	
39	850	2,020	4,350	6,540	8,000	-	-	
40	5,500	6,850	8,000	-	-	-	-	
41	3,460	5,950	8,000	-	-	-	-	
42	3,400	6,080	8,000	-	-	-	-	
43	820	1,675	2,900	3,780	6,825	8,000	-	
44	7,000	8,000	-	-	-	-	-	S.I.E.P.
45	6,850	8,000	-	-	-	-	-	
46	7,020	8,000	-	-	-	-	-	S.I.E.P.
47	4,080	6,575	8,000	-	-	-	-	
48	2,675	5,000	7,040	8,000	-	-	-	Polyester/cotton blend
49	6,800	8,000	-	-	-	-	-	S.I.E.P.
50	6,040	7,920	-	-	-	-	-	

[1]S. I. E. P. = Spaces inbetween ends and picks

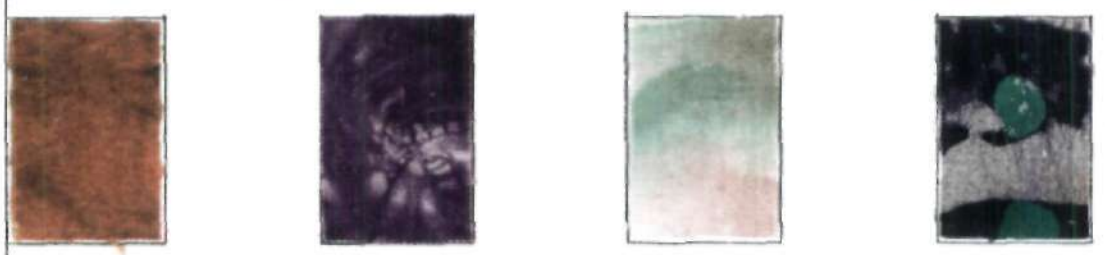
Fabrics which had close ranging numbers of warp and weft threads per centimetre (e.g. sample 21 - 30 E/cm, 30 P/cm, 9 - 27 E/cm, 22 P/cm etc.) were less permeable to air than those with a wider range in the number of their warp and weft threads (e.g. samples 10 - 50 E/cm; 30 P/cm, 3 - 52 E/cm; 14/Pcm). This is because close ranging number of warp and weft thread results most of the time, in fabrics with heavier weights and denser setts which were generally less permeable to air (e.g. samples 9, 11, 21. 24, 37, 22, 30, 43 etc.). This accounts for the relatively higher air permeability of the guinea brocade fabrics.

The polyester/cotton blends (e.g. samples 4, 8. 19, 20, 48) were less permeable to air probably due to their fine yarns, dense setts and relatively lower hydrophilic nature of polyester fibre. Unstarched or de-sized samples were found to be more permeable to air than the starched samples. This is due to the fact that when size is present on a fabric, it reduces or limits the spaces in between the yarns through which air and water can pass. Samples which were resisted by stitching had slightly higher permeability values due to the needle holes most of which were still visible on the fabric. On the other hand, fabrics resisted with wax, especially those dewaxed by ironing (e.g. samples 17 & 20) were found to be generally heavier in weight and possess relatively lower air permeability values. This is because wax is hardly ever completely removed from fabric whether by dewaxing in hot water or by ironing. During laundering therefore, the few leftover crumbs of wax get further crushed or melted and adhere more closely to the fibres thereby, hindering the passage of air or water.

On some of the guinea brocade samples, designs which resemble adaptations of basket weave were observed. These had looser structures which made the fabrics highly permeable to air (Plate 4.7). There was no significant difference in the air permeability values of either the wrong (Fabrics



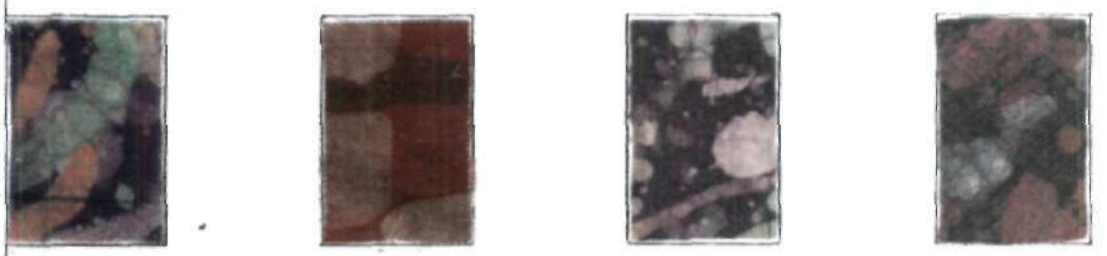
SPACES INBETWEEN ROWS OF ENDS AND PICKS



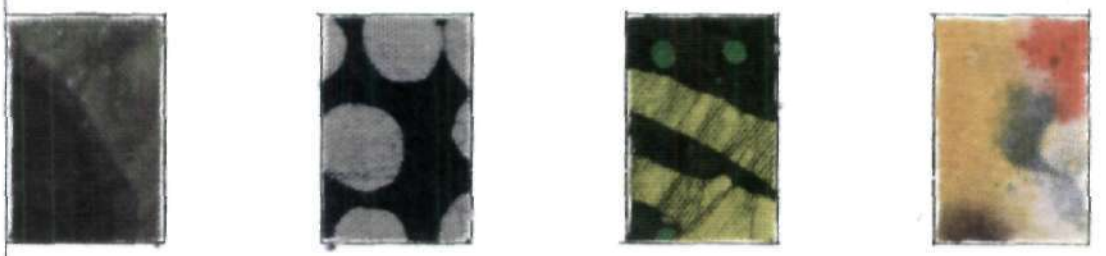
RELATIVELY HIGH SETT



RELATIVELY LOW SETT



DYE RESISTED WITH WAX



STARCHED WITH CASSAVA PASTE

Plate 4.7 :ASSORTED FABRIC STRUCTURES, TEXTURES AND FINISHES FOR AIR AND WATER PERMEABILITY TESTS.

technical back) or right (fabrics technical front) sides of the tested fabric. This is because of the simplicity of the types of weaves with which most of the samples were constructed which makes the front and back to be structurally identical. Also, no significant difference was observed in the values obtained by testing fabrics in either the warp of weft direction.

4.5.2. The water permeability potentials of fabrics

The water permeability test was carried out using the AATCC spray tester (Plate 3.8) The results of the test are presented in Table 4.9.

Of all the tested samples, 4% proved unwettable. These are samples 17 and 20. Their unwettable nature were as a result of residual wax which they contain. 30% of the samples had slight random wetting of their upper surfaces. 20% had their upper surfaces wetted at spray points. Another 20% had the whole of their upper surfaces partially wetted. Complete wetting of the whole upper surface was recorded in 16% while 8% had the whole of their upper and lower surfaces completely wetted after the spraying. It was observed that the samples with which complete wetting was achieved (samples 1, 10, 27 and 34) were all without size (usually starch) at the point of testing. Therefore, all the tested samples were desized and allowed to dry without ironing. Each of the samples were then retested one after the other. The results are presented in column B.

With the exception of two samples (samples 17 and 20) complete wetting of lower and upper surface was achieved with all the samples after the de-sizing process. This shows that size can act as a barrier to thorough wetting of fabrics. Furthermore, it was observed that agitation of the fabric (in the process of washing) produced creases which tended to increase the surface area of the fabric as well as rapid absorption of water.

Table 4.9: Result of water repellency tests

Sample No	Repellency rate (After 30 seconds)		Remarks
	A[1]	B[2]	
1	0	0	Relatively light weight, S.I.E.P.
2	90	0	
3	50	0	
4	90	0	Polyester/cotton blend
5	90	0	
6	90	0	
7	80	0	
8	90	0	Polyester/cotton blend
9	90	0	Baft
10	0	0	S.I.E.P.
11	90	0	
12	80	0	
13	90	0	
14	90	0	Baft
15	50	0	S.I.E.P.
16	50	0	
17	100	50	Contains wax
18	50	0	
19	90	0	Polyester/cotton blend
20	100	70	Polyester/cotton blend
21	70	0	
22	80	0	V. high sett
23	80	0	
24	50	0	High sett
25	70	0	
26	70	0	
27	0	0	
28	80	0	Baft
29	70	0	
30	50	0	
31	80	0	S.I.E.P.

Table 4.9 (Continued)

32	70	0	
33	90	0	S.I.E.P
34	0	0	Baft
35	90	0	S.I.E.P.
36	80	0	
37	90	0	High sett
38	80	0	
39	80	0	
40	90	0	
41	70	0	
42	70	0	
43	80	0	
44	50	0	S.I.E.P.
45	70	0	
46	70	0	S.I.E.P.
47	70	0	
48	90	0	Polyester/cotton blend
49	50	0	S.I.E.P.
50	70	0	

[1]Samples obtained sized or smoothened

[2]Samples desized and re-tested

[3]S.I.E.P. = Spaces inbetween ends and picks

During the spraying, samples with relatively coarse yarns and lower sett (e.g. sample 29) were seen to be more permeable to water - the water was seen to diffuse into the surrounding immediately on touching the fabric surface. On the other hand, water drops on hitting the surfaces of fabrics with thin yards and high sett (e.g. 11, 22, 24, 37) fall away immediately leaving little or none to stick to them.

The decorative parts (or space enclosing weaves) (Plate 4.7) on the guinea brocade were seen to be much more absorbent than the surrounding areas. This situation may lead to patchy dyeing if precautions are not taken.

In the cotton/polyester blends (samples 4, 8, 19, 20, 48), permeability of water was generally lower and the pattern of absorption was lineal.

There was no significant difference in the water permeability values of either the warp or weft fabric and likewise on either the wrong or right side of the fabric.

4.6 Evaluation of Fabric Durability Characteristics

4.6.1 The abrasion resistance properties of fabrics

The test to determine the abrasion resistance of fabrics was carried out using the TBJ universal wear tester (Plate 3.10) The results of the tests are presented in Table 4.10). On the tested samples, the abrasive action resulted in any one or a combination of the following; loss of colour (fading), folding, fuzzing out of surface fibres, hole formation and tearing (See Plate 4.8). All these resulted in loss of weight by all the tested samples which ranged between 0.02% and 4.24%. Loss of colour was observed on almost all samples notably 2, 5, 11, 14, 22, 24, 30 and 35. Folding occurred on samples 12, 1, 9 and 24. Though there was appreciable loss of weight (0.34 - 0.96%) in the polyester/cotton blend, tearing did not occur. Rather, there was fuzzing

Table 4.10:Result of abrasion resistance test

Sample No	Weight Loss/Minute (%)[1]		Remarks
	A[2]	B[3]	
1	0.68	2.90	
2	0.32	0.86	
3	1.52	1.65	
4	0.96	1.68	Cotton/Polyester blend
5	0.02	0.49	
6	0.88	0.88	
7	1.12	0.54	
8	0.50	1.50	Cotton/Polyester blend
9	0.62	0.10	
10	0.62	0.12	
11	0.08	1.32	
12	3.84	1.32	
13	0.86	1.48	
14	4.24	6.00	
15	0.67	0.91	
16	1.05	1.26	
17	0.24	0.57	
18	1.15	1.38	
19	0.82	1.10	Cotton/Polyester blend
20	0.47	0.75	Cotton/Polyester blend
21	0.38	0.43	
22	0.72	1.22	
23	0.54	0.59	
24	2.24	2.98	
25	0.58	0.53	
26	0.92	1.02	
27	3.77	3.94	
28	0.63	0.63	
29	1.41	1.56	
30	0.40	0.36	
31	0.85	0.99	

Table 4.10 (Continued)

32	0.89	1.08	
33	0.74	0.94	
34	0.46	0.73	
35	0.86	0.91	
36	0.39	0.52	
37	0.20	0.27	
38	1.03	1.09	
39	0.80	0.94	
40	0.54	0.81	
41	1.66	1.59	
42	1.35	1.41	
43	0.45	0.52	
44	0.38	0.49	
45	0.51	0.77	
46	0.89	0.98	
47	0.53	0.72	
48	0.34	0.32	Cotton/Polyester blend
49	1.40	1.51	
50	0.93	1.21	

$$\% \text{ Weight loss/minute} = \frac{X_1 - X_2}{X_3} \times 100$$

Where X_1 = Initial weight (gm)

X_2 = Weight after abrasion (gm) and

X_3 = Abrasion duration in minutes

2_A = Samples obtained sized and smoothened

3_B = Samples desized and retested

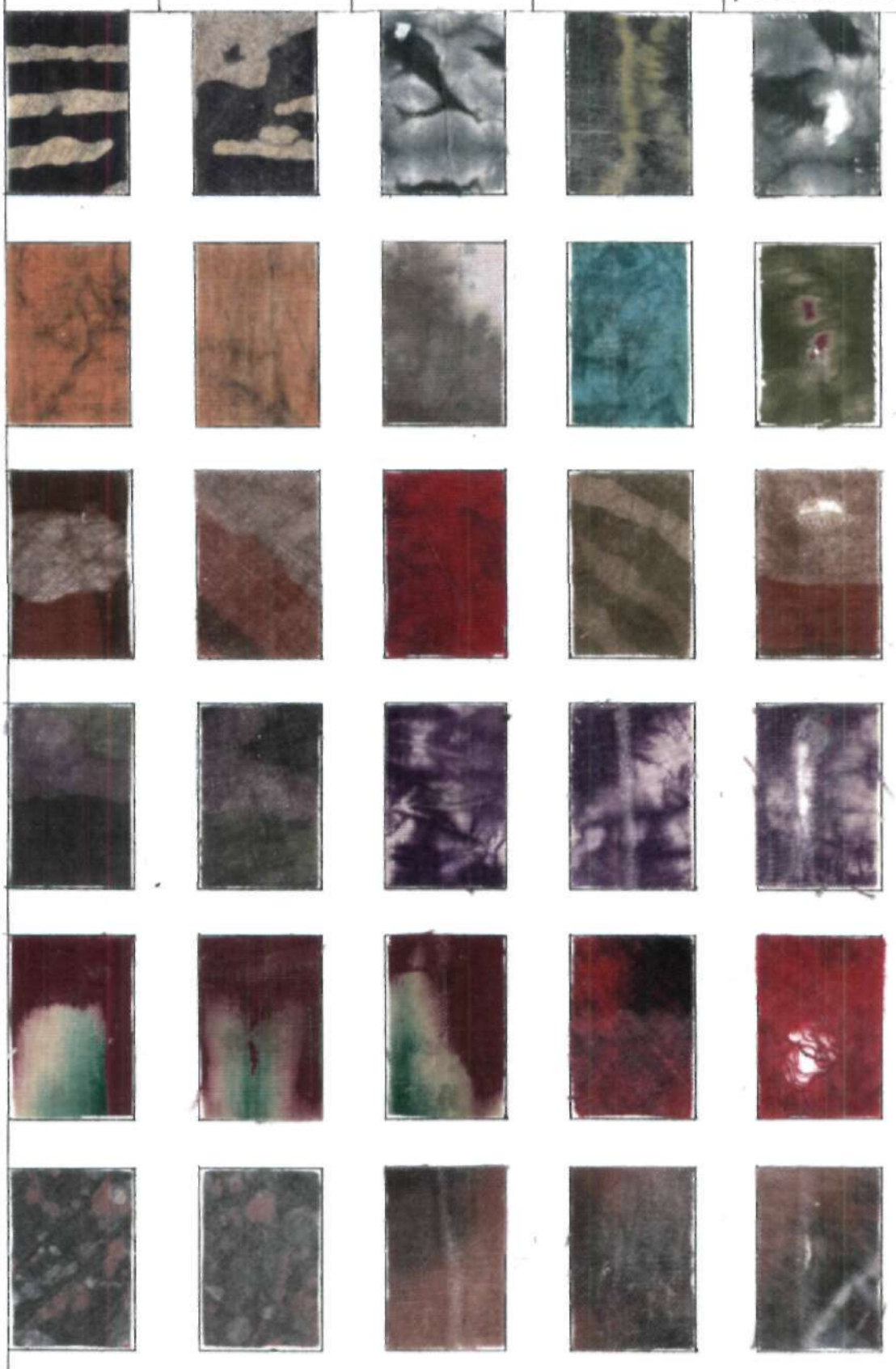


Plate 4.8 :EFFECTS OF ABRASION ON FABRICS.

out of fibres from the abraded areas. Fuzzing of fibres was also observed on other samples notably those with dense setts (e.g. samples 2, 6, 24, 14, 21, 10, 46 and 50). Loss of surface fibres occurred in samples 13, 25, 28, 30, 39 and 43. Formation of holes and/or tearing were noted on samples 1, 3, 7, 12, 14, 24, 35, 39, and 42.

Samples were desized and retested. The results are presented in column B of Table 4.10. The values obtained show that loss of weight ranged between 0.10% and 6%. The effect of abrasion was less glaring on samples 17 and 20. This may be ascribed to the fact that wax serves as a protective coating for textile fibres.

4.6.2 The dimensional stability properties of fabrics

The results of the test carried out to determine the dimensional stability *of pattern dyed fabrics are presented in Table* 4.11.

From the table, it is obvious that the changes in dimension were all in form of reduction in the original dimensions in the first column, the percentage rate of shrinkage ranged from -1 to -3%. The results obtained from agitating fabric samples during soaking are presented in the second column. Here, the percentage shrinkage ranged from -1 to -5%. The higher shrinkage rate may be due to the fact that agitation helps to ensure thorough wetting, which causes a swelling of the fibres. This in turn leads to the removal of size, which extends the fabrics beyond their original dimension.

On drying, some of the samples lost their shapes. This loss of shape was more pronounced in the guinea brocades (e.g. samples 1, 3, 6, 26, 32, 41 & 42) some of which became badly distorted in shape. Low shrinkage rate was observed in the polyester/cotton blends which were generally very stable in

Table 4.11:Result of fabric dimensional stability test

Sample No	Change in Dimension (%)[1]				Remarks
	Soaking - Agitation		Soaking + Agitation		
	A[2]	B[3]	A	B	
1	-0	-1	-1	-2	M.D[4]
2	-2	-1	-3	-1	F.S[5]
3	-1	-1	-1	-1	M.D
4	-0	-0	-2	-1	V.S[6]
5	-0	-0	-2	-6	D[7]
6	-2	-1	-5	-3	M.D
7	-0	-1	-4	-2	F.S
8	-0	-3	-0	-3	V.S
9	-1	-1	-2	-3	S[8]
10	-0	-1	-1	-2	S.D[9]
11	-1	-1	-1	-2	F.S
12	-2	-1	-1	-2	S.D
13	-2	-1	-0	-1	S
14	-1	-2	-2	-3	
15	-1	-0	-2	-0	
16	-1	-1	-2	-1	
17	-2	-0	-4	-3	F.S
18	-1	-0	-2	-1	
19	-0	-0	-1	-1	V.S
20	-1	-0	-2	-0	
21	-0	-0	-1	-0	
22	-0	-1	-2	-0	F.S
23	-1	-0	-2	-3	S
24	-2	-1	-2	-0	V.S
25	-0	-0	-0	-0	S
26	-2	-0	-1	-0	D
27	-3	-2	-2	-2	F.S
28	-1	-2	-3	-3	
29	-2	-1	-3	-2	
30	-0	-0	-1	-0	

Table 4.11 (Continued)

31	-0	-1	-1	-4	S.D
32	-1	-0	-4	-2	S.D
33	-3	-1	-4	-3	S.D
34	-1	-1	-2	-2	F.S
35	-0	-0	-2	-4	
36	-1	-2	-2	-2	
37	-2	-1	-2	-2	S
38	-2	-2	-4	-2	S.D
39	-2	-0	-2	-2	
40	-2	-2	-4	-1	
41	-3	-1	-2	-3	
42	-2	-2	-3	-3	
43	-1	-1	-1	-4	
44	-1	-0	-2	-2	
45	-2	-2	-4	-1	
46	-2	-2	-2	-3	
47	-1	-2	-2	-2	
48	-0	-1	-0	-2	V.S
49	-3	-2	-4	-1	
50	-1	-0	-2	-3	

[1] + = Increase in dimension
- = Decrease in dimension
[2]Measurements taken warpway
[3]Measurements taken weftway
[4]Much Distortion
[5]Fairly stable
[6]Very stable
[7]Distortion
[8]Stable
[9]Slight distortion

size and shape. A good number of plain woven cotton samples were also fairly stable in size and shape.

Fabrics with looser structures (e.g. 1, 3, 15, 27 etc.) were generally more susceptible to shrinking. While those with denser setts shrank less. This is due to the fact that wetting leads to swelling and the contraction or shrinking of textile fibres as the humidity lowers. This contraction is more severe when there are gaps in between yarns. This is the reason why most light-weight guinea brocade fabrics of today shrink very badly after the first washing.

4.6.3 The tensile strength of fabrics

The test to determine the tensile strength of pattern dyed fabrics was carried out using the ballistic tear tester (Plate 3.11). The results of the test are presented in Table 4.12.

The effort required to rip apart a fabric 60 x 5cm in dimension are presented in columns A and B with A representing the warpway fabrics and B representing the weftway fabrics. The greater the effort recorded (in kilograms), the tougher the fabric.

Greater extensibility or elasticity was exhibited in the weft direction of most of the plain woven fabrics. This may be attributed to the fact that the percentage crimp is higher in this direction. However, the readings on the table depict the weft threads as generally having lower tensile strength than the warp threads. This is probably due to the fact that the weft yarns are often irregular in shape and length (verified by visual examination) Hence, rupturing will occur more easily here than in the warp threads which are generally finer, stronger and more regular in shape and dimension.

Table 4.12: Result of fabric tensile strength test

Sample No	Effort of Pendulum Bob (Kg)[1] A[2]	B[3]	Remarks
1	26.3	12.3	
2	31.3	31.8	
3	34.9	10.9	
4	49.9	30.9	Polyester/Cotton Blend
5	25.9	36.3	
6	29.9	18.6	
7	29	25.9	
8	35.8	36.3	Polyester/Cotton Blend
9	45.4	32.2	
10	39.5	23.1	
11	32.7	35.8	
12	29.5	37.2	
13	32.7	33.1	
14	42.6	25	
15	34.9	23.6	
16	26.8	39	
17	29.5	33.1	
18	33.6	35.4	
19	43.1	48.5	Polyester / Cotton Blend
20	42.2	44.9	"
21	40.4	31.8	
22	17.7	21.2	
23	25	37.2	
24	34.9	28.6	
25	32.2	46.3	
26	30.4	20.9	
27	28.1	13.6	
28	39	23.1	
29	30.9	27.2	
30	39.5	33.1	
31	36.7	24	

Table 4.12 (Continued)

32	35.4	22.2	
33	39.5	27.2	
34	45.8	31.3	
35	36.7	30.9	
36	29.5	38.6	
37	33.1	34.9	
38	27.2	28.6	
39	32.2	33.6	
40	33.6	36.7	
41	25.4	28.1	
42	37.7	20.4	
43	35.8	28.1	
44	30.9	31.8	
45	36.3	24.5	
46	34	25.9	
47	41.3	28.1	
48	28.6	44	Polyester/Cotton Blend
49	28.6	21.8	
50	33.6	23.1	

[1]Coverted to kilograms from pounds (1 pound = 0.4536 kg)

[2]Warpway direction

[3]Weftway direction

A high degree of extensibility otherwise called tensile strength gives cloths the ability to withstand varying degrees of tension without rupturing/tearing. In the plain woven (baft) fabric samples, much greater elasticity was exhibited by the warp threads. The highest degrees of tensile strength were exhibited by the cotton/polyester blends (samples 4, 8, 19, 20, 48). This is due to the relatively tougher and stronger nature of polyester fibre. Furthermore, the plain woven fabrics were found to possess higher tensile strength than the guinea brocade weaves. Low tensile strength was found on guinea brocade fabrics which had the loose structured designs. In these cases, tearing often began from the spaces in between rows of yarns.

4.7 Summary

The basic knowledge necessary to be able to select, use and understand present day fabrics correctly can only be acquired by deliberate study. The field study yielded useful information which served as clues for the researcher to adjust the research questions; and base the laboratory work on. A scientific analytical approach to the problem helps to verify the earlier gathered information and reveal much more than are presently known as this chapter has shown. The information provided by the data in this chapter will form the basis for the conclusion of the study.

CHAPTER 5
SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

Having discussed in detail the data obtained for the study in the previous chapter, a summary here will facilitate comprehension. The inferences drawn from the data (research findings) served as the basis for drawing the conclusions for the study. The problems encountered during the study were also identified and described. Finally, recommendations that require action by those concerned as well as those for future research were put forward in this chapter.

5.2 Summary of Findings

Raw material input: The pattern dyeing industry is one of the major consumers of the factory produced cotton fabrics of Nigeria. Cotton fabrics of different lengths, breadths, weights, setts, weaves and finishes are the most common in use for pattern dyeing. Fabrics with different fibre compositions e.g. viscose rayon and polyester/cotton fabrics are used less commonly. Synthetic vat dyes remain the most available and most popular in use among the dyers of patterned fabrics. The resist agents in use are candlewax, microcrystalline wax, beeswax, cassava starch, raffia strings, crocheting threads and so forth. The equipment used for imparting resist are wooden stamps, synthetic foams, tjantings, zinc stencils and needles among others. The receptacles used for dyeing are earthenware pots, galvanised metal drums and rubber plastics.

The techniques and procedures of pattern making and dyeing: Resist techniques remain in form of tie and dye, cassava starch application

wax application as it has been for the past few decades. Slight modifications which took place affected only the patterns which are now less elaborate and faster to complete. A contemporary development in the craft is the discharge dyeing which produces some distinct and bright patterns. It was found out that very few dyers wash their fabrics prior to resist application or immersion in dye. No identical standard of measurement was found to be in use among the dyers. The fabrics were finished mainly by applying cassava starch and beetling.

The question of quality: Both the makers and users of adire were aware of most of the properties of which can affect the beauty, comfort and durability performance of the pattern dyed fabrics either negatively or positively. Colour fastness and shrinkage were named as the most problematic. The users mentioned that the other aspects in which performance has been very satisfactory is in the draping properties and abrasion resistance. They felt satisfied with the comfort (air and water permeability) performance of the fabric and rated their tensile strength as fairly good.

Findings from the laboratory work: The results of tests carried out in the laboratory confirmed most of the information obtained from the field, though in varying degrees. For instance, colour fastness tests revealed the fact that heavy bleeding or crocking may occur during washing or rubbing. However, this loss of colour did not lead automatically to fading of the tested fabrics as feared by most users. All the tested samples had very good colour fastness to light and hot pressing, good colour fastness to washing and perspiration and fairly good colour fastness to rubbing. The crease recovery characteristics of the fabrics were generally poor except in the polyester/cotton blends. The fabrics have good water and air permeability. Results show all

the fabrics are susceptible to abrasion which resulted in loss of weight and either fading, folding, fuzzing, or loss of surface fibres, tearing or hole formation. The tensile strength can be considered good when compared with fabrics of similar fibre content and construction pattern.

The relationship between the quality and/or manipulation of raw materials and fabric performance: Indeed, the study helped to confirm the fact that the nature or quality of raw materials or the way they are manipulated or both have an impact on fabric performance. It is obvious from the results that fabric setts and the type of resist used affected their water and air permeability, abrasion resistance, dimensional stability and tensile strength. Size (cassava starch in the case of the pattern dyers) is applied to fabric to impart strength, fullness, stiffness and gloss. Results show that starched fabrics were more resistant to abrasion and distortion. On the other hand, higher water and air permeability as well as crease recovery were recorded when fabrics were desized. When colour is used in excess of a fabric's requirement during dyeing, it leads to heavy bleeding or crocking when the fabric comes in contact with water or another fabric. Heavier crocking was exhibited by fabrics which had most of their colours concentrated on the surface and not penetrating right through to their backs. This situation was common in fabrics which were folded or pleated prior to tying or stitching.

The impact of the SON on the pattern dyeing industry: Investigation reveals that at present, there is no contact between the SON and the pattern dyeing industry (among other small scale industries) in Nigeria. As a result, most of the dyers are not aware of the existence of the organisation let alone feel the impact.

5.3 Conclusion

The following are the main conclusions drawn from the work although certain conclusions have been made in the preceeding chapter.

1. The pattern dyeing craft is raw material intensive. The raw materials are all locally available in assorted qualities, compositions, constructional patterns, packaging and finishes.

2. The techniques of pattern making and dyeing remain the same over the years with only slight modifications taking place in the design details and dyeing procedure.

3. The practice of division of labour has aided specialisation in the different aspects of the craft. However, some dyeing sheds have not been given attention to quality output. Emphasis is often placed on mass production of the design in vogue. As Nigerians like to keep up with what is in vogue, these artists go ahead to produce cheap, low quality fabrics which are soon replaced by another in vogue.

4. The laboratory tests confirmed most of the data obtained from the field to be valid. It can be concluded from the results of this study, that the pattern dyed fabrics of small scale dyeing industries in Nigeria have characteristics which make them most suitable for apparel wears. Furthermore, the variations in the raw materials as well as production techniques used give them the potentials of being used for furnishing and many more end uses than are presently known.

5. The nature or quality of raw materials can affect fabric performance in several ways some of which are presented below:

- Most fabrics with low sett have good air permeability which enhances oxidation after dyeing and provide comfort for wearers.
- Pure cotton fabrics are easily wetted. This enhances dye liquor penetration while dyeing and also makes it a comfortable wear in the tropics.
- Vat dyes possess outstanding colour fastness to light and hot pressing as well as to other agencies of wear and when used in the correct proportion and procedure on cotton fabrics, the result is reliable.
- Size (or starch) is as useful as it can be troublesome. A knowledge of its effective manipulation is essential.
- Fabrics which have been stretched and sized during manufacture shrink badly when dyed and when washed.
- Wax can effectively serve as a fabric filler, water and air repeller, fabric stabiliser and as a abrasion resister.

In the same vein, the techniques or procedures of raw materials manipulation also affect fabric performance in various ways. Some of these are:

- Dyes and chemicals are not blended in the right proportion and this gives rise to bleeding and fading.
- Fabrics are not desized to make them more absorbent and pre-shrink them prior to dyeing. This prevents thorough penetration of dye into the fibres and leads to bleeding and drastic shrinkage when washed by the buyer.
- Dyed fabrics are often not thoroughly rinsed for fear that the appearance will change. This leads to bleeding and crocking which stain other fabrics.

The SON has not made any impact on the craft. There is no free flow of technical information among the dyers. A lot of unemployed youths have suddenly become dyers without acquiring the necessary skills. Furthermore, a good number of apprentices are turned out half-baked as a result of their trainers keeping some 'trade secrets' to themselves. The ignorance of these category of dyers as well as financial constraints often have negative effect on the quality of their outputs. The non-availability of standards for measuring dyeing ingredients among the dyers is a major cause of variations in the finished products. Similarly, the sale of dyestuff and chemicals without instruction bearing labels contributes largely to most of the faulty dyeing which do occur.

Based on all the previous discussions, it can be concluded that the pattern dyed fabrics of Nigeria can withstand competition from most contemporary fabrics with identical construction patterns and decoration procedures. The defects detected are not peculiar to Nigerian patterns dyed fabrics but to other foreign patterned fabrics which are the favourite of the Nigerian populace. As much of the defective properties of the fabrics as can be remedied by the Nigerian craftsmen will be mentioned in the recommendations of the study. Other defects have to do with the nature or quality of the raw materials used and these can actually be manipulated and used to an advantage.

5.4 Problems Encountered During the Research

The problems encountered during the research are highlighted below:

Financial Constraint: Most phases of the research could not be promptly accomplished at the pre-planned period due to financial constraints on the part of the researcher.

Acquisition of samples: The fabric samples obtained from tailors' shops or offered by some of the dyers were often too small for testing purposes. Therefore, virtually all the samples used had to be bought in spite of the fact that the smallest unit available for sale was 945cm (2 yards) long. This put a big financial strain on the researcher.

Furthermore, the sellers sometimes insist on selling a whole unit (sometimes 5 or 4 yards) and nothing less, of a fabric which the researcher considers necessary for inclusion among the samples to be tested. On some occasions, this situation forced the researcher to buy longer lengths of fabric than were needed, consequently, reducing the chance of obtaining a variety of other samples.

Non-co-operation by some potential interviewees:- Not all the craftsmen whom the researcher attempted to interview were co-operative. In addition, some of those who initially co-operated became uncomfortable the moment the question of pattern making or dyeing procedures was raised. In some dyeing sheds the researcher was specifically debarred from asking any question on quality or taking photographs of production activities. All these events happened in spite of the fact that the researcher presented a letter of introduction from the department on arrival at every shed and released some amount of money wherever the demand was made.

On the other hand, there was positive response from most of the youngsters who are just beginners in the craft. However, nothing much was seen to be of documentary significance from this group of people. Hence, the researcher had no option than to keep on 'disturbing' the older dyers who were predominantly women.

5.5 Recommendations

1. Both textile design students and professionals should focus their attention not only designing, but on such researchers as will help improve the quality of their products and enhance wider acceptability.
2. Dyers of patterned fabrics should pay particular attention to the colour fastness of fabrics. They can achieve this by;
   - Washing the fabric prior to dyeing
   - Blending the dyes and chemicals in the correct proportion
   - Dyeing at the correct temperature and agitating the fabric as required.
3. Dyers should form co-operative societies whose aim will be to provide financial assistance to members, projects the image of the craft through exhibitions, advertisements and sponsoring of researches relevant to their field. Furthermore, dyers should co-operate with researchers in the field whenever their helps are needed.
4. There is need to ensure that our textile laboratories are adequately equipped and staffed. The staff should be well trained to ensure continuity of knowledge. The universities authorities, the staff and students should ensure careful handling, adequate maintenance and prompt replacement (when necessary) of textile testing equipment.
5. Universities as centres of academic excellence should establish well-equipped testing laboratories, to save researchers from going for testing in Polytechnics.
6. Sponsorship should be granted to students carrying out research on quality control as testing is both expensive and laborious.
7. The SON can do a lot to raise the pattern dyed fabrics of Nigeria to a higher standard than it has at present. Some of the possible ways are by:

- Mounting an enlightenment campaign through the mass media to bridge the gap between the SON and the small scale dyeing industries.
- Collecting random samples from the open stalls in the market for testing and analysis.
- Organising extension services which will make small scale entrepreneurs quality conscious and help them to keep up with current trends in their profession.
- Compelling the retailers of dyestuff to provide adequate information on labels which should be placed on the dyestuff containers prior to sale. This will prevent some of the faulty dyeing which result from inadequate instruction. Likewise, the same should be done for the reducing agent (sodium hydrosulphite) and caustic soda to be used in dyeing.

5.6 Recommendations For Further Research

1. The result of this study should be used in a future research to explore the possibility of adapting pattern dyed fabrics to much more varied end uses than are presently known.
2. Discharge dyeing: Research into the limitations and possibilities of products of discharge dyeing should be conducted.
3. Crayon batik - an aspect of pattern dyeing which is both cost and energy saving should be explored for contemporary production and consumption.
4. Ethnographic study of Pattern Dyeing is desirable.
5. Apprenticeship system of professional Dyers should be examined.

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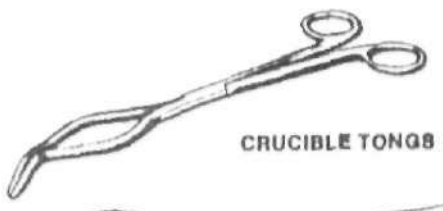
Laboratory Equipment Most Often Employed in Textile Laboratory Experiments.



STIRRING ROD



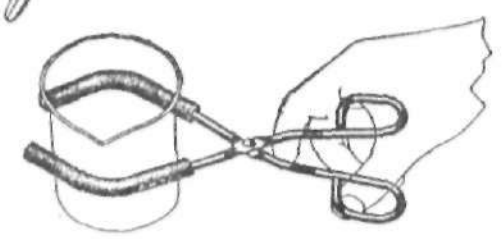
SPATULA Stainless Steel,



CRUCIBLE TONGS



Wire Gauzes



BEAKER TONGS



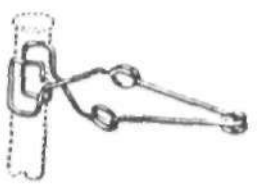
BURNER, Bunsen,



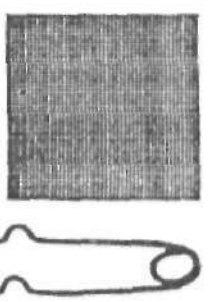
PIPETS



TEST TUBE



CLAMP, Test Tube,



Gas Lighter



BEAKER



CYLINDERS, Graduated,



BRUSH, Test Tube.



BURET



TRIPOD



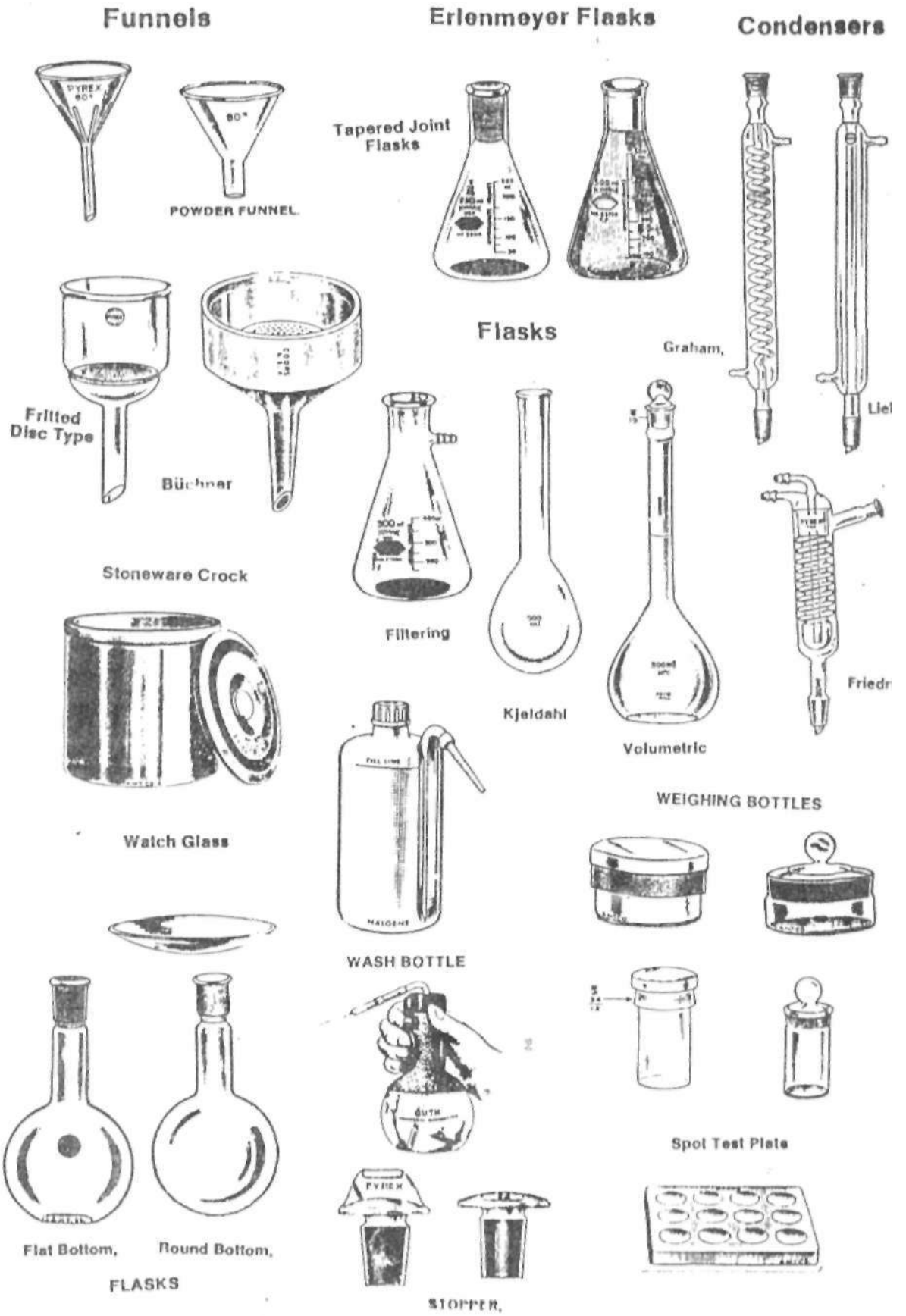
Dye Pot

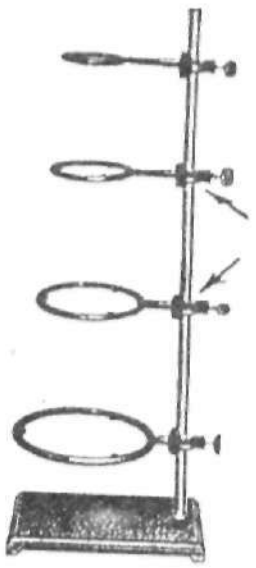


Tall Form,



Disposable Aluminum Dishes,


Funnels
Erlenmeyer Flasks
Condensers
POWDER FUNNEL
Tapered Joint Flasks
Flasks
Graham,
Fritted Disc Type
Büchner
Stoneware Crock
Filtering
Kjeldahl
Volumetric
Watch Glass
WEIGHING BOTTLES
WASH BOTTLE
Spot Test Plate
Flat Bottom,
Round Bottom,
FLASKS
STOPPER,



Support Stand

Tubing Clamps





Evaporating Dish

SUPPORT RINGS



Fritted Glass Thimbles



Laboratory Bottles



Reagent,



Dropping,



Narrow Mouth



Wide Mouth,

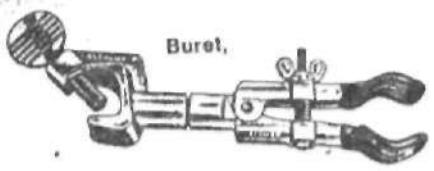


Aspirator,

Clamps



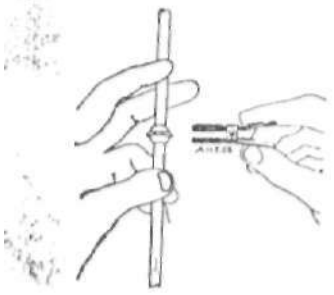
Extension,



Buret,

Pinch Clamps

- For ball-and-socket or O-ring glass joints
- In universal use for quick, convenient and safe mounting and dismantling of apparatus



2841-A05

Fig. 1. Showing method of attaching to joint. Parts held securely by spring upon release of finger pressure.



MORTAR AND PESTLE,



DRYING TUBE



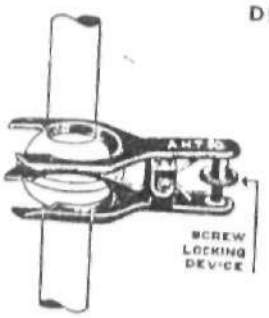
Addition



Squibb



HYDROMETER



Separatory Funnels



FORCEPS



SHEARS-



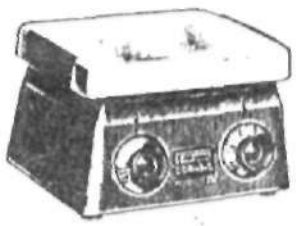
Dropping Pipet



ASBESTOS GLOVES



GLOVES, Polyethylene, Disposable,



Stirrer-Hot Plate

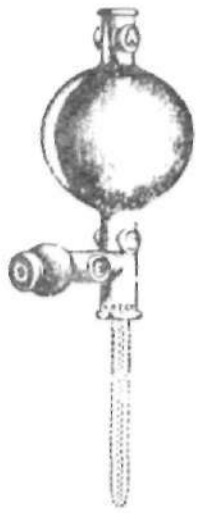


Safety Goggles



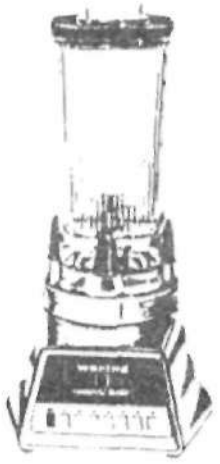
PIPET FILLERS

For toxic, corrosive, or noxious samples

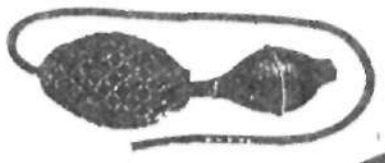




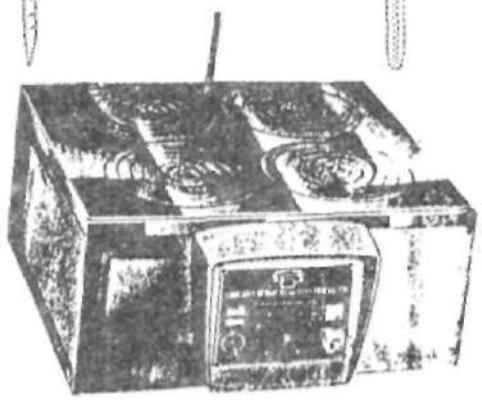
Hot Air Blower



Waring Blendor



RUBBER BULB



CONSTANT TEMPERATURE BATH

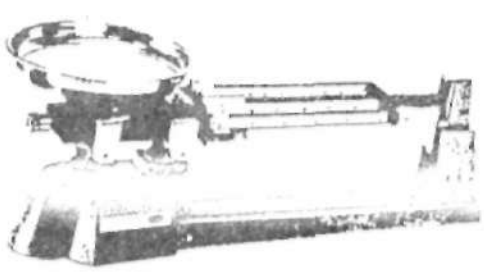


CLOCK

INTERVAL TIMER,

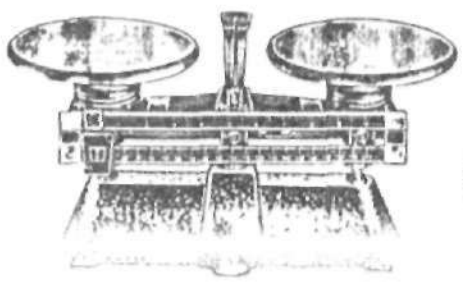


CENTRIFUGE

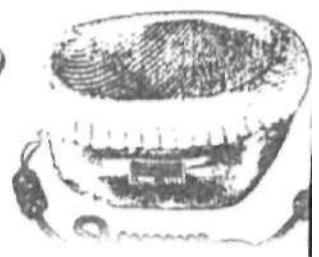


Triple Beam,

Balances



Solution,



HEATING MANTLE

AIR PERMEABILITY

(Calculated values of air permeability, A.P[1])

Sample No	10	15	20	25	30	35	40
1.	66.3	-	-	-	-	-	-
2.	29.2	42.9	56.8	66.7	-	-	-
3.	66.5	-	-	-	-	-	-
4.	22.5	32.1	50.8	66.7	-	-	-
5.	30.6	45.6	59.1	66.7	-	-	-
6.	22.5	40.8	47.3	66.5	-	-	-
7	49	66.7	-	-	-	-	-
8.	18.3	31.3	48.5	66.3	-	-	-
9.	10	24.2	37.2	52.6	66.7	-	-
10.	35.8	66.7	-	-	-	-	-
11.	6	16.3	25.8	40.5	52.9	59.4	66.7
12.	51.2	66.7	-	-	-	-	-
13.	8.8	15.6	29.6	45.1	66	-	-
14.	23.5	30.4	44.8	59.2	66.7	-	-
15.	30.8	52.1	66.7	-	-	-	-
16	54.4	66.7	-	-	-	-	-
17	4.42	9.33	25	34.5	44.6	52.3	66.7
18.	24.8	38	50.7	65.8	-	-	-
19.	23.8	38.3	58.3	66.7	-	-	-
20.	3.96	8.54	19.9	25.6	38.8	48.3	66.5
21	21.3	27.5	35.6	50	58.5	66.5	-
22.	6	13.2	30	41.8	52.3	65.5	-
23.	6.66	1.75	36.3	51.9	66.7	-	-
24.	6.25	15	26	40.4	54.8	66.3	-
25.	40.4	66	-	-	-	-	-

I63

26.	29.2	51.7	66.6	-	-	-	-
27.	66.6	-	-	-	-	-	-
28.	21.5	40.7	48.9	60.4	66.7	-	-
29.	55.8	66.7	-	-	-	-	-
30.	20.8	37.5	45.8	51.2	62.5	66.7	-
31.	58	66.7	-	-	-	-	-
32.	33.3	54.6	66.7	-	-	-	-
33.	65.4	-	-	-	-	-	-
34.	35	43.3	51.5	60.2	66.7	-	-
35.	58.7	66.7	-	-	-	-	-
36.	40	66.7	-	-	-	-	-
37.	6.5	13.8	25	41.7	52.8	66.7	-
38.	50	66.7	-	-	-	-	-
39	7.1	16.8	36.3	54.5	66.7	-	-
40.	45.8	51.1	66.7	-	-	-	-
41.	28.8	49.6	66.7	-	-	-	-
42.	28.3	50.7	66.7	-	-	-	-
43.	6.83	14	24.2	31.5	48.5	66.6	-
44.	58.3	66.7	-	-	-	-	-
45.	57.1	66.7	-	-	-	-	-
46.	58.5	66.7	-	-	-	-	-
47.	34	54.8	66.7	-	-	-	-
48.	22.3	41.7	58.7	66.7	-	-	-
49.	56.7	66.7	-	-	-	-	-
50.3	66	-	-	-	-	-	-

$^{1}AP = \frac{\text{Flow rate}}{\text{Tested area } (\pi r^2)}$ $cm^3/s/cm/cm^2$

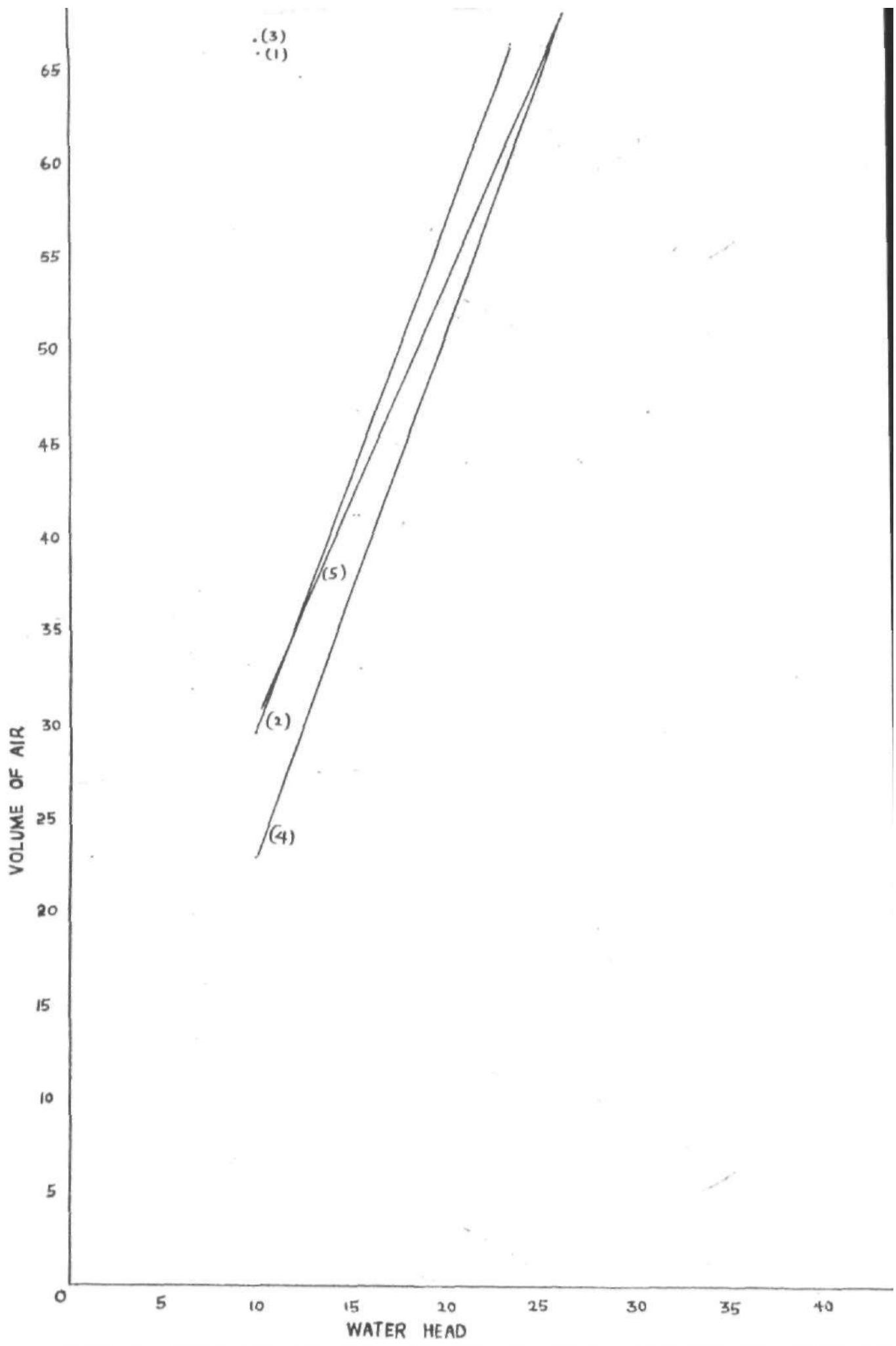


FIG. 1: PLOT OF VOLUME OF AIR AGAINST PRESSURE AT WATER HEA

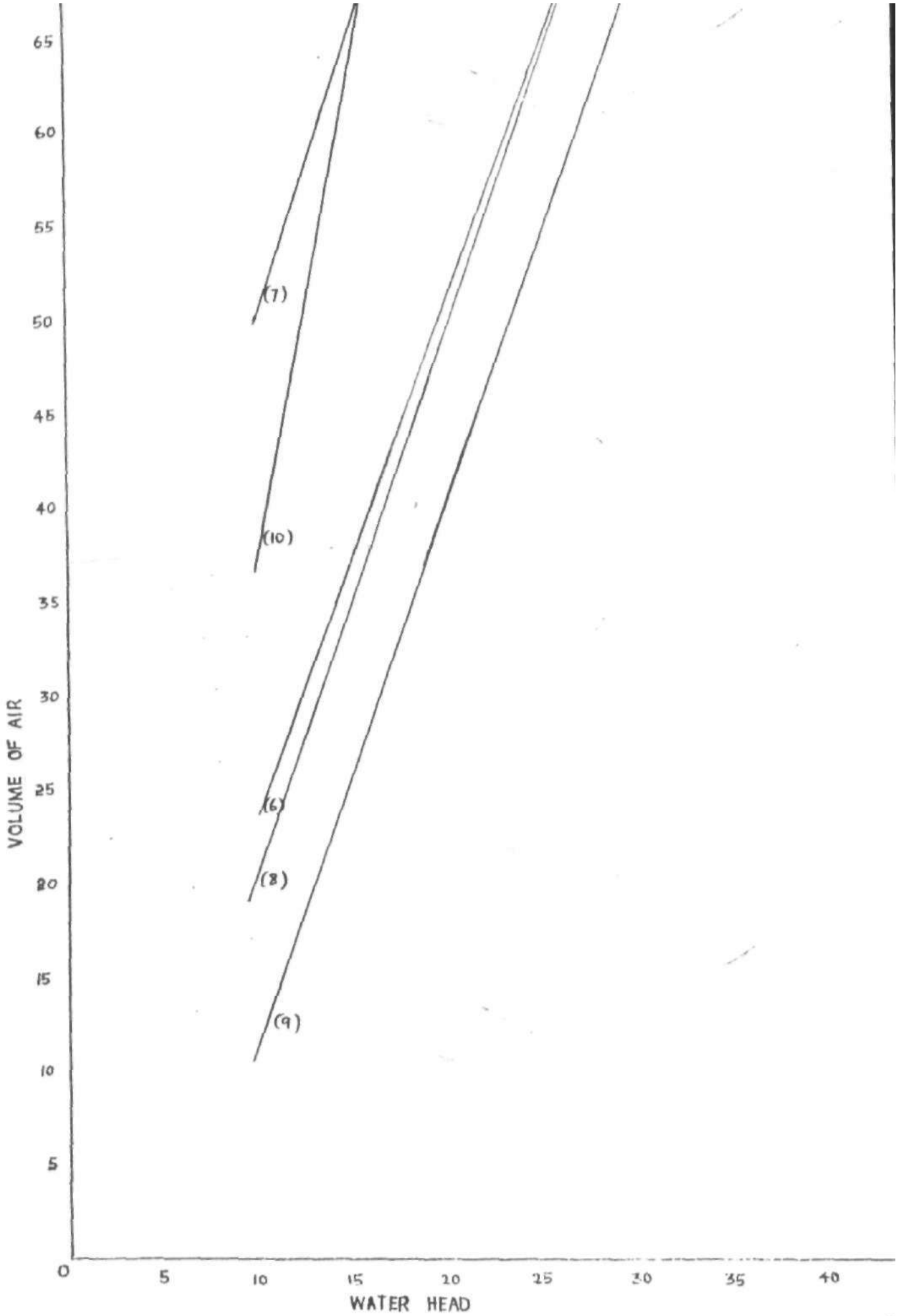


FIG.2 : PLOT OF VOLUME OF AIR AGAINST PRESSURE AT WATER HEA

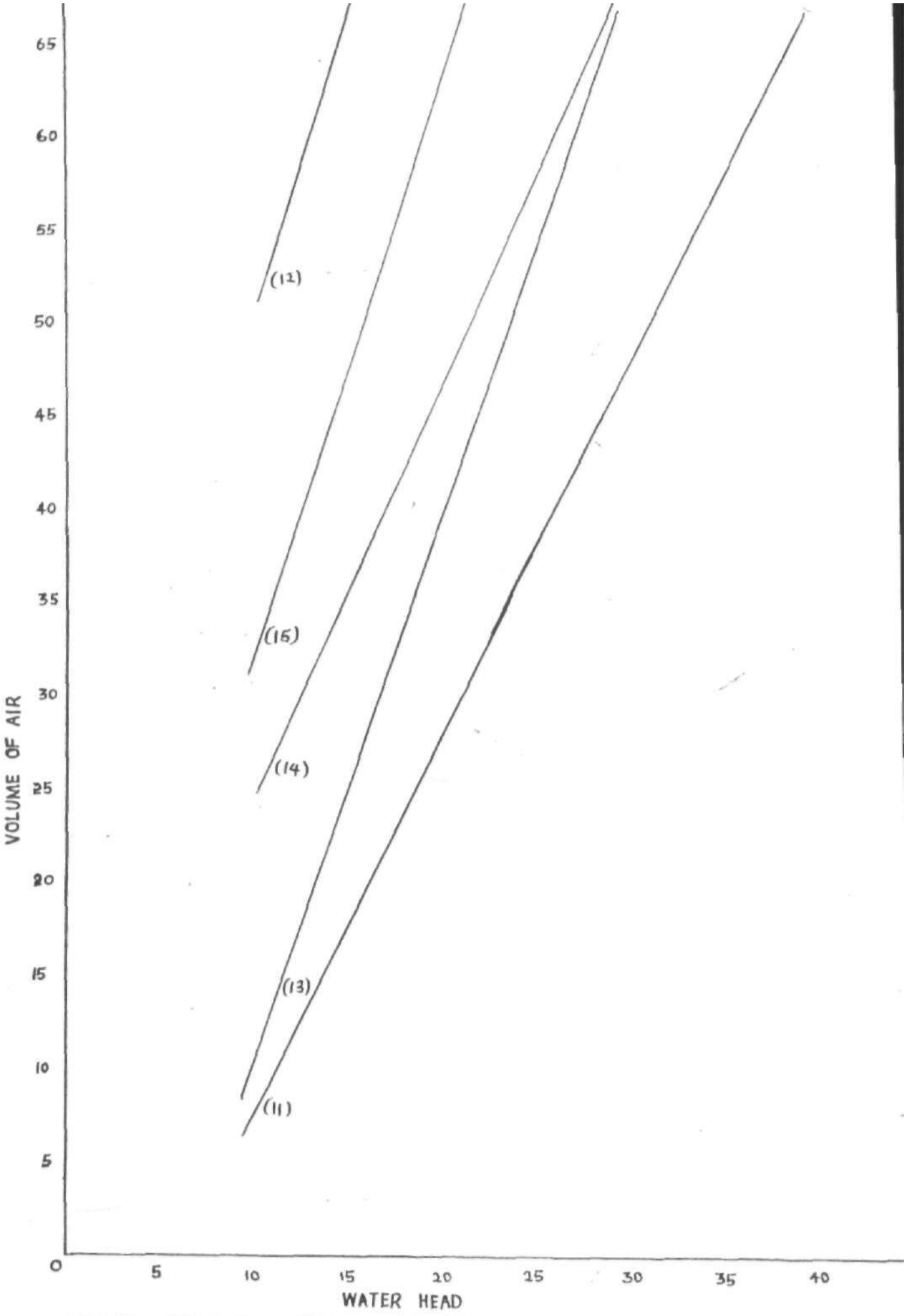


FIG. 3 : PLOT OF VOLUME OF AIR AGAINST PRESSURE AT WATER HEAD

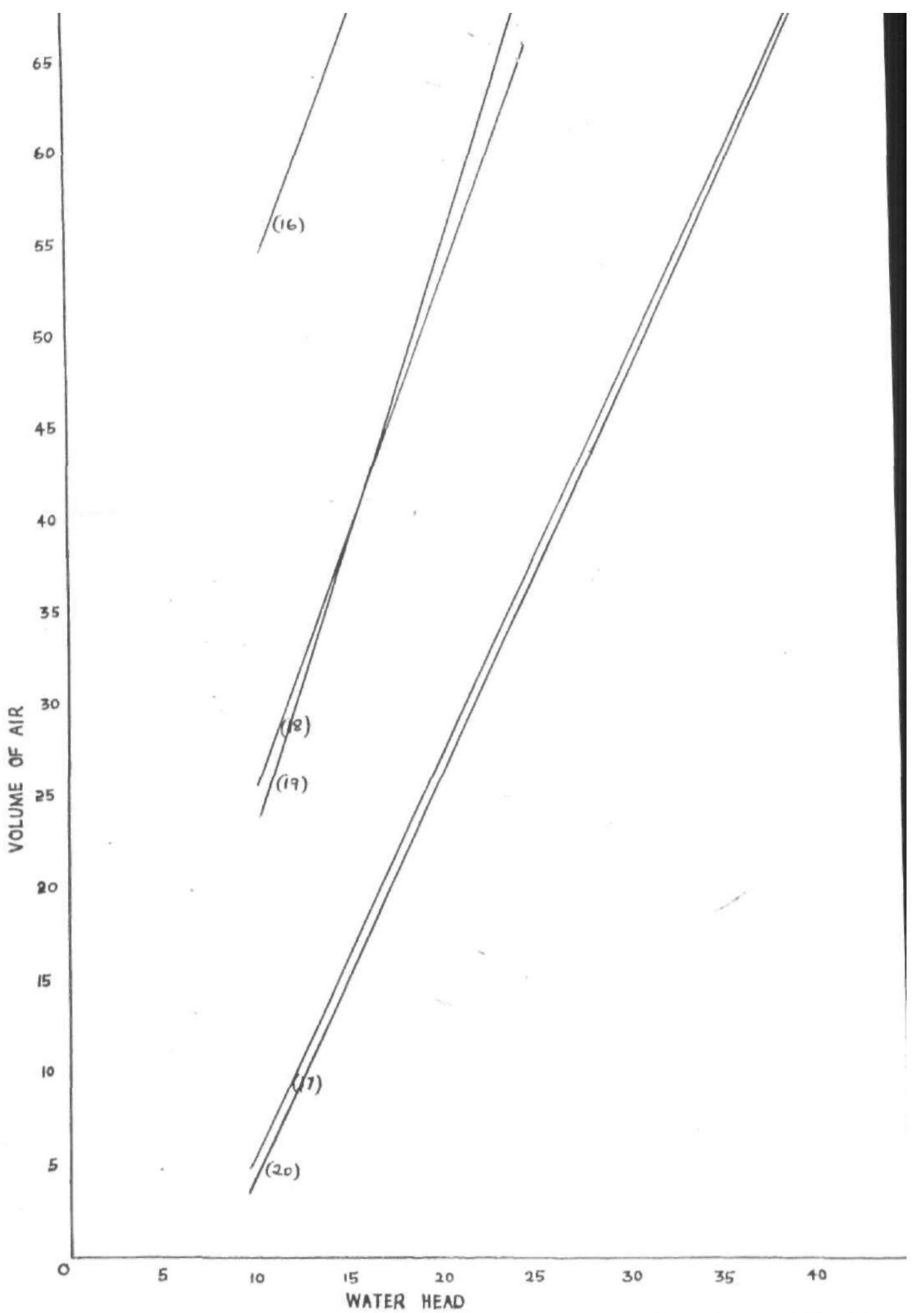


FIG. 4 : PLOT OF VOLUME OF AIR AGAINST PRESSURE AT WATER HEAD

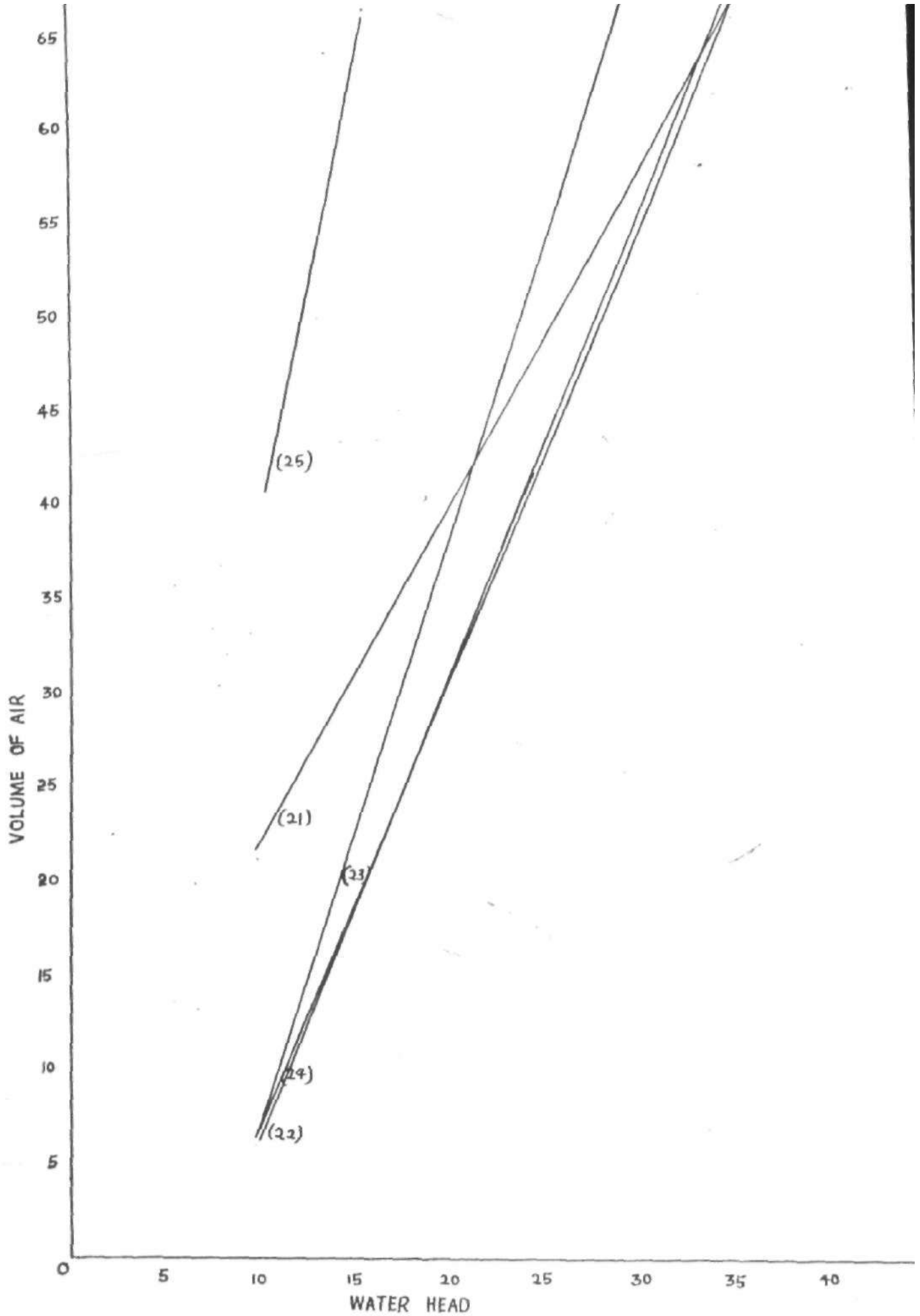


FIG.5 : PLOT OF VOLUME OF AIR AGAINST PRESSURE AT WATER HEAD

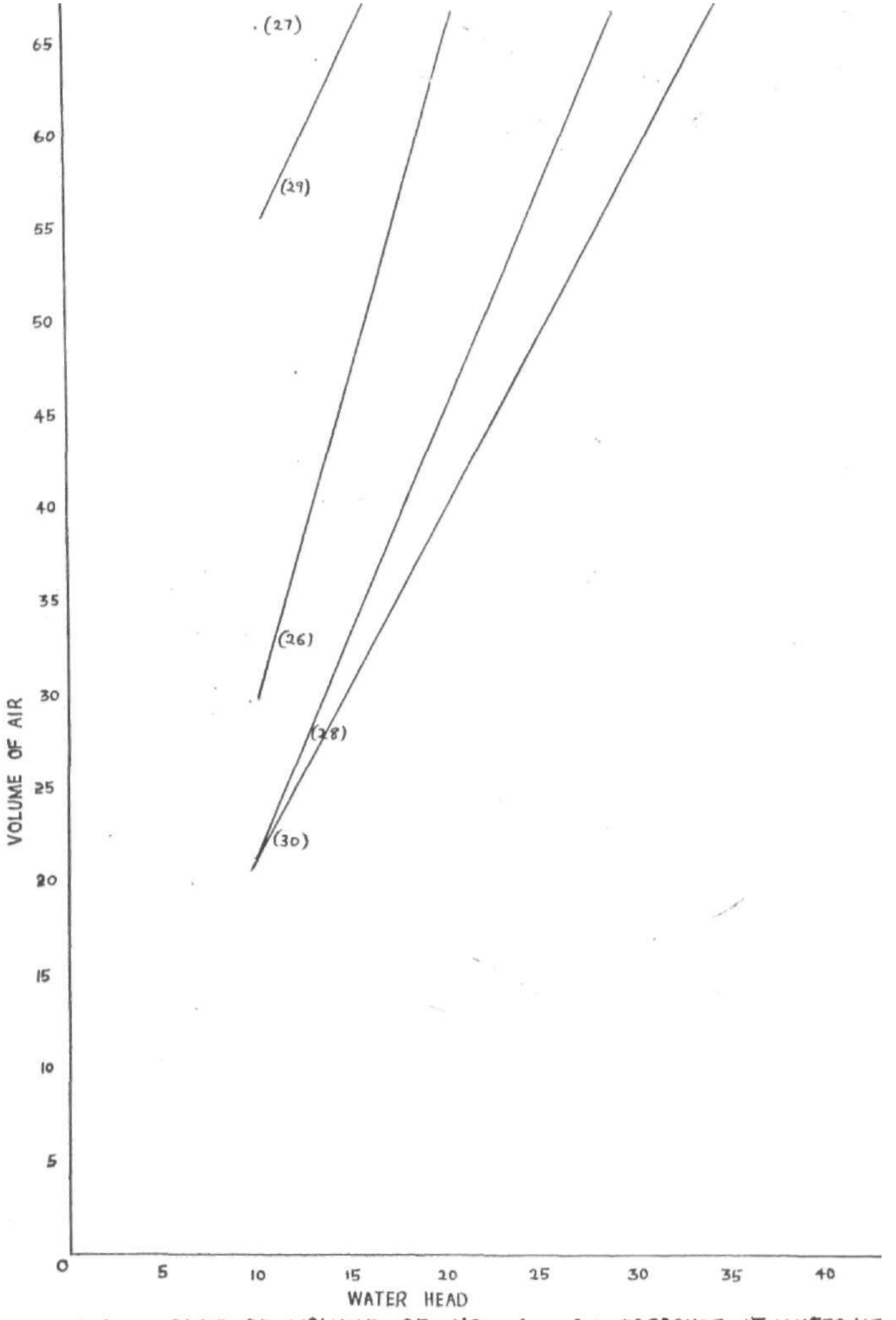


FIG. 6 : PLOT OF VOLUME OF AIR AGAINST PRESSURE AT WATER HE

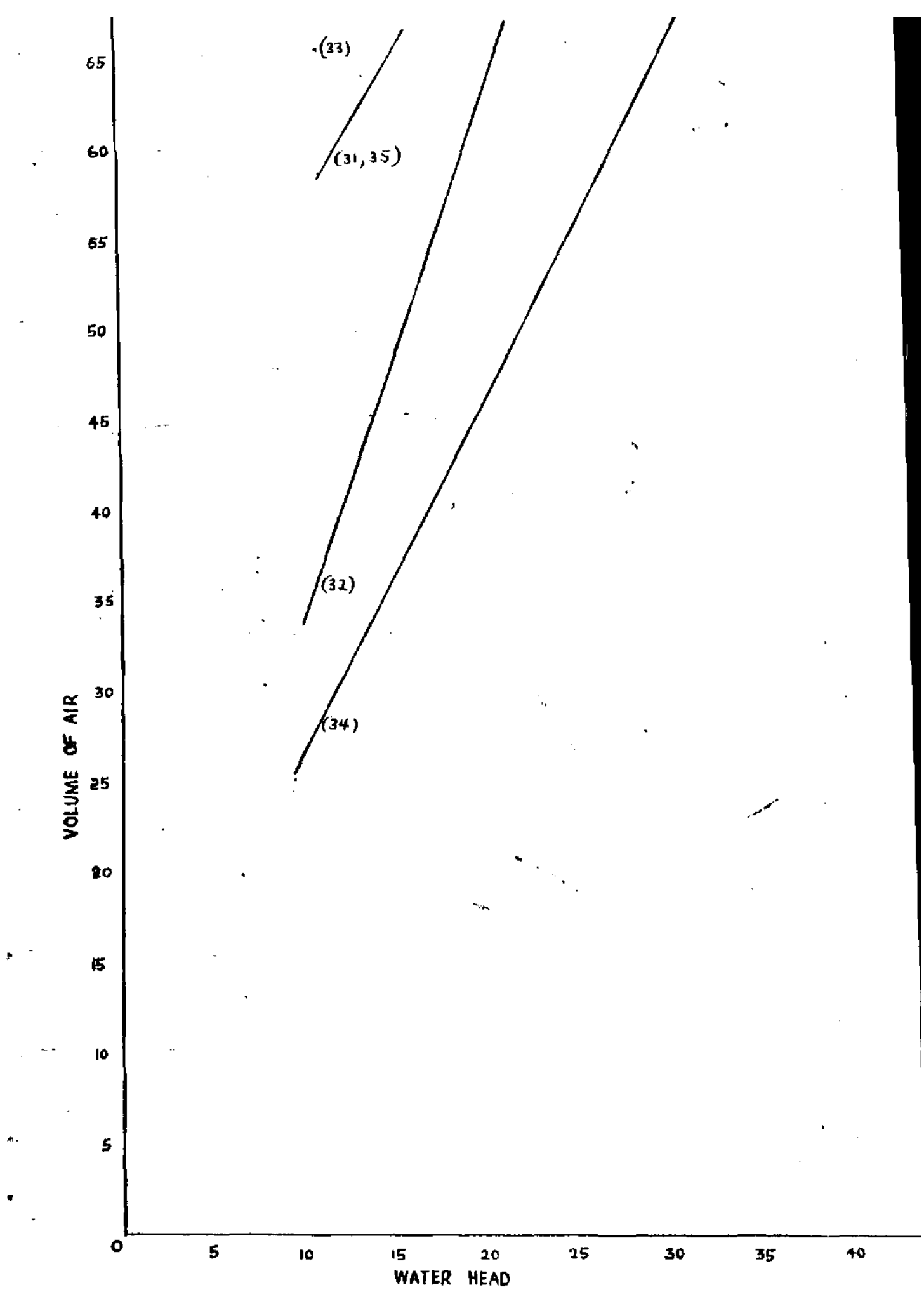


FIG. 7 : PLOT OF VOLUME OF AIR AGAINST PRESSURE AT WATER HEA

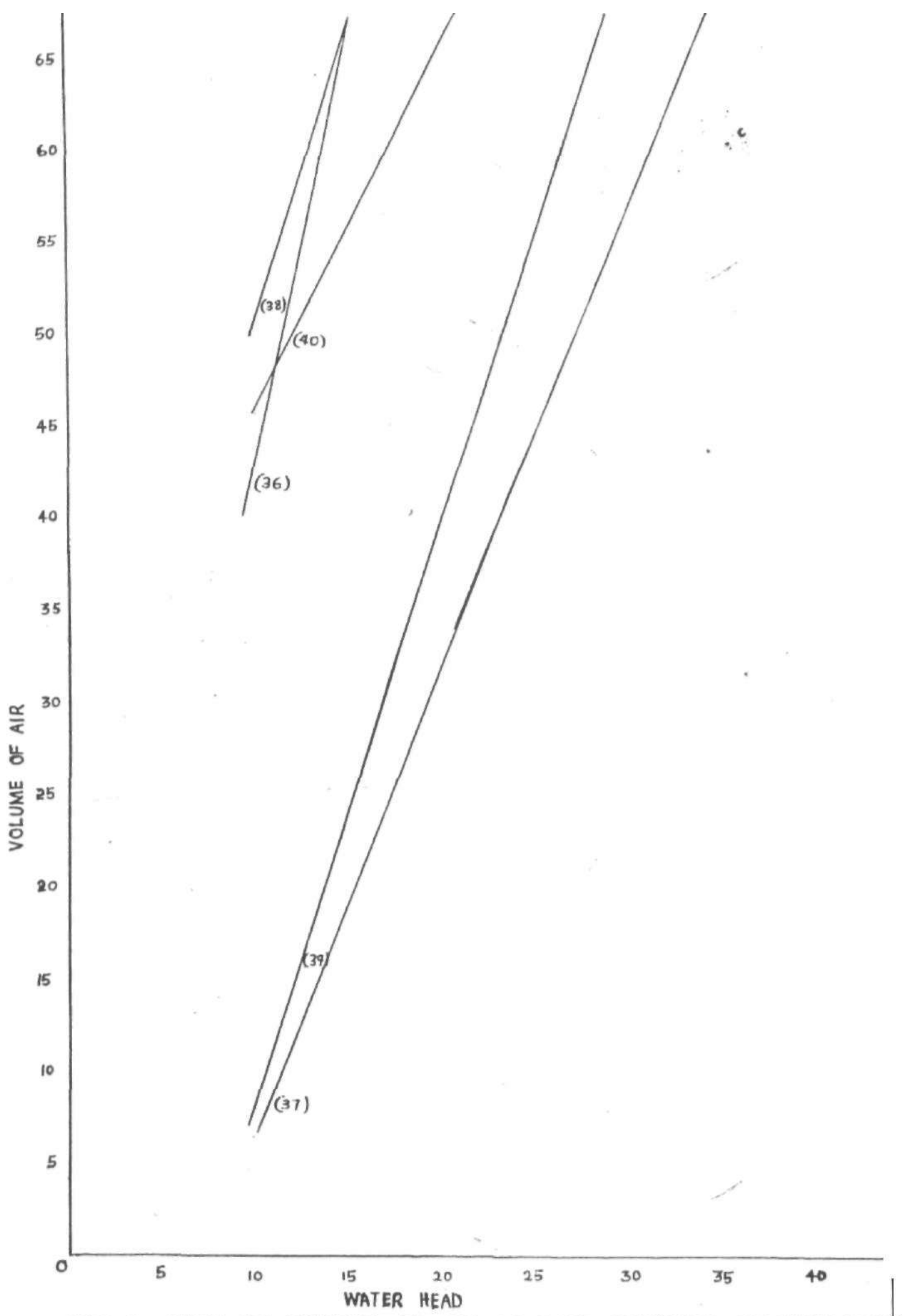


FIG. 8 : PLOT OF VOLUME OF AIR AGAINST PRESSURE AT WATER HEAD

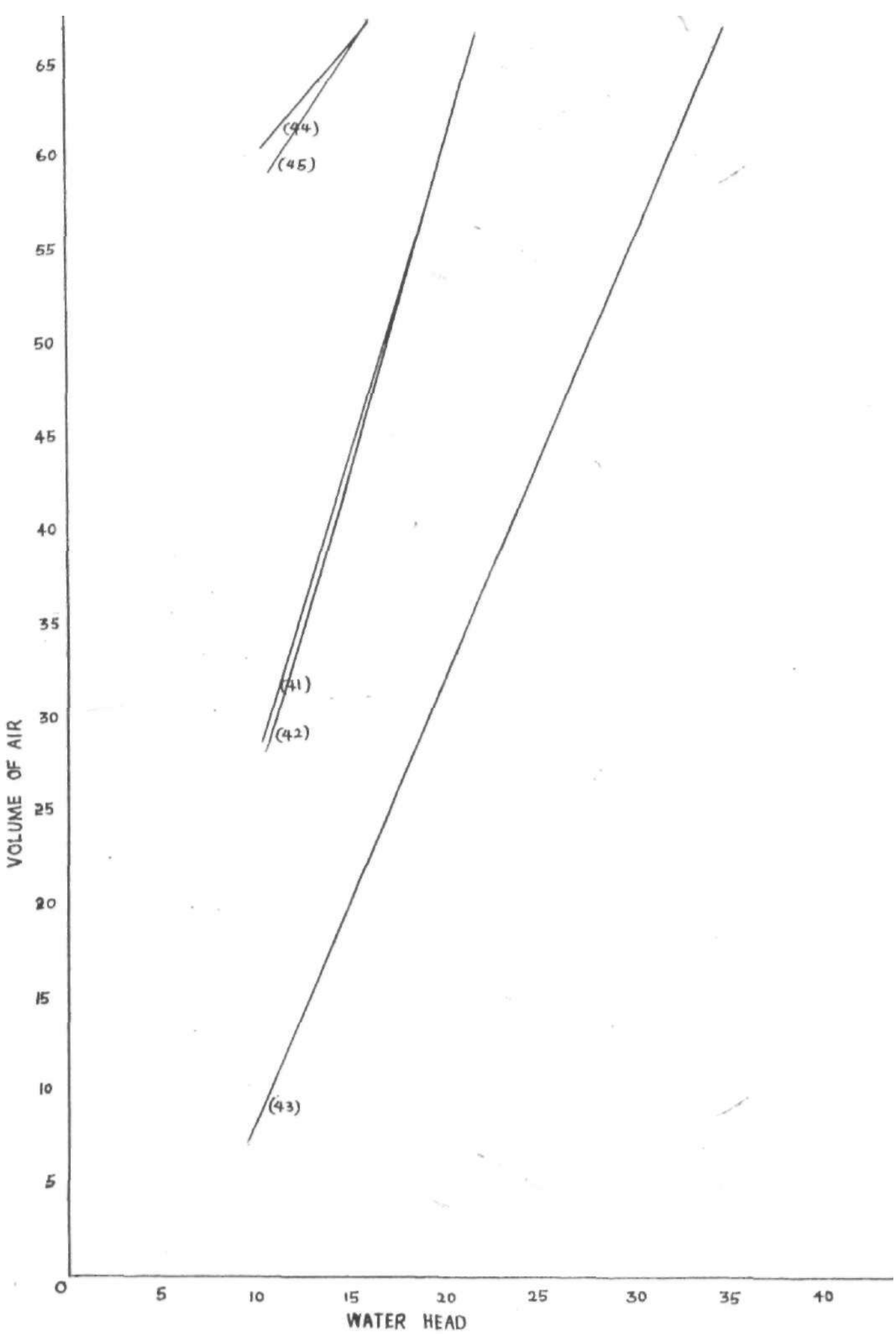


FIG. 9 : PLOT OF VOLUME OF AIR AGAINST PRESSURE AT WATER HEA

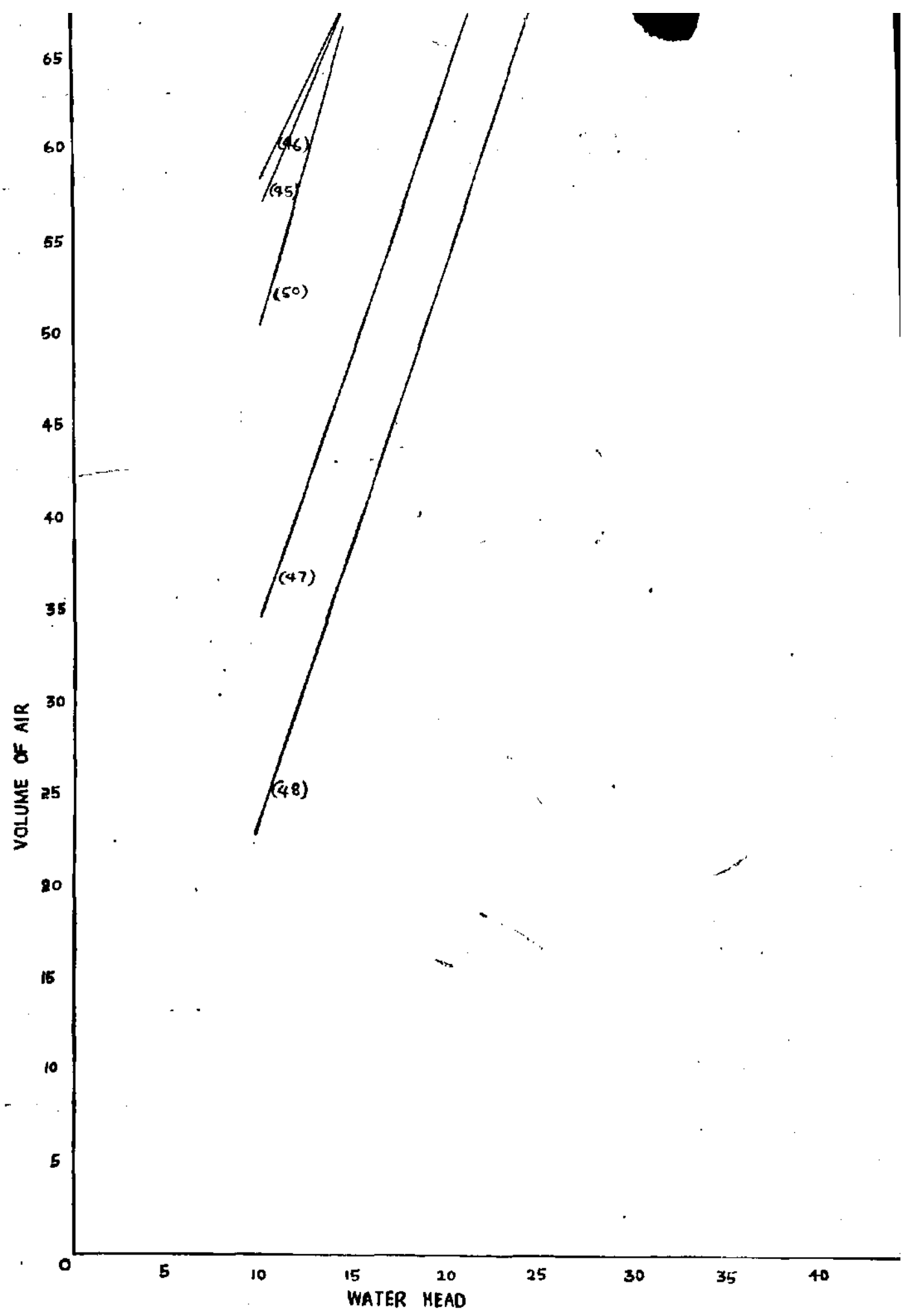


FIG.10: PLOT OF VOLUME OF AIR AGAINST PRESSURE AT WATER HEAD

on the stand of the tester so that the fabric is uppermost in such a position that the center of the spray pattern coincides with the center of the hoop. In the case of twills, garbardines,

against a so[illegible]ject, with the [illegible] facing the object, then rotated [illegible] and tapped once more on the p[illegible] previously held.

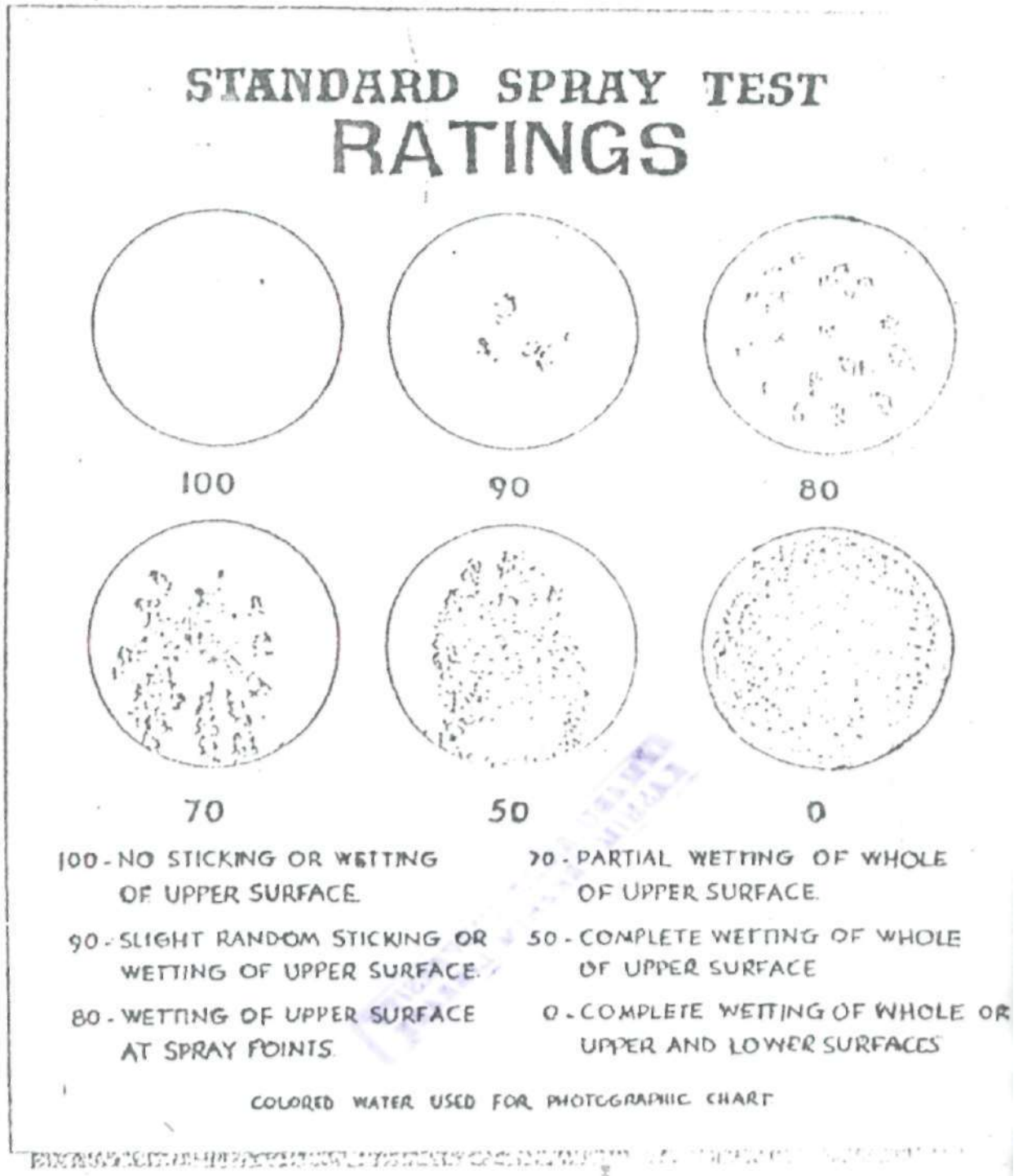


Fig. 1—Spray Test Rating Chart.