Technical Problems and Solutions in the Indigenous Leather Industry: Implications for Art Education in Ghana

b
y

John Osei Bobie Boahin, BA (HONS.), P/G DAE, M/PHIL

A Dissertation submitted to the School of Graduate Studies,

Kwame Nkrumah University of Science and Technology, In partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY IN ART EDUCATION

Faculty of Fine Art, College of Art and Social Sciences

October 2008

Leatherwork is an art form that has a strong traditional foundation in Ghana; it is practiced in diverse forms in different areas of Ghana, particularly in the three regions in the northern part of Ghana where production is highly concentrated. The Ghana government's desire to promote the indigenous vocations in schools has necessitated the improvement of the technologies used by indigenous leatherworkers.

Some pertinent problems affecting the industry were identified these are (a) Lack of simple but efficient tools and equipment for the execution of the tanning process, (b) Poor quality leather resulting in offensive odour and its susceptibility to grow moulds as a result of fungal attack, (c) Non-fast vegetable based dyes that easily fade in the presence of sunlight and also

bleeds when washed, and (d) Limited colour range of red, black, white and brown. The research will lead to the following solutions to the identified problems:

(a) The production of new tanning equipment comprising, tanning vessels, scudding, tumbling and cutting machines will improve the leatherwork industry.

(b) That, leatherworkers will be able to produce some working tools locally.

(c) That alternative local colourants can be applied on leather.

(d) The offensive odour and the fungus attack on leather will be subdued. Solutions to these identified technical problems associated with traditional leatherwork techniques to make it attractive to leatherwork education in Ghana are the focus of this project.

The results of the research were attained through the experimental research methods

The research lead to the following solutions to the identified technical problems: (a) introduction of alternative tanning vessels that will be useful for academic and commercial purposes, and make it possible for tanning to be done indoors and outdoors; (b) Development of scudding equipment for dehairing and fleshing, the equipment makes it possible for the craftsman to do scudding in a more comfortable posture for increase in productivity; (c) Design and construction of two types of leather dryers, open- dryer and electric-dryer; (d) Tumbling equipment for boarding oil into leathers and also softening leathers and fur, and (e) Thong cutter for cutting long strips of leather for thonging or weaving.

The research also identified alternative colourants that are locally available for colouring leather; these are grouped into two, Dyes and Pigments.

Dye; The dyes were vat dye and suede dye, these proved to be useful on leather. and the identified pigments were oil paint and acrylic which were successfully applied on leather.

Starch was also mixed successfully with vat dye as pigment in colouring leather. The research also identified techniques for controlling the offensive odour associated with indigenous tanned leathers and fur, and prevents the development of moulds on them in order to promote the marketing of leather articles locally and awaken the export of leather articles which has not been very attractive due to these problems.

The findings of the research will help in the promotion of leatherwork education and the indigenous leather industry in Ghana

It is recommended that specially equipped studios be built in schools at all levels for the teaching of every aspect of leatherwork to sustain the manpower

needs of the industry. Beside, a research Center must be established to support the industry in the areas of design, material and technological development to meet modern needs as well as boost up national development.

DECLARATION

This is to certify that the project report is the candidates own account of his research and that it contains no material previously published by any other person nor materials which have been accepted for the award of any other degree of the university, except where due acknowledgement has been made in the text.

John Osei Bobie Boahin

PG 6516203

Certified by:

Dr. S. Y. Peligah

Supervisor 1

Dr. S. K. Amenuke

Supervisor 2

Nana Opoku-Asare (Mrs

Head of Department

ACKNOWLEDGEMENTS

I wish to express my sincere gratitude to all those who have contributed in diverse ways to make this research successful.
Specific names to mention are my supervisors Dr. S.Y. Peligah and Dr. S.K. Amenuke of the Department of General Art Studies, History who jointly supervised the project and all the other lecturers of in the department for their unceasing encouragement to me during the course of the research. I further extend my gratitude to Mr. Yaw Asante, English tutor and assistant headmaster of S.D.A.
Secondary School, Kumasi for proofreading the script.

I extend my special thanks to the technicians and National Service personnel who assisted me in constructing the various equipment required for the project. I thank my wife and children for their spiritual and moral support during the course of my research.
Above all, I extend my sincerest thanks to the Almighty God for guiding me through these periods of research with strength, wisdom and knowledge.

ABSTRACT

Leatherwork is an art form that has a strong traditional foundation in Ghana; it is practiced in diverse forms in different areas of Ghana, particularly in the three regions in the northern part of Ghana where production is highly

concentrated. The Ghana government's desire to promote the indigenous vocations in schools has necessitated the improvement of the technologies used by indigenous leatherworkers.

Some pertinent problems affecting the industry were identified these are (a) Lack of simple but efficient tools and equipment for the execution of the tanning process, (b) Poor quality leather resulting in offensive odour and its susceptibility to grow moulds as a result of fungal attack, (c) Non-fast vegetable based dyes that easily fade in the presence of sunlight and also bleeds when washed, and (d) Limited colour range of red, black, white and brown. The research will lead to the following solutions to the identified problems:

(a) The production of new tanning equipment comprising, tanning vessels, scudding, tumbling and cutting machines will improve the leatherwork industry.

(b) That, leatherworkers will be able to produce some working tools locally.

(c) That alternative local colourants can be applied on leather.

(d) The offensive odour and the fungus attack on leather will be subdued. Solutions to these identified technical problems associated with traditional leatherwork techniques to make it attractive to leatherwork education in Ghana are the focus of this project.

The results of the research were attained through the experimental research methods

The research lead to the following solutions to the identified technical problems: (a) introduction of alternative tanning vessels that will be useful for academic and commercial purposes, and make it possible for tanning to be done indoors and outdoors; (b) Development of scudding equipment for dehairing and fleshing, the equipment makes it possible for the craftsman to do scudding in a more comfortable posture for increase in productivity; (c) Design and construction of two types of leather dryers, open- dryer and electric-dryer; (d) Tumbling equipment for boarding oil into leathers and also softening leathers and fur, and (e) Thong cutter for cutting long strips of leather for thonging or weaving.

The research also identified alternative colourants that are locally available for colouring leather; these are grouped into two, Dyes and Pigments.

Dye; The dyes were vat dye and suede dye, these proved to be useful on leather. and the identified pigments were oil paint and acrylic which were successfully applied on leather.

Starch was also mixed successfully with vat dye as pigment in colouring leather. The research also identified techniques for controlling the offensive odour associated with indigenous tanned leathers and fur, and prevents the development of moulds on them in order to promote the marketing of leather articles locally and awaken the export of leather articles which has not been very attractive due to these problems.

The findings of the research will help in the promotion of leatherwork education and the indigenous leather industry in Ghana

It is recommended that specially equipped studios be built in schools at all levels for the teaching of every aspect of leatherwork to sustain the manpower needs of the industry. Beside, a research Center must be established to support the industry in the areas of design, material and technological development to meet modern needs as well as boost up national development.

TABLE OF CONTENT

LIST OF FIGURES

LIST OF PLATES

82. Forming the frames
129

83. Covering the sides
129

84. Drying box with stretchers
129

85. Finished electric dryer with fittens
129

86. Fullsheet metal plate.
135

87. The sheet was cut to size
135

88. one side of the drum
135

89. The supporting metal bars
135

90. The bearing holders
135

91. Welding the supporting bars
135

92. The finished tumbling equipment
136

93. Spacers
145

94. Metal blades
145

95. Rubber rolled over shaft
146

96. Blades over shaft
146

97. The ‘stands’
146

98. Bearings, these enable the shafts to revolve.
146

99. Feeding(a) and receiving (b), metal plates 146

100. The cover plates 146

CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

The leather industry is one of the earliest industries developed by humanity since the prehistoric period, because of man's desire to find a suitable material to protect him from the harsh weather conditions he was confronted with. The choice of leather as a convenient material for protecting the body influenced its development over several generations, with one generation improving upon the ideas and techniques learnt from the other.

In Ghana, the leather industry is one of the oldest and popular indigenous industries, and it is largely practiced in the northern part of the country. However, some leatherworkers from this part of Ghana have established small-scale leather tanning industries in some towns and cities in Southern Ghana, particularly, Kumasi. The industry has provided employment for a large number of people in its various specialized areas such as Curing, Beaming and Tanning, as well as the processing of different forms of leather articles; such as: clothing, decoration, upholstery and containers.

Although these products attract a large number of patrons all over the country and beyond, yet the quality of work and the technologies used for their processing have remained the same. This does not augur well for the industry, particularly at a time when there is deliberate effort by Ghana government, to promote the export of non-traditional products, including leather goods.

The training offered by the indigenous leatherworker is through the traditional apprenticeship method, where the techniques for production are passed from one generation unto another and as a result, the method of production remains the same for several years. To promote the development of the indigenous craft industry the government has since 1990 caused to be introduced into schools and colleges certain courses, which are indigenous based and among these is a course in leatherwork. Students from institutions where a course in leatherwork is offered are supposed to be trained to make qualitative improvement upon the technologies and designs of products in this vocation to meet modern needs and standards, both internally and externally.

In the light of this, it requires the development of technologies that will make teaching and learning more effective. To further make leather processing more convenient in schools, it requires the provision of tools, equipment and materials which can be easily accessible to students.

1.2 Statement of the Problem

Generally, people prefer the use of leather to all forms of artificial imitations, as a result of its numerous relative advantages. Unfortunately local technologies used in processing the material and its articles leave much to be desired.

Leather as a material lends itself to several uses, but the offensive odour it emanates leaves much to be desired. The resulting effect is that people who buy articles made with such poor quality leathers find it difficult to use or keep them in their rooms. They have to be left outside their rooms in a highly ventilated area for over a period of time to get the offensive odour to reduce before using them. Even such a procedure does not lead to the removal of the

odour. Whenever the articles are exposed to moisture, they begin to smell again. The finished articles also grow mouldy easily and this causes stains to appear on them.

The tannins and dyes for tanning leather and fur are vegetable based; hence, the term "vegetable tanned leather" is used most often. However, since these plantbased chemicals are seasonal their supply is always reduced whenever they are out of season. This shortage of tannins also affects the acquisition of requisite chemicals for teaching and learning and the production of leather and fur all year round.

The vegetable-based dyes used by the local tanners easily turn pale after a while or when they are exposed to sunlight. They also turn dark after they have been handled in the arm over a period of time. This requires finding an alternative means of protecting vegetable dyed leathers which can withstand such a problem.

Tools for executing leather products are very difficult to come by and without efficient and quality tools, leather works cannot be properly made. There are no specific local centres where leather tools and equipment can be obtained readily as most of them are imported. As a result, very few people can raise resources to buy them.

Another important setback is the non-availability of organized literature that can be useful in the teaching, and learning of the subject. The available literature for students also has scattered information, hence the need to provide alternative literature locally.

1.3 Objectives

1.3.1 To identify local tanning technologies with the view of developing new ones suitable for processing leather in schools and colleges.
1.3.2 To produce sample leatherwork tools and equipment.

1.3.3 To explore the use of alternate locally available dyes and pigments for dyeing or colouring leather; and to develop a mechanism through which the

offensive odour, and moulds, which are associated with vegetable-tanned leathers, can be reduced.

1.4. Hypotheses

1.4.1. That it is possible to develop improved local tanning technology, which can be used in schools and colleges in Ghana.
1.4.2. That students and leatherworkers can produce some basic leatherwork tools and equipment locally to improve upon the efficiency of the industry.
1.4.3. That the offensive odour and the moulds, which are associated with local vegetable tanned leathers, can be subdued to make them more appreciable.
1.4.4. That it is possible to adopt alternative locally available dyes for use in dyeing indigenous tanned leathers.

1.5 Assumptions

1.5.1. That the leather industry has problems

1.5.2. That indigenous technology used for processing vegetable tanned leather contributes towards the production of leathers with offensive odour.
1.5.3. That the problems and solutions have bearings for art education.

1.5.4. That the technologies used by indigenous tanners make it difficult for schools and colleges to adopt them for use.
1.5.5. That most basic leatherwork tools useful for teaching and learning are scarce, with the few that are available imported and also expensive.
1.5.6. That the problems affecting the indigenous leather industry can be solved.

1.5.7. That teachers and students can practise the tanning process with more refined technologies.

1.6 Delimitation

1.6.1. The research centred on the identification of new technologies useful for producing leather and fur in schools and colleges.
1.6.2. The adoption and use of locally available fabric dyes alternatively on leather.
1.6.3. The development of mechanism for reducing the offensive odour and moulds associated with indigenous tanned leathers. 16.4. Design and production of some basic leatherwork tools through appropriate technology.
1.6..5 Experimenting with some leathers produced from the improved technologies in the production of some basic leather articles.

1.6.6. The study is limited to indigenous leather industries in Ghana and institutions offering leatherwork as a course of study.

1.7 Limitation

The research work did not encounter any major hindrance.

1.8 Importance of Study

1.8.1 The project will be useful to schools offering leatherwork for the teaching and learning of tanning.
1.8.2 It will make it possible for the production of leather and fur, which are free from the strong unpleasant odour that is associated with indigenous tanned leathers.

1.8.3 It will make it possible for students and local craftsmen to acquire knowledge in the techniques for using locally available fabric dyes on leather.
1.8.4 It will provide proper mechanism for the preservation and storage of tannins and dyes which are from vegetable sources for use by schools and local tanners all year round.
1.8.5 It will provide valuable information on vegetable tanned leather and fur for use by students, teachers and leatherworkers.
1.8.6 Students trained in leatherwork will promote the development of leatherwork techniques for the leather industry.

1.8.7 It will make it possible for leatherwork students to produce basic leatherwork tools from local resources.

1.8.8 The visual artists trained in leatherwork will produce artifacts that will be useful for export and promote tourism in Ghana.

1.8.9 The research will render immense help to leatherwork-students and art teachers to foster national development.

1.8.10 The students trained in leatherwork will be capable of employing themselves.

1.8.11 The research will increase knowledge in education in general.

1.9 Definition of Terms

1.9.1 **Leather:** Animal skin or hide converted through a chemical process known as tanning. Animal skins and hides treated to preserve them in a process known as tanning to make them suitable for use.

Though the skins of such diverse animals as; ostrich, lizard, eel, and kangaroo have been used, the more common leathers come from cattle, including calf and ox; sheep and lamb; goat and kid; horse, mule, and zebra; buffalo; pig and hog; and seal, walrus, whale, and alligator. Leather making is an ancient art that has been practiced for more than seven thousand (7,000) years.

1.9.2 **Leatherwork:** It is the art of making useful and decorative objects out of leather.

1.9.3 **Fur:** this refers to animal skin or hide that has the hair on it either in a raw or processed state.

1.9.4 **Dye:** A substance used to change the colour of things.

1.9.5 **Dyeing:** process of colouring materials such as textile fibres so that the coloring matter becomes an integral part of the fibre.

1.9.6 **Pelt:** This is the general term for both hide and skin in their raw state.

1.9.7 **Staking**: this is the act of making leather softer.

1.9.8 **Dry Milling:** this is a method used for softening leather.

1.9.9 **Tanning:** Chemical treatment of raw animal hides or skins to convert them into leather. Tanning converts the otherwise perishable skin to a stable and non- decaying material.

1.9.10 **Vegetable tanning:** the process whereby tanning solutions obtained from plants are used to turn pelts into leather.

1.9.11 **Tannic acid:** also called tannin; is a group of chemical substances found in the bark, fruits, roots, and other parts of many trees. Tannin is obtained from such trees as oaks, mangroves, wattles chestnuts, hemlocks, and quebrachos and bagaruwa.

1.9.12 **Vat:** a large container filled with tannin solutions in which tanning are carried out.

1.9.13 **Dehairing:** the process of removing the hair from the grain side of the skin after the hair has been loosened.

1.9.14 **Hue:** the attribute of colours that permits them to be classed as red, yellow, green, blue, or an intermediate between any contiguous pair of these colours. 1.9.**15. Scudding knife:** a double handled blunt knife used for unhairing and defleshing.

1.9.16. Scudding: the scrapping of hair (unhairing) or flesh (defleshing) from pelt with scudding knife. Scudding is done by driving the scudding knife forward from one end to the other in a single direction over pelts which have been made ready for such an exercise.

1.9.17. Colorant: a substance used for colouring a material.

1.9.18. Pigment: any intensely coloured compound used to colour other materials. Unlike dyes, pigments do not dissolve; they are applied as fine solid particles mixed with a liquid. In general, the same ones are used in oil and water-based paints, printing inks, and plastics. They may be inorganic compounds (usually brighter and longer-lasting) or organic compounds. Natural organic pigments have been used for centuries but today most are synthetic or inorganic.

1.9.19. Lime: the small globose yellowish green fruit of a lime with an acid juicy pulp used as a flavouring agent and as a source of vitamin (Limes are used to flavour many foods.)

1.9.20.Collagen: Any of a class of organic compounds, the most abundant proteins in the animal kingdom, occurring widely in tendons, ligaments, dentin (see tooth), cartilage, and other connective tissues.

1.9.21 Burnish: to make shiny or lustrous especially by rubbing or polishing leather (material) with a tool for compacting or smoothening.

1.9.22.Detergent: a cleansing agent: such as, a, soap b, any of the numerous synthetic water-soluble or liquid organic preparations that are chemically

different from soaps but are able to emulsify oils, hold dirt in suspension, and act as wetting agents c, an oil-soluble substance that holds insoluble foreign matter in suspension and is used in lubricating oils and dry-cleaning solvents

1.9.23. Reactive Dye: These are dyes that form stable chemical links with textile materials to produce coloured fabrics with excellent overall fastness.

1.9.24. Mordant: Fixing solution that is applied to fiber to enhance a dye's

fastness

CHAPTER TWO

REVIEW OF RELATED LITERATURE

The conventional art forms, which were introduced in the educational system during the period of colonisation, and which have been taught in Ghanaian schools over the years, such as painting, sculpture, and ceramics were all once art forms developed mainly from ancient European cultures.

Therefore, the recognition given for the study of leatherwork and some other indigenous vocations, such as Woodwork, Cane and Rattanwork, in the Ghanaian educational system is a great effort to harness the potentials within these vocations. Hence, it is necessary to identify the problems affecting the

technologies used in the teaching of leather with the view to finding solutions which will help to improve upon the teaching and production of leather products qualitatively for the country.

The major material in the indigenous leather industry is the pelt, which is obtained from both large and small animals, and the technology is the means by which the pelt is prepared. According to World Book Encyclopedia (2001), technology refers to the ways people use in their inventions and discoveries to satisfy their needs. Ever since people appeared on earth, they have had to work to obtain food, clothing, and shelter.

Through the ages, people invented tools, machines, materials and techniques to make work easier. The encyclopedia further states that:

> …Many people call the age we live in the age of technology. Yet people have always lived in a technological age to obtain most of life's necessities and many of its pleasures. Technologies thus, include the use of both primitive and highly advanced tools and methods of work…

Formal education provides an opportunity for the improvement of these technologies, while conscious effort is made to encourage students to find solutions to problems affecting the leather industry.

In the Visual Art syllabus for Senior Secondary Schools it is stated clearly that Art should be taught in the schools to preserve, transmit, improve and promote indigenous art technologies.

This principle is corroborated by the following statement:

> …any system of education should aim at serving the needs of the individuals, the society in which he lives and the country as a whole. In particular, the system should, in a country like Ghana, aim at instilling in the individual, an appreciation of the need for change directed towards the development of the human and material resources of the country… (Ministry of Education, 1990),

It is therefore in the right direction for this research to seek to identify problems within the indigenous leather industry and institutions offering leather as a course of study in order to find solutions to some of them with the

hope of making it a viable academic subject. There are no books written by Ghanaian writers on leatherwork and the available books are mostly foreign based with different educational, professional and cultural backgrounds. These will be reviewed to improve upon the technical qualities, design and aesthetic of indigenous leatherwork for use in the educational institutions in Ghana.

An introductory statement from the internet on the training courses for leather industry has it that, the leather industry always needs technicians and specialised workers.

2.1 Historical Background

2.1 The educational influence on leather is as old as the early discovery of leather. The history of leather dates as far back as the time the prehistoric man saw the need to search for a more convenient material to protect him other than the tree barks and leaves he was wearing. The pelt of animals was seen to be a more convenient clothing material to withstand the harsh weather conditions.

The choice of pelt brought about serious efforts to improve upon its quality which accordingly brought about the leather industry. Leather therefore, is the pelt which has gone through a chemical process known as tanning to prevent it from decay. It is impervious to liquids but it allows gases or vapour to pass through.

Many writers such as R.Reed and Ron Winsor have tried to trace how the prehistoric man came by the use of leather. One such idea put forward is that, the skins obtained from hunting and breeding were initially used to make clothing but they became stiff at low temperatures and rotted in the heat. When he found out this occurrence, he sought for more convenient ways of preserving it. The desire to preserve leather properly led the pre-historic man to make several efforts at different periods to find improved technologies.

Britannica Junior Encyclopedia (1975) opined that, the making of leather is one of man's oldest industries. Since he usually hangs his skins over fire to

dry, he found that smoke preserved the hides. He also removed the hair to make a fur.

Khan Impex Co. (2004) has contended that;

> …Another process used in ancient times was smoking – almost certainly discovered by chance. This then led to tanning with aldehyde, an element present in the smoke emitted by burning leaves and green twigs. It was soon found that the putrefaction process could also be slowed down by drying, carried out by exposure to the sun or by rubbing in salt…

Further historical information on the tanning technology used in the ancient days is contained in the Encyclopedia Britannica (2001). Dilating on this, it indicated that:

> …Leather may have been man's earliest manufactured goods. Scraping the skin till it was more or less free of flesh by flint tools was probably the only operation carried out by the primitive man, sun drying prevented rapid decay but hide became hard. To make them soft and suitable for wear, animals fats and brains were rubbed…

This statement is also made more certain by another from the website of Down Home Leather, which states that, the earliest attempts to make dried skins pliable and water-resistant probably involved softening them with animal fat. The curative effect of wood fire smoke was also an early discovery.

One other interesting aspect of the pre-historic man's efforts was how he discovered the use of vegetable tanning and Down Home Leather speculate on this that vegetable tanning may have resulted from noting the beneficial effects of hides that had lain in pools of rainwater that had absorbed tannin, tree bark, or from attempts to dye skins with the juice of bark, berries or nuts.

The determination of man to find a more durable and soft leather for use led to continuous search for a means of achieving this objective. This desire happened to be common to people of different societies who lived far apart from each other.

The World Book Encyclopedia (1972) emphasized this by indicating that;

> …North American Indians made a yellowish type of leather called buckskin from deer-skins. They piled the skins in packs so the tissue surrounding the hair rotted off. They scrapped the flesh from the inner side of the skin by hand and pounded oil and the brains of animals into the skin. Then they let it hang in thick smoke. They produced good, soft leather…

The value attached to leather influenced the vigorous efforts put in to make it better preserved. As a result, numerous approaches were made to improve upon the quality of leather they wanted to produce. Regarding these approaches' it further reiterated that:

> …The processes of sweating and enzymatic hair removal are all based on early discovery that hair will fall out of a hide that has been allowed to rot slightly. Wood-ash and lime were used in the Middle Ages. Much later, the cleaned hides were treated with dog dung and drenched in fermented broth. These procedures were later replaced by acid deliming and bating with enzymes. Bating is a treatment of light type of leather to attain a smoother and clearer grain, or greater softness and pliability. In this process, hides are placed in vats containing ammonium sulfate or chloride as the deliming agent and certain enzymes that act selectively to remove proteins and also to improve colour…

From this development of tanning technologies more and improved leathers are produced to meet numerous leather requirements. It is also seen that technologies which can be adapted for use vary. In some cases, it depends upon the type of leather being produced and its purpose and since many uses of leather continue to be found. Concerning this, Down Home Leather htm

page 1, has commented that the progress on the long road to civilization can be measured by the uses to which skins and hides have been put.

Khan Impex Co. (2004) also stated that:

> …These processes, which gradually became more refined and effective, provided the basis for the use of leather in the ancient world, and continued to do so for centuries, right through to the present. Evidence of widespread use of these technologies has been found in numerous written documents and paintings, and in archaeological findings…

This statement reinforces the conviction that the introduction of leather as a course of study will provide the much needed opportunity to identify variety of techniques, tannins and dyes that are needed to improve upon the production of quality leather for the ever increasing identified uses of it.

As early civilization grew, different people used different technologies and materials to treat leather. The World Book Encyclopedia (1977) explains the technologies used by different people by saying that:

> …Eskimos may have rubbed into animal skins to make the fur soft and durable. This may have been the beginning of the use of oils for tanning (a process termed oil tannage), and of chamoising (art of making skins and hides extremely soft). Japanese white leather and Ethiopian red leather are still produced with rape and staff lower oil. Smoking of hides and skins involves a reaction with aldehyde, several of which today are used for tanning. Oxidation of oil also produces aldehyde. American Indians still make leather by a process that combines oil and smoke…

The Babylonians and the Assyrians used alum, oil, myrrh and sumac to produce the varieties of leather.

Tanning has had a long and popular history among the people of Northern Africa, particularly in Egypt and Morocco than the rest of Africa, archeological evidence has revealed variety of leather articles used in ancient Egypt. Pieces of leathers have been found in Egypt that date as far back as 1300 B.C. According to the American Education Encyclopedia (1970), "well preserved leather articles dating from as early as 2000 B.C. have been found

by archaeologists and that the mummies of ancient Egypt are examples of the early art of tanning".

Owusu-Ansah (1978) has reiterated that the tanning skills known to the Egyptians may have been derived from the Phoenicians when they invaded North Africa in 1,600 B.C.; the Moors acquired their leather-craft from the invaders, added their ingenuity to the process and developed the famous Moroccan leather process from goatskins. Secrets from leather tanning in Africa could have come from the Moors and the Indians who had excelled in leatherworking processes and have had trade links with North Africa.

Although the methods for processing leather may have differed, yet the use of certain materials is found to be common to people of different cultures. This explains the numerous technologies adapted to process leather. One of such is the use of oils to soften the leather and make it pliable. The serious attentions paid to the development of quality leather within a wider geographical zone indicated its importance for the development of civilization. According to Blackstock, in History of Leather (2003):

> …Long before the digital age, leather helped to create the global village. This sturdy, versatile material from nature was essential to daily life around the world in clothing, shelter, transportation, communication, commerce and weapon. During prehistoric times, survival depended on leather's diverse uses and applications. Early civilizations grew, as they discovered new ways of manipulating leather's chameleon-like ability to change appearance and purpose...

Reed, ( ) has also commented that:

> …Highly developed bark 'tanneries' were common in ancient Greece, Rome and Egypt. The earliest known example of vegetable tanning comes from Gebelein Egypt, a tannery thought to be over 5000years old. Bark tanned leathers were the important

> tools in the development of civilization, providing an immensely strong and durable material that was pliable, a very unique and useful combination…

The great demand for leather led to the development of a new source of commerce and concerning this, R. Reed, states that: Bark tanning continued to be an important and basic trade throughout Europe, North Africa, the Middle East and India until the late 1800's when cheap modern chemical tanning methods came into widespread use. Some Egyptian leather articles found are said to have been made 3,300 years ago.

Beside the North African countries, leather tanning had also been practiced in East and Southern Africa countries extensively; this is due to the availability of large herds of cattle and animals in the wild and the need to acquire containers and clothing products for daily use. Tanning could have spread to the rest of Africa through interaction with Arabic traders and Islamic preachers from North Africa.

In West Africa, Northern Nigeria is identified as one of the famous centers for professional leather tanning; inhabitants from Northern Nigeria, the Hausa,
Fulani, Tuareg, and Kanuri have carried to great heights the art of leatherworking.

Craftsmen from Northern Nigerian States migrated to other Nigerian States and West African countries including Ghana, to practice the vocation. Tanning of leather became a secret tradition among the people, where transfer of skills virtually revolved among family members.

In Ghana, information on early professional tanning is based on oral history, leather tanning was not very popular among the indigenous people, it was only common among drum producers who were court artists. Indeed tanning was not as popular and in advanced state as craftsmen used mainly the cured hide and skins and animals whose skin were used had to be hunted from the wild before their skins could be secured.

Some Northern Nigeria immigrants of the Hausa and Fulani ethnicities settled in some popular cities Northern Ghana such as Yandi, Tamale, Wa, and Bolgatanga to practiced leather tanning as family vocation in closed guild.

Some of these leatherworkers migrated to settle in Kumasi, and few of them were employed as court artist in the palace of the Asantehene (King of the Ashanti's).
These leatherworkers were made to produce some royal regalia such as traditional sandals (ahenema), poufs, amulets, helmet, pendants and many others.

Although tanning was done among most ethnic groups in Ghana in varied forms, the arrival of the Northern Nigerians enhanced the value of the trade, they produced beautiful leathers and leather articles such as slippers, sandals, belts, pouches, hats and poufs.

Articles produced from leather continue to be used for several purposes, and as a versatile material; it requires a more formal approach for its use now than before.

The varied tanning substance used further demonstrates the unique nature of leather. Different cultures at varied geographical locations use different tannins for processing leather. According to Encyclopedia Britannica (1977), "vegetable tannage is quite ancient. The Hebrews used oak bark, the Egyptians, babul pods (400 B. C.) and the Arabs bark and roots".

It further states that:

> …In the classical method of vegetable tannage the pelts are placed in a pit or vat, in alternating layers with ground vegetable tanbark, pod, leaf, wood, or roots. Water is poured on to cover and the pelts left for 6 to 12 months. Even today, this 'contact or sandwich tanning method is employed with modifications. In another method called "bag" or "bottle" tanning, the pelt is made into bag, filled with tanning material and water and tied to

> a pole. The water leaches from the material inside the bag and the tanning diffuses osmotically through the pelt, completing the tanning in three to six days. Long before Christ, the Chinese ware skins with mud and alum. Alum an accidental substitution for salt, led to tanning, the first mineral tannage. There is evidence in early use of tanned leather in Assyria, Babylonia, Phoenicia, and India and later by Greeks and Moors…

Two or more processes were sometimes combined, for example alum and oil; alum and gallnut or sumac leaf producing soft nappa leather. By early 11th century A.D. three basic tanning processes were used (1) Oil; (2) Vegetable and (3) Alum.

Of all the materials adapted for use as tanning agents, roots, bark of trees and leaves were the most common to different cultures and the automatic method used was the vegetable tanning. This method is common because the required materials for its application are easily available for use. Besides, the leather produced through this method lends itself to be used for variety of articles. According to Down Home leather (2003):

> …Over the course of time leather products have always been perceived as having a high value. In Rome leather sandals were warned by the upper classes, the plebeians usually going unshod. In China, in the second century B.C., currency made of leather was in widespread use. Among the Romans, leather was so highly prized that Caesar decreed that coins were to be made of the material…

The article explained the high value of leather by stating that, the English word "pecuniary," which refers to monetary rewards, is derived from the Latin word "Pecos," meaning "hide" not only were the numerous instances during the medieval times when leather was the basis of currency, even as late as WW1, (World War 1) leather coins were used in Germany and Austria.

The rapid spread of tanneries and the accompanying varied technologies, were partly contributed by migration of people for better settlements and mingling of cultures. Matt Richards (June 2000), cited Reed's, that when the colonists came to America they brought their leather working skills with them. Bark (vegetable) tanneries were set up in nearly every settlement of the new world because this type of leather was considered a necessity.

The Illustrated World Encyclopedia Vol. 13 also has it that, the first tanner to set up shop in the colonies was Experience Miller, who arrived in 1623.

Reed 'further emphasised that:

> …In 1623, Peter Minuit had the first bark mill in North America built in New Netherlands (later New York). It was a stone mill powered by a horse and its creation coursed a number of tanneries to begin operations in the area. Bark from the clearing of forests for agriculture was in great supply…

The new settlers in America needed to set up industries and used variety of machines. However, many of these machines had leather as some of their components. The economic value of leather as an important component for industrial performance, therefore, required further development in the technology for processing it. In the light of this, R. Reed says that the census of 1840 estimated some 8,229 tanneries in operation in the US. This statement helps to buttress the important role leather plays in the industrial growth of a nation, for which reason, conscious efforts is required to improve upon the training of the requisite manpower needed.

The history of leather gives enough facts about the height at which leather has developed in America and the desire people have for it. Reed comments on this,
that;

> …The timeless appeal of leather lies in its luxurious texture, warm colour, wholesome aroma, and exceptional durability. The world's love affair with fine leather continues to be the influence as much by its appeal as a status symbol as by its utilitarian value…

The American experience is a good example for a developing nation such as Ghana to follow, by making every effort to the knowledge in leatherwork. This will create more avenues for expansion in its utility value. The Encyclopedia Britannica has explained that from early days, leather was made more decorative and adaptable by finishing.

In the Middle Ages, vegetable dyes and earth pigments provided various colours. Leather was frizzed (curled or lofted) to make Morocco leather. In boarding, the skin is doubled, grain surface inside, and pressure is applied in the required direction either by hand, a cork-covered board, or by rotating cork-covered cylinders. The natural grain of the leather is enhanced or brought into sharp definition. The leather was also scented with birch tar oil and cured with grease.
Today, a wide variety of dye oils and finishing agents are used.

2.2 Tools And Equipment

The study of the development of leatherwork can never be complete without a look at the tools and equipment used over the years.

Encyclopedia Britannica vol. 15 (1977) , has indicated that,

> …The earliest tanning tool was flint, used to scrape off flesh. Later, hair and flesh were removed by curved blunt knife over a wooden beam. Leather was shaved to the required thickness with a sharp knife. Such hand tools were improved constantly…

Until the invention of leatherwork machines from the 18^{th} to 19^{th} centuries, the making of leather had remained a manual job for the skilful craftsman. There is no dispute about the fact that machine work is faster and more precise than the handwork. But the fact that people opt for hand-made goods confirms that machine can never beat the hand that manufactured them.

The increasing demand for leather and leather articles necessitated the use of machines in the advanced countries. The knives used for dehairing are always kept sharp to make scraping easy. The beamster uses a dull, curved knife that has a handle at each end to scrape the flesh side of the pelt. The latter is stretched over a board that is curved in the same way as the knife. One end of the peltcovered board rests on the floor whilst the other end extends to the board towards the beamster for scraping.

Concerning the tools required for making leather goods, Peterson (1961) has explained that, a good knife and a cutting board are all that one really needs for simple leather craft. However, for complicated articles, a few more tools are available for use. The possibility of using some few tools to produce leather articles is very encouraging since that will make it easier for students to acquire the basic ones without much difficulty.

Peterson's statement confirms the possibility of using some basic locally made tools to produce leather articles in schools. Herder, (1968), has outlined some basic tools useful for leatherwork. Below is a list of these tools:

(a) Lacing chisel, for pounding slits in the leather prior to lacing;

(b) Rotary punch; for making holes of different sizes;

(c) Mat knife; or well-sharpened paring knife for cutting all straight edges of the leather with a knife drawn along a metal ruler;

(d) Metal 'T' square, scissors; for cutting curved edges and for laces; (e) Tracing wheel; this is handy for marking the edges of leather at uniform intervals for punching;

(f) Stencil knife or linoleum cutter; for cutting within the leather.

(g) Soldering iron; for scorching designs into the leather.

(h) Mallet or hammer; for embossing.

Since formal education on leather requires a deliberate search and creation of new ideas as designs for leatherwork, the availability of variety of tools will give sufficient room for creative activities to go on. This will therefore enhance the teaching and learning of leatherwork in schools and colleges.
Concerning the care of tools, Peterson (1961), has emphasized that; a good working knife must always be kept sharp. Herder advises that:

> … any knives that you use – stencil knife, mat knife, paring knife, skiving knife – should be well sharpened to begin with, and periodically stropped on a knife sharpener, or on a razor strop. A dull knife slows down the work, makes it less enjoyable and tends to produce untidy results…

2.3 Materials for Leatherwork

The materials which are useful for leatherwork are many. However, none is of more importance than leather itself. Therefore it is necessary for the craftsman to know the type of leather useful for his project in leatherwork. In confirmation of this statement, Petersen (1961), opines that it is important to choose the right kind of leather in the correct thickness and pliability for the article one intends to produce. In the light of this, leatherwork students must know the nature of the number one material they will be working with, as well as, other essential items.

The pelts which are commonly processed into leather come from domestic animals. The following are some of these animals and some articles, which can be made with their leathers as outlined by Petersen.
Cowhide – is used for soles, cases, bags and briefcases that must wear well. The middle of the hide or back of the animal is the thickest part of the skin. The sides are some-what thinner and less uniform in thickness.
Calfskin – is a close-grained leather which is beautiful and durable. It is available in many different weights, which are suitable for handbags, cases, chair cushion and tooling.
Pig skin – has a very distinctive grain with wrinkle and holes from the pig bristles. It is often initiated but one can determine its authenticity by examining the flesh side; the small hole should go completely through the

skin. This leather is appropriate for the same articles which are made of calfskin.

Sheepskin – is an extremely versatile, soft and supple leather to work with. It is used for cases, handbags and jackets, among other things. Sheepskin is hard to model.

Goatskin - has a fine, soft surface but is durable nevertheless. This leather is suitable for purses, cases, gloves and many other articles. It is obtained in many colours. Its natural grain often referred to as morocco grain is sometimes covered with an artificial one.

Suede – is a finish on the flesh side of leather. Calf suede is used for footwear. Goat and sheep suede are used for many items of clothing. Suede should feel soft, uniform and pliable. Lizard, snake, crocodile, elephant, camel, turtle, ostrich suede are amazing to work with but they are not common. Equipped with the knowledge of the type of leather available to him, the craftsman next goes in for other materials useful to support the making of leather articles.

Thread – is of varied kinds and uses. It must be chosen to suit the work at hand. Saddlers' thread is good for heavy-duty articles such as briefcases. Bookbinders thread is strong and easy to use for decorative works.

Copper yarn - is available in several colours and gauges and is strong.

Buttonhole silk – comes in all colours and are appropriate for gloves, cases and bags. Nylon threads come in different colours and are very strong.

According to Petersen (1961), the stronger the kind of cotton, silk and nylon thread, work well in a sewing machine. Most machines will operate with a heavier thread provided the needle size is increased and the hole in the work-plate allows the needle to pass through.

He further explains that: To sew leather you will need straight and curved needles, glover's needles, which are sharp-pointed, and saddler's harness needles which are blunt. To lace leather you should have a thonging or tapestry needle and a spring thonging needle.

The use of sewing machines will enable craftsmen to produce leather articles at a faster rate to meet market demands. This is so, because formal education in leather involves the search for more and easier means of producing equally beautiful and quality articles.

2.4. Leather Processing Technologies

Most of the tanning technologies which were used years ago are still being used in many countries today. This is particularly true in the developing countries and also among craftsmen in industrialized countries who prefer to use manual approaches to produce leather. This is done to enable craftsmen to manipulate it to achieve the exact effects they prefer.

The Encyclopedia Britannica ready reference has defined technology as the application of knowledge to the practical aims of human life or to changing and manipulating the human environment.

It further explains that, Technology includes the use of materials, tools, techniques, and sources of power to make life easier or more pleasant and work more productive. Whereas science is concerned with how and why things happen, technology focuses on making things happen. Technology began to influence human endeavor as soon as people began using tools, and accelerated with the Industrial Revolution and the substitution of machines for animal and human labour.

The revolutionary development in leather processing came with the improvement of the tannins properties as well as the technologies needed. Khan Impex Co.
(2003) has stated that,

> Another revolutionary factor was the substitution of the tanning pit with the rotating drum, along with the discovery of new type of tannins. As a result of these innovations, the time needed for tanning was greatly reduced; a process requiring eight to twelve months was reduced to just a few days….

One interesting fact about tanning is that most manual technologies and tools used several years ago have remained the same. Concerning this Khan Impex Co,(2004) indicates further that:

> …and we find that these remained almost unchanged from the Paleolithic times to the threshhold of the modern era, apart from improvements in efficiency and ease of use. Similar tools for fleshing 'scraping, shaving, perching, padding and trimming have been found from almost every historical period in which tanning was carried out.

For the purpose of this project, indigenous technologies are considered. However these technologies have some common processes or techniques. The Encyclopedia Britannica, (1977) has outlined the basic techniques involved in the preparation of leather as follows:

> ….(1) Removal of undesirable constituents such as hair, flesh and fat, leaving a concentrated network of high-protein collagen fibers, greatly softened and interspaced with water.
>
> (2) Tanning, that is tanning the hide with an agent, called tannin that displaces the water and then combines to coat the collagen fibres. Tannin increases resistance to heat, hydrolysis
> (decomposition caused by water), and micro-organisms.
>
> (3) Leather finishing is used to obtain proper thickness, moisture, lubrication and aesthetic appeal. Thus leather is essentially animal skin protein combined with tannins, small amounts of oils, dyes, finishes and moisture…

Through this major process, it is possible to adapt leather tanning to suit classroom conditions. To achieve this, vegetable-tanning technique transcends continental and national barriers. Although chemical or machine tanning produces more leather at a faster rate, vegetable tanning is the most preferred because of its better response to tooling and other decorative techniques. The Encyclopedia Britannica (1977) comments on it that vegetable tannage is still an important tanning method. Delimed pelts are treated with infusions of vegetable tan stuffs resulting in full, solid leather. Most tanneries purchase hides and skins that had been cured or preserved to prevent decay. The technique for curing consists of dehydration without

disturbing the skin structure. According to the Encyclopedia Britannica, the common methods are simple air drying which yields bony flint hides; salting which includes treating the hide with a saturated solution (brined); rubbing the flesh side with salt (wet salted); further drying (dry salted) and picking the pelt acid and salt. Preservatives are also added to improve curling efficiency. Curing is an essential skill which can be adapted to suit the classroom situation.

The first operation after hides or skins are received in the tanneries is beaming. This is done to remove dirt, salt and some soluble proteins. Beamed pelts are taken through fleshing process where razor-sharp knives are used to scrape the flesh and tissues from the inner side of the hide. The knives leave clean, smooth surface. After fleshing comes dehairing which according to the World
Encyclopedia vol. 12 (1972), states:

> …To remove the hair, workmen soak the hide from three to seven days in a tank containing lime and a small amount of sodium sulfide. They stir the hides in the tank each day.
> This soaking loosens the hair from the hides…

Pelts must be refleshed after dehairing. This is done because the lime used in the dehairing process swells small particles of flesh that were not removed in the first fleshing operation, and it makes the flesh side of the skin rough. Each stage for preparation of pelt for tanning is very important because without proper preparation, good quality leather cannot be produced.

After dehairing bating is done, it involves the removal of the lime which was used in dehairing to make the leather soft. The pelts are washed with cold water. Then they are treated with bating materials like ammonium sulfate, ammonium chloride or any other mineral that will eliminate the effect of the lime. It also contains some enzyme, a protein that softens the pelts. The bating process may last from thirty minutes to four hours (30min.-4hr). When it is finished, the pelts are washed in cold water and bating material is allowed to drain off, and a clean – white pelt is produced. Once leather has gone through the preparation stages commonly known as ‘beam house operations’, it is made ready for tanning to be done. The choice of vegetable tanning technology is that it is very common to the local people, therefore teachers

and students can get assess to materials and technical advice easily. It is comparatively cheaper in terms of production cost and no machine is involved.

The technique for vegetable tanning is very much dilated upon by the 14th edition of the Encyclopedia Britannica, (1977); it explains that:

> …Vegetable tanning may be conveniently dealt with in two distinct groups-
>
> (a) the tanning of heavy leather-sole, belting, harness, etc.and
>
> (b) the tanning of lighter leather-shoe uppers' fancy leathers, book-binding etc.
>
> The tannage of sole leather usually consists of three group operations: - (1) Colouring, by suspending the goods in a series of weak liquors of gradually increasing strength.
>
> (2) Laying the goods in strong liquors and transferring them to stronger liquors as the tannage proceeds; the operation being called handling and the series of pits being described as the "handlers".
>
> (3) Placing the goods for comparatively long periods in strong liquor after they have been dusted (in layer pits, called "dusters") with a small quantity of solid tanning material between each piece of leather. The suspender tannage is accomplished in a series of pits containing weak liquors that have been used upon previous goods.
>
> The goods are moved from the strongest suspender pits to the
>
> "handlers" or "floaters" being handled daily by being drawn up on the side of the pit, allowed to drain and then retransferred to the pit in a horizontal position moving the goods to pits of gradually increasing strength of tannin. At the end of the "handler" round the goods are usually almost completely tanned and are then transferred to the "layers" which contain very strong liquor obtained from the leaches of previously

> unused tannin; or by addition of chestnut or oak wood extract. In the "layer" the goods may be re-transferred into increasing strength solution at the end of each one or two weeks. This treatment permits the deposition of bloom and conduces to the production of firmer, harder, heavier and better wearing leather.
> To complete the process, the goods are removed and drained and then scoured to remove the deposited bloom from the grain…

The production of heavy leather however is not very often done by local tanners in Ghana and as a result most of the hides are exported to other countries. This probably is due to the common use of light leather by local leatherworkers. The Encyclopedia Britannica (1971) continues to expound on the tannage of
lighter leather such as calf skins by stating that:

> One of the essential differences in the manufacture of this leather by the vegetable process is in the preparation before tanning. After liming, unhairing, fleshing and scudding the goods are either most commonly bated, or very thoroughly delimed. The goods after bating are sometimes pickled: sometimes, however, this operation is omitted. Usually the tannage is begun by suspending the skin in nonastringent liquors consisting of used liquors originally prepared from a mixture of two or more of the following materials –mimosa bark, mirobalans, gambier, quebracho chestnut and oak wood extract after the goods have been suspended for a period varying from two to seven days, the tannage may be completed in a "handler" round, the good being finally given a retannage with a view to lightening the colour by drumming, paddling or suspending in a warm sumac infusion.

Tanning of lighter leather is very common and it is useful for adaptation in the school curriculum. The processes involved and the materials required are very simple and easily available. Concerning the materials used for tanning, the American Educator (1970) states that:

> Among the most common sources of tannic acid, or tannic, are hemlock bark, oak bark, chestnut wood and bark, myrobalans, sumac bark, valonia, divi-divi, mangrove bark and wattle bark. The choice often depends on the country in which the leather is made.

The wide range of sources of tannins is a great advantage for adapting vegetable tanning techniques. This enables tanning to progress so long as pelts are available for use.

The third and last stage for preparing leather is finishing. The American Educator states that after it has been tanned the leather must be treated to acquire the feel and the appearance necessary for the product in which it is to be used .

As leather dries after tanning it becomes stiff and rough and it must be carefully worked to serve its purpose. The process for finishing involves many skills. This begins with shaving: where leathers are shaved on the flesh side to remove any small bits of flesh left that might be clinging on the leather. This may be followed by 'splitting' where the leather is very thick; a razor-sharp knife is used to split it into two. The upper thickness is called 'grain' and the lower thickness is called 'flesh split'. Next, the leather is scoured by hand until the grain surface is thoroughly cleansed from bloom and excess tannin.

The next process is 'fat-liquoring' where leather is treated with oils or grease to make it flexible and strong. Excessive stretch is removed from the leather so that it will maintain its shape when wet, this is done by the act of 'staking' where one edge is pulled. Tacking follows immediately; the wet leather is tacked, clamped or pasted on boards, and then allowed to dry.

The next stage for finishing is dyeing. The choice of dye depends on the tanner and it involves so many approaches. According to the Encyclopedia Britannica (1971)**, t**he dyeing process is accomplished by the following Methods, (1) Brush: dyeing or 'staining', (2) Clipping, (3) Dyeing in paddle or drum, (4) Spraying.

2.5 Decorating leather

The decoration of leather may come in diverse forms and they are meant to add more value and attractiveness to the leathers. These include; textures, painting, ironing, dyeing, and several others.

According to the American Educator (1970), The attractiveness of some leathers is often increased by 'boarding' an operation in which an operator continually folds the piece of leather and makes tiny creases in it through the pressure of a curved board fastened to his forearm .

Commenting on the use of leathers and their decorations as found in some countries in Africa, Trowell (1960), explained that;

> Skins both in the form of raw hide among primitive peoples and dressed leather among the more technically advanced have always been widely employed. Not only can they be used for clothing but also to make screen and shelters, harders, and binding thongs, shield and scabbards, shoes and sizes. It is therefore not surprising to find that a number of different methods have been evolved for their decoration.

Among the decorative techniques mentioned by her are, 'Shaven pattern' where skins from which hairs have not been removed are shaven off in certain parts.

Patterns are carved in low relief where thick, tough hide can be carved.

After observing certain tribes in East Africa, Trowell, made a statement that, perhaps the most exciting patterns on hides are painted designs on shields used by certain tribes in East Africa.

She further states that:

> Among the Masai and kindred tribes a form of heraldry has been developed by which those who know the signs can tell the district from which the warrior has come and whether he is considered by his fellows to be a brave man and so on(p. 42)

She has again explained that, the Masai warrior did not carry an identity card to identify himself, yet he could be identified by the traditional designs found on him.

In Northern Ghana, decorations on leather articles have been based on identifiable traditional motifs through the techniques of incision, painting and line tooling.

Documentary report from the files of Down Home Leather on the history indicates that the basic form of leather working was to simply cut the skins to form decoration. This early cutting of leather was responsible for one of the best known designs, a design that still is in production today.

Hard leather that was thought be unworkable was found to be pliable when soaked in water. This allowed the leather to be moulded into buckets, drinking vessels, bottles, boxes, quivers, and even armour. These in turn were then decorated by embossing a design onto them while they were wet. An alternative means of decoration was to "tool" the skin; this was achieved by drawing a pattern onto the surface of the leather, then lightly impressing it with a heated brass tool.
The decorative effect was completed by the use of gold finger being applied to the pattern. This was then complimented by the use of decorative studs.This type of design is what has evolved into the type of work found on all types of leather products.

The unique characters of leather make it possible for divers' decorative techniques to be applied to it. Satan's (2003) has contended that:

> …The real fun of leather crafting is the creative aspects . . . making an altogether new design, simulating and improving an existing one, or combing things in unique ways. The skills required to actually execute the construction of a piece are pretty basic, once they are mastered a whole realm of possibilities open up….

Beside the occupational avenue it can provide, leather articles decorated with traditional motifs harmoniously with contemporary ideas will be educational material for local people who have lost touch with their tradition. It will also maintain the Ghanaian identity in the face of foreigners who buy them. Pictorial illustrations of stories as found in Egyptian tombs, walls of

Babylonian palaces and Greek temples have been found to be carved out of leather. Many important ancient Roman manuscripts have had leather covers designed with pictorial scenes.

The common problem of teachers and students of not getting access to books and relevant material with local background will be solved with the availability of the project report .The report will help teachers and students to identify materials, tools, equipment and technologies which relate to the local communities to facilitate teaching and learning. This is emphasized by Dunnet (1948), that, in education of children the quality and value of an activity must be considered in relation to life in a community as well as in relation to the development of the individuals.

It is therefore of great value that the Educational Reform has made it possible for indigenous based courses to be introduced in the educational system in order to make the student a useful member of the community after his or her schooling. This is to be achieved through the objectives envisaged in the programme that will enable the student at the end of his course to:

a, Identify, prepare and use material in his localities for a particular vocation;

b, Design and execute leatherwork in terms of processing of the material or using it for making articles; c, Appreciate and criticize his own work as well as other work of art.

The development of improved tanning technology to suit the school condition will enable students to understand the nature of the material they work with better since different types and parts of leather have varied uses. It will also enable students to learn how to preserve the material and protect it.

CHAPTER THREE

MATERIALS, TOOLS, AND EQUIPMENT

This chapter deals with the materials and tools used during the execution of the project work.

3.1 Materials

Materials are items used in making the physical and the visual product of the project. The materials form part of the work. The raw materials used for this project include, vat dye, suede-dye, alum, common salt (sodium chloride), caustic soda, sodium hydrosulfide, leather, water. wood glue, cassava starch, enamel paint, acrylic paint, printing paste sandpaper, Hardened rubber (combo) , shaft (two), bearings , hardener (a carbon solution for hardening soft metals), metal rod,"L" metals, motor belt, motor, metal plate, screws, pulleys, blades, wood, bolts and nuts, oil.

3.2 Tool

This refers to any hand- or machine-operated device employed in engineering, manufacturing, woodworking, and metalwork to cut or shape metal or wood products or parts. Hand tools and important machine- or power-operated tools used for this project include screwdrivers, wrenches, saws, drills, pliers, staplers, spirit levels, and calipers, lathes, dies, presses, and equipment used for boring, milling, and welding, plastic spoon, plastic bows (one 1liter and one 4liters), These tools were used in the execution of the project to enhance the easy execution of work.

1. **Knife;** for cutting straight edges and curves. For cutting straight lines in hide or other thick leather.
2. **Pinking shears;** it has sharp zig- zag edges to make a zig- zag cut where leather edges are particularly to be left. It also helps to decorate leather edges.
3. **Hammer;** for general use in hammering folds and edges and also for use with press- stud tool, thonging tool, stitches spaces, fancy punches, etc.
4. **Pliers:** Pair of ordinary pliers are good for pulling needle through tight holes.
5. **Burnisher:** This is a smooth plastic or hardwood wheel with a groove round the rim. It is fitted over the edges of the leather and rub hard till you get a smooth shiny finish.
6. **Leather shears;** these are for cutting through anything from skiver to hide, especially heavy- weight garment leather (but they will not go through sole
leather).
7. **Sanding block:** This is a little wooden block around which a piece of glass paper (Sandpaper) is wrapped tightly for easy handling and sanding.

8.Sanding machines; Machines under which abrasive sheets are fixed to make smooth the surfaces of wood. (see plates 1&2).

Plate 3.1a Sanding machine **Plate 3.2b** Sanding machine

9. Pestles; A club-shaped implement for pounding or grinding substances in a mortar. (Plate 3.3).

Plate3. 3 Pestle

10. Hammer: This tool consists of a piece of metal with a flattened end which is fixed on a long thin usually wooden handle used for hitting the nails.

11. Pincers: This tool was used for pulling nails out of the wood.

12. Square: This tool was used for straightening the ends and corners built up of the work.

13. Plane: This tool was used to make the wooden surfaces and edges flat and smooth by shaving off small strips of the wood.

14. Saw: A tool with a long blade and a row of sharp points along one edge which was used to cut smaller wood

15. Brush: An object with short pieces of brittle hair which is fixed into a wooden handle. It was used for painting(plate 3.4) .

Plate 3.4 Brushes

Plate3. 5 Measuring Tape

16. Tape measure: This is a device for taking measurement

17. Combined sawing surfacing and mortise: A device that is used to cut bigger boards into smaller units

18. Screwdriver: for tightening and loosening of screws. The screw driver was used in most part of the work especially when fixing something onto the platform of the work.

19. Adjustable spanner: to tighten big and small bolts and nuts used in the work.

It was also used in tightening the turning machine whenever we fix a rod of metal to be turned to the required shape. Plate3.6.

Plate3. 6 Adjustable spanner

Plate 3.7 Flat spanner

20. Centre Punch: for locating the centre of the rod to be drilled. The rod of metal was punched with the center punch (made of hard steel) anytime a metal rod is to be drilled, this prevents the drill from warbling when drilling.

21. Hacksaw: For cutting metal rods and other parts of metal objects. The machine type of hacksaw was used for cutting heavy metal rods for the

production of the work. Plate3. 8.

22. Calipers (inside and outside): Mechanical device is used to determine small lengths with reasonable accuracy. Simple calipers have two movable legs of some desired shape to meet the surfaces whose separations are to be measured. The adjusted width between the leg tips is then placed against some length scale. The more complex vernier caliper is wrench like and has a scale that allows direct reading of the adjusted width between the jaws of the wrench.

23. Vernier caliper: For measuring the circumference and the depth of a hollow metal. Fig:3. 9.

Plate 3.8 Hack saw

Plate 3. 9 Vernier caliper

24. Electrodes: The electrodes used in arc welding are made of flux-coated metal. It comes with a gauge that aid in the welding of metals. Every part of the work was welded for it to become firm.

25. Dividers: for transferring measurements from rule to metals by making markings to be cut.

26. Protractor: for measuring the diameter of a metal rod for accuracy

27. 60° Triangle: for measuring angels with 60° or below it.

28. Bench vice: for holding metals firm to be cut with the hack saw blade.

29. Lathe; (Plate3.10). The oldest and most common type of turning machine holds and rotates metal or wood while a cutting tool shapes the material. The tool may be moved parallel to or across the direction of rotation to form parts that have a cylindrical or conical shape or to cut threads. With special attachments, a lathe may also be used to produce flat surfaces, as a milling machine does, or it may drill or bore holes in the work piece. Plate3.10.

Plate 3.10 Lathe

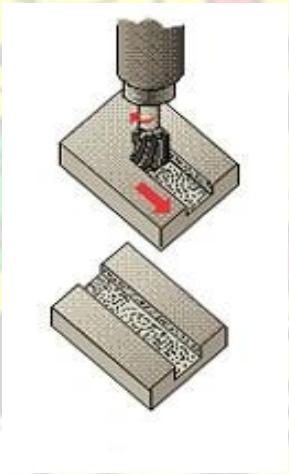
30. Shaper; (Plate3.11) The shaper is used primarily to produce flat surfaces. The tool slides against the stationary work piece and cuts on one stroke, returns to its starting position, and then cuts on the next stroke after a slight lateral displacement. In general, the shaper can produce almost any surface composed of straight-line elements. It uses a single-point tool and is relatively slow, because it depends on reciprocating (alternating forward and return) strokes. For this reason, the shaper is seldom found on a production line. It is, however, valuable for tool and dies rooms and for job shops where flexibility is essential and relative slowness is unimportant because few identical pieces are being made. It is also a kind of machine used for cutting dents in metals. The machine moves forward and backward in that order, as it does so; it will be cutting the dent in the metal held in place by the clamp. A "tool" is fixed at the tip of the machine. It is also used in straightening the edges of a metal.

32. Planer; (Plate3.12). The planer is the largest of the reciprocating machine tools. Unlike the shaper, which moves a tool past a fixed work piece, the planer moves the work piece past a fixed tool. After each reciprocating cycle, the work piece is advanced laterally to expose a new section to the tool. Like the shaper, the planer is intended to produce vertical, horizontal, or diagonal cuts. It is also possible to mount several tools at one time in any or all tool holders of a planer to execute multiple simultaneous cuts. Plate 3.3.

Plate 3. 11 Shaper

Plate 3.12 Planer

33. Milling Machine; In a milling machine, a work piece is fed against a circular device with a series of cutting edges on its circumference. The work piece is held on a table that controls the feed against the cutter. The table conventionally has three possible movements: longitudinal, horizontal, and vertical; in some cases it can also rotate. Milling machines are the most versatile of all machine tools. Flat or contoured surfaces may be machined with excellent finish and accuracy. Angles, slots, gear teeth, and recess cuts can be made by using various cutters for shaping rod to the required size; it is powered by a heavy motor (with high speed, above 278h/r) and high electricity current. Most parts of the work were shaped by the use of this Machine. Figure 2.



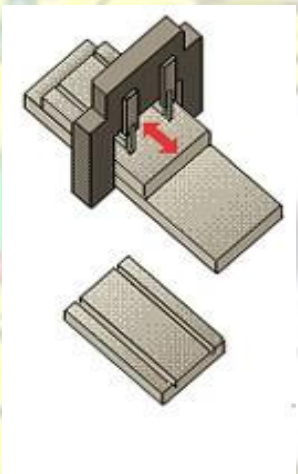


Fig. 3.1 Lathe

Fig.3. 2 Milling Machine

Fig.3.3 Planer

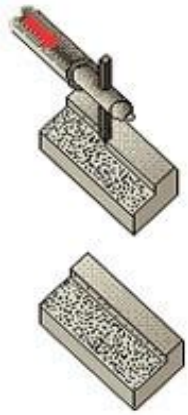


Fig. 3.4 Shaper

34. Drilling and Boring Machines; Hole-making machine tools are used to drill a hole where none previously existed; to alter a hole in accordance with some specification (by boring or reaming to enlarge it, or by tapping to cut threads for a screw); or to lap or hone a hole to create an accurate size or a smooth finish. Drilling machines vary in size and function, ranging from portable drills to radial drilling machines, multispindle units, automatic production machines, and deephole-drilling machines.

Boring is a process that enlarges holes previously drilled, usually with a rotating single-point cutter held on a boring bar and fed against a stationary work piece.

Boring machines include jig borers and vertical and horizontal boring mills.

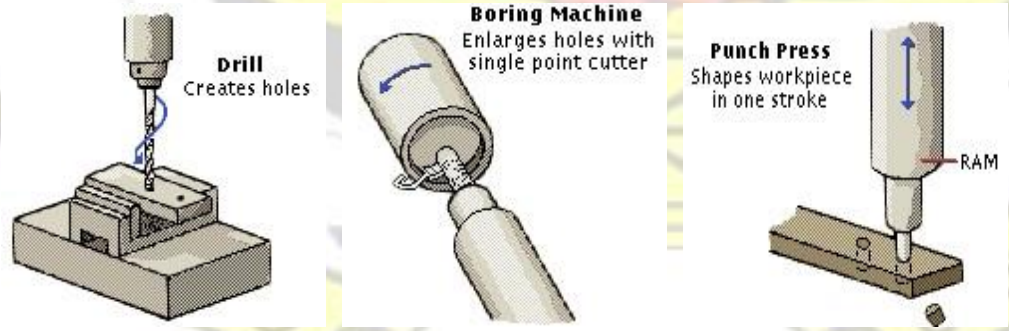


Fig. 3.5 Hole Making Machine

35. Grinder; Grinding is the removal of metal by a rotating abrasive wheel. The action is similar to that of a milling cutter. It smoothens rough surfaces of metals. Parts of the work was smoothing with the sanding machine before it was fixed onto the board or the plat form. The wheel is composed of many small grains of abrasive, bonded together, with each grain acting as a miniature cutting tool. The process produces extremely smooth and accurate finishes. Because only a small amount of material is removed at each pass of the wheel, grinding machines require fine wheel regulation. The pressure of the wheel against the work piece can be made very slight so that grinding can be carried out on fragile materials that cannot be machined by other conventional devices. Fig: 3.6

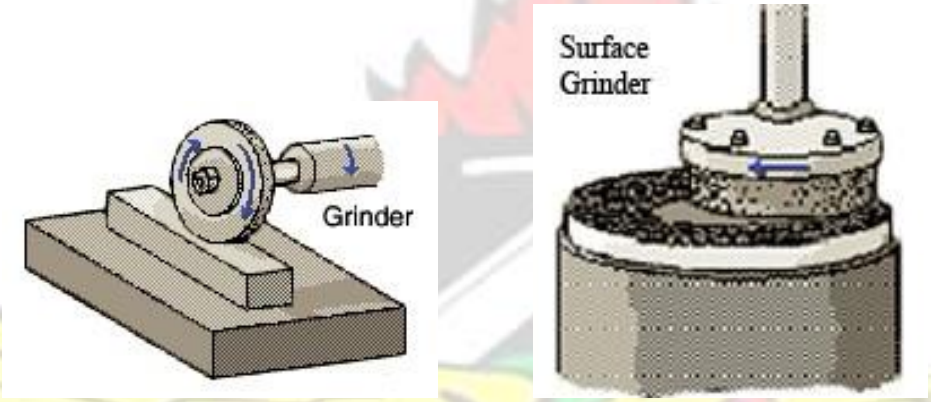


Figure 3.6. Grinding machines

36. Nail; This is a small and thin piece of metal with a pointed end. It is driven into wood with the aid of a hammer fastening pieces together.

37. Working table; It is covered with a sheet of hardboard to protect the top. Craftsmen can cut on it directly or on a piece of plywood or plastic support. This will not blunt the cutting knife.

38. Emerald paper; this is a fine grain abrasive paper used for sanding the grain side of leather for easy absorption pigments.(Plate3.13)

39. Wood glue; This was used to hold joints firmly together before they were nailed together firmly. (Plate 3.14.)

Plate 3.13 Emerald paper **Plate3. 14** Wood glue

40. Dyes: Any of a class of complex organic compounds that are intensely colored, used to color textiles, leather, paper, and other materials. 1,Vat dye 2, suede dye.

41. Mordant. Chemicals that combined with dyes to prevent them from dissolving easily.

42. Beewax: It is used for sealing and polishing hide edges

43. Velcro: A fastening material consisting of two nylon surfaces one of tiny hanks and the other of tin fibres which bond tightly when pressed together but are easily pulled apart. –HOOKED VELVET.

44. Safflower Oil: it is boarded into the fibers to soften the leather. Native to parts of Asia and Africa, Oil obtained from the seeds, it is valued for its high proportion of polyunsaturated fats it does not yellow with age.

45. Plywood: Different sizes of plywood were cut into various sizes to construct the two dryers ,(i.e. the sides of the frames and the stretchers).

46. Mortar; A strong vessel in which material is pounded or rubbed with a pestle.

See plate 3.15

Plate 3.15 Mortar and pestle

47. Perspex – A strong transparent heat resistant plastic substance. It was used in making the covering of the equipment at the top and to seal bottom of the dryer.

48. Nail; a slender metal shaft, pointed at one end and flattened at the other end, used as a fastener.

49. plastic bow; dye solutions were prepared in them, plate 16.

50. Wooden trough; this is used to hold the size (cassava starch) during control marbling, see plate 3.17.

Plate 3.16 Dyes bowl with liquid dye

Plate 3.17 Wooden trough

51. Vegetable tanned leather; leather that has been prepared with plant based chemicals, see plate 3.18

Plate 3.18 Vegetable tanned leather

52. Fur; this refers to animal skin or hide that has the hair on it either in a raw or processed state, see plate 3. 19.

Plate 3.19 Fur from goat.

53.Oil paint; this was used as leather colourant through control and uncontrol marbling techniques, see plate 3.20.

Plate 3.20 Oil paints in adapted containers

54. Hardener solution: A mixture of carbons, phosphate, potassium and nickel that are used for hardening mulled steel or soft metals to make them hard to break. 20% of it was used to harden the blades.

55. Metal rod: a solid metal used for metal fabrication. The metal rod was used for producing the stands that will hold the roller and the blades.

56. "L" Metal: is a flat metal shaped in the 'L' form. It was used for the stands that will hold the whole work firm to the table.

57. Sanding sealer; A watery chemical applied on wood surfaces to seal pores for a good finish**. See** plate 3. 21.

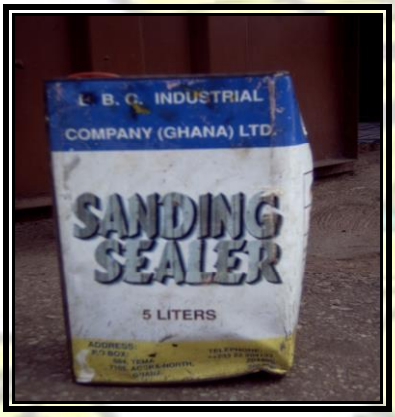


Plate 3.21 Sanding sealer

58. Acrylic paint; A paint put on the surface of wood to decorate and preserve it.

59. Hard rubber: it is a rubber, which was turned to serve as a roller and as a support whenever the leather is passing through the blades to be cut.

60. Motor: A powered machine that turns or moves objects. It was used to move the blades to be able to cut and roll out the cut thong out.

61. Metal plate: it was used as for the housing of the motor and the cutting place of the machine and it serve as the main body of the machine.

62. Screws: it was used in tightening most parts of the machine and it is the only material that can make the machine stand firm.

63. Pulleys: it is a solid metal that is attached to power motors to aid in accelerating wheels and other objects. It is moved by a belt that links it to the blades.

64. Shaft: a hard metal which was used as the main support for the blades and the rubber roller.

65. Sandpaper; These are abrasive sheets applied rigorously on wood and leather to smoothen them. See plate 22.

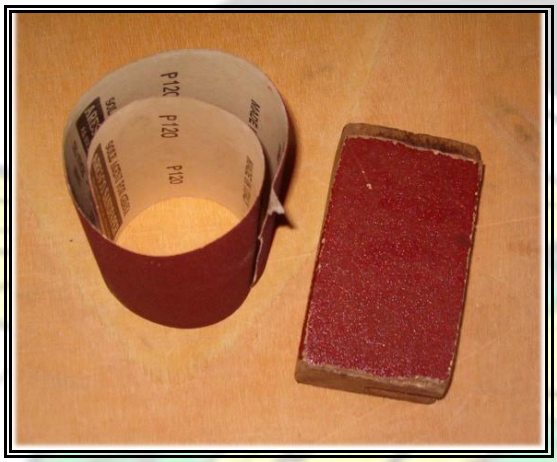


Plate 3. 22 Sand paper and sanding block

CHAPTER FOUR

METHODOLOGY

4.1. Research Design

The researcher employed the Descriptive and Experimental and the Qualitative Research Methodologies for the research.

4.2. Library Research

Library research forms a major part of the study. The following popular libraries were visited on a number of times; the Kwame Nkrumah University of Science and Technology Libraries, the Ashanti Library, The British Council Library, The University of Winneba, and Kumasi Campus Library. In all the libraries, sufficient efforts were made to secure much information for the secondary data. The sources of information from these libraries include books, encyclopedia catalogues, and the internet.

Important information on leather processing from literary materials directly related to Art Education and leather manufacture were critically looked at. In all, about fifty (50) articles from the web sites and five (5) books were read, however only a few web site information was used for the related literature. The literature, which was scanty and was directly or indirectly related to indigenous leather processing technology, was only written by foreign writers. For the sake of the related literature review, this was broken down into Historical, Tools and Equipment, Materials for Leather, Leather Processing Technology, and
Decorating Leather.

In an attempt to find solutions to some of the technical problems in the Indigenous Leatherwork Industry and their implications for Art Education in Ghana, efforts were made to understand the various technologies identified in the various sources of information to adapt the relevant ones for this project.

4.3. Industrial Research

The researcher visited the following tanneries in Ghana; Indigenous Leather

Tannery at Asawase, a suburb in Kumasi, Sarbon Zongo at Tamale and at Bolgatanga to seek information relating to indigenous leather manufacturing techniques. These included the types of tannins and their sources, the materials tools and equipment they use, as well as the technologies they use. A visit was also paid to Kumasi Leather Tannery at Kwamo but unfortunately it was realized that it had been closed down for some years now. Every effort to trace the owner for information on the operations of the factory before its closure and the reason for the closure proved futile.

A visit was also paid to some master craftsmen who use indigenous tanned leathers in Bolgatanga and Kumasi to identify their approaches to the use of tanned leathers. Besides, some curators, gallery owners and leather product dealers were also contacted.

The researcher also paid some visits to some educational institutions, which offer leather as a course of study and talked to some of the teachers and students who offer the subject. By so doing, the researcher was able to identify some of the problems confronting teachers and students in the teaching and learning of leatherwork in such schools.

4.4. The Research Instruments

The research instruments used were interview and observation to solicit the knowledge (data) of respondents concerning the technical problems in the indigenous leather industries and their implications for art education in Ghana The researcher also tried to modify certain parts of some existing machinery to solve some of the identified problems.

4.4.1. Interviews Conducted. Formal interviews were conducted. This technique was more relevant to the researcher than other information gathering devices, since most of the respondents could neither read nor write in English. Besides, this technique enabled the researcher to get closer to the respondents, win their confidence and establish cordial relationship with them. This was important because it enabled the researcher to acquire information crucial to the project.

Direct interviews were conducted both at local tanneries and in schools, these were in Hausa, Twi, and in English languages where applicable (especially when dealing with some of the local tanners, interviews in Hausa were conducted through interpreters).

4.4.2. Observation: Visits to local tanneries enabled the researcher to make on the spot observation of the technologies indigenous tanners use in processing leather. The researcher also had the opportunity of seeing some of the equipment, tools and materials used by the tanners. On the spot observation was also made at selected leatherwork-shops and stores where tanned leathers and leather articles were processed or sold This was to identify how they handle some of the tools and materials they use in their vocations. Visits were also made to some schools where leatherwork as a course of study is offered as a course of study. This was to enable the researcher to interact with respondents in such institutions for first hand information on some of the problems they encounter in the teaching of leatherwork.

4.4.3 Data collection: The primary data was solicited from indigenous tanners, leatherwork teachers, observation of the leather processing activities of local leatherworkers, those who trade in leather and manufacturers of leather goods.

These involved information on the technologies, materials, tools, and equipment used by indigenous leatherworkers.

The secondary data were mostly collected from documentary sources (books, publications, and the internet), and

Data collected from both primary and the secondary sources were assembled, synthesized, critically evaluated (analyzed).

The processes involved in executing the project are divided into groups of activities and these are based on the stated objectives. Before each project is carried out the indigenous approach is first identified with photographic illustration

4.5. Procedures in Executing the Project.

4.5.1. Overview: The leather industry in Ghana has largely depended on indigenous technology; however, the natures of some of these technology do not make them attractive for use by students. It is in view of these, that selected technologies have been designed to solve these problems. The methods adopted in solving the identified problems are meant to be simple for students and craftsmen to work with.

4.5.2. The first objective is meant to identify local tanning technologies, with the view to developing new ones, suitable for processing leather in schools and colleges. To solve this problem the researcher has designed and constructed tanning vessels suitable for being used in schools and colleges.

4.5.3. The second objective is meant for the production of sample leatherwork tools and equipment that will be suitable for use in schools and colleges. The tools and equipments that have been identified as very essential for the teaching and production of leather are Scudding equipment for fleshing and unhairing, dryer for drying pelt and leather, tumbling equipment useful for softening, boarding and drying leather, selected basic hand tools for making leather articles. These tools have been designed for construction with locally available materials in a manner that will make it easy for reproduction.

4.5.4. The third objective aims at identifying alternative locally available dyes and pigments for dyeing leather and fur, and to develop a mechanism through which the offensive odour, and moulds which are associated with vegetable-tanned leathers can be reduced.

The colorants that have been identified are vat dyes, sulfur dyes, reactive dyes, enamel paint, acrylic and printing paste. These colorants are available locally and can be secured in large quantities. Experiments are designed to control the offensive odour and moulds associated with indigenous tanned leathers.

4.6. Identified processes and equipment used by indigenous craftsmen

4.6.1. Vats or pits used at the indigenous tanneries. Craftsmen at the various local tanneries visited use either dugout pits also known as 'vats' or large open pots for the various stages of tanning. Those who produce leather on commercial quantities mostly use large vats for processing them. It was observed that the water that contains chemicals used for washing and deliming, as well as, the excess tanning liquor, are left unchanged for months whilst new tannins are added to them and then used over a long period of time. This gives out very strong odour which affects the immediate environment. This situation may not be permissible within the school compound where strong hygienic conditions are demanded. In the light of this, alternate tanning mechanism has been designed to make it possible for tanning to be carried out within the school environment. Typical scenery at a local tannery is depicted to demonstrate the conditions under which indigenous tanning takes place on commercial basis. (see plate 4.1).

Sample photographs of conditions in existing local tanneries.

Plate 4.1. A pit used as water reservoir.

Plate. 4.2. Wooden vats for tanning

Plate 4.3. A vat used for soaking and washing

Vats are often made or assembled closer together to facilitate easy transfer of pelt or leather from one vat to another. See plate 4.4, 4.5, and 4.6, vats that

have been dug closely together to permit easy transfer of pelts from one pit to another.

Plate 4.4. A broad vat used for liming.

Plate 4.5. Round pits used as vats

Plate 4.6. Tanning pits surrounded by heap of residue of hair and tannins

Plate 4.7. A vat used for tanning with ‘bagaruwa’ liquor.

Plate 4.8. Removing soaked pelts from pit, ready for unhairing.

4.6.2. Scudding technique used by indigenous leatherworkers

The cured skins are soaked in pure water to eliminate salt, blood, and dirt, and also to replace moisture lost in the curing process. After the skins have been soaked for a period varying from two hours to seven days, the flesh is removed by hand with a dull knife from the inner surface. To loosen the hair, the skins are then immersed for one to nine days in a solution of lime and water containing a small amount of sodium sulfide. Following this operation the hair is easily removed by defleshing in the same way as dehairing, and the distinctive pattern known as the grain can be distinguished on the outer surface of the skin. To ensure clear, clean surfaces, any remaining flesh and hair is further scrapped off, this process is known as scudding.

Round logs, large pieces of broken pipes and old long mortise are surfaces on which unhairing and defleshing is done. The craftsman sits on a piece of log and hook the edge of a pelt firmly with the knee to the scudding device before the scudding knife is used to work on it, by scudding from the top downward continuously in one direction until the entire surface is covered.

The technology used by indigenous craftsmen cause them to be soiled with dirt and the residue of the chemicals used for tanning; and these chemicals when smeared with it for a long time affect the health of the tanner. This situation does not make the work attractive to students so most schools do not practice tanning. They find the technology unattractive and difficult to practise, therefore they mostly purchase already tanned leathers.

Plate 4.9. Indigenous process for dehairing.

Plate 4.10. Defleshing process, the same as dehairing.

4.6.3. Drying techniques used by indigenous leatherworkers.

Drying is one of the processes pelts are taken through more than once before they are finished as leathers. However, because of the dependence on weather conditions for drying, production is often slowed down during rainy seasons. Besides, inadequate space and the fear of theft also make drying a problem for leatherwork students.

Sample view of mechanism for drying pelts and leathers as used by indigenous tanners. This technique is particularly done during the curing stage of processing pelts in the open air when they are held down with wood or bamboo pegs or long nails as in plate 4.11, 4.12and 4.13.

Plate 4.11. Drying pelt on the ground by stretching with nails.

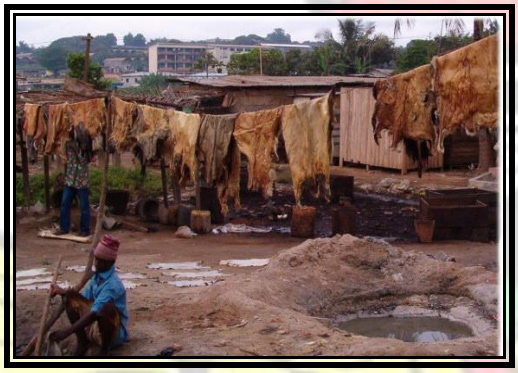


Plate 4.12. Drying Pelts on drying lines **Plate 4.13.** Drying leathers on the ground

This technique is specially used when fleshly skinned pelts are meant to be used early. Plate 4.14. Cream (Khaki) coloured leathers

Unavailability of specially designed stretchers causes students to stretch their pelts and leathers on any available surface as in Plates 4.14, 4.15, 4.16, and 4.17.

Plate 4.14. stretching on an old plywood

Plate 4.15. Stretching on a workshop table

Plate 4.16. Stretching on a workshop storage box

Plate 4.17. Stretching on a drawing board

Leathers that were dried on flat boards with grain side up under the sun became boney and stiff after drying, than those dried in a shade. Plate 4.18.

Plate 4.18. Stretching on a wooden pole.

4.6.4. Indigenous technique used for softening leather.

Leathers easily become hardened during the drying process as a result of the contraction of the collagen fibres. Indigenous craftsmen therefore pull them by using their feet and a piece of rod to break up or loosen the fibres; this activity is performed when the leather is partially dry.

Leatherworkers fold leather loosely and then hit it several times on a cement block for the fibres to loosen out.

A sample view of the softening process used by indigenous craftsmen, plate 4.19 and 4.20**.**

Plate 4.19. Beating leather on a hard-smooth surface to soften it

Plate 4.20. Pulling-up leather to soften it.

4.6.5. Indigenous technique for cutting leather thong:

Indigenous craftsmen cut their thongs in straight strips from pieces of leathers by placing them on wooden boards and then cutting out with short knives. Accuracy is achieved after several years of practice and however, this technique does permit the cutting of longer thongs for thonging.

Students also cut thongs spirally from pieces of leathers, this permit the cutting of longer thongs. This technique is laborious and constitute bottleneck in the thong cutting because it takes a long time for thongs to be cut. Students complain about the pain of using the scissors and besides that, they always face the problem of cutting straight edges, and this affects the beauty of the thonging. The development of a thong cutter would therefore be a positive contribution to the training of students and promotion of the industry.

4.6.6. Indigenous technique for dying leather:

The dyes used by indigenous tanners are vegetable based and the most common colour is red. This is sourced from dry guinea cornhusk. Black is obtained by pouring water and limejuice onto iron filings that is kept in a plastic container. The other common colour is cream; this is obtained after vegetable tanning. To obtain the red colour, craftsmen cut dried guinea cornhusk into pieces and these are then put into a mortar and then pounded. The dyes easily turn pale after a while particularly when they are exposed to sunlight. Beside they also turn dark after they have been used over a period of time. The dyes are also limited in colour range and this restricts the choice of colours to achieve variety to enhance the value of leather articles both in aesthetical and in costing. The problem with vegetable based dyes is again compounded by the seasonal nature of the plant sources and their distant locations.

The problems encountered on the use of vegetable-based dyes do not argur well for the teaching of leather as a material useful for making variety of art forms. It is therefore necessary to explore the use of alternate available colourants which will help in the teaching and production of leather goods. Plate 4.21, Guinea cornhusks are pounded to leach out red dye (Plate 4.22).

Plate 4.21 Guinea cornstalk

Plate 4.22 Extracted dyes

Samples of Indeginous dyeing practices are illustrated in plates 4.23, 4.24 and 4.25.

Plate 4.23. Workers preparing leathers for dyeing

Plate 4.24. -Workers processing red leathers

Plate 4.25. Dyed leathers that are wringed out

Plate 4.26 Dyed leathers are dried on the ground or on dry-lines.

4.6.7. Development of Moulds on Indigenous Tanned Leathers;

Among the numerous problems confronting manufacturers and traders in leather goods is the rampant development of moulds on finished leather products. Leatherwork students lament over the development of moulds on their neatly finished products as a result of the irregular stains they cause on their surfaces. Traders in leather goods complain of not being able to sell their goods for the same reason and beside these, the Export Promotion Board is not able to promote the export of leather goods as they do to other crafts because of the offensive odour and the effect of moulds on leather products.

The effect of offensive odour and moulds on indigenous tanned leathers affects the development of the leather industry and education in leatherwork in Ghana. It is therefore expedient to find both technical and material means of solving these problems since large number of leathers continue to be produced by indigenous tanners and the articles produced cannot attract the much expected foreign buyers as other craft items.

A careful understanding of the effect of fungus attack on leather is essential for the craftsman to develop the mechanism for its control. In its description of mould, the Microsoft Encarta Encyclopedia Standard Edition 2004 states that, mould (fungi),

a fuzzy, cobweb-like growth produced on organic matter by several types of fungi. Mold and mildew are commonly used interchangeably, although mould is often applied to black, blue, green, and red fungal growths, and mildew to whitish growths.

In some cases the term mildew is commonly used. This is as result of the white substances found on the leathers. The Britannica Ready Reference also describes mildew as a conspicuous mass of threadlike hyphae (mycelium) and fruiting structures produced by various fungi. It further emphasise that mildew grows on cloth, fibres, leather goods, and plants, using these substances as food for growth and reproduction. When moulds are allowed to develop on leather for a longer period of time they cause unpleasant stains to appear on them and these are reveled after they have been wiped out. It has further been explained that molds thrive on a great many organic substances, and provided with sufficient moisture, they rapidly disintegrate wood, paper, and leather. Moulds have been identified in different forms, Encarta has stated that:

> Black bread mold, Aspergillus niger, one of the most familiar molds, begins as microscopic, airborne spore that germinates on contact with the moist surface of nonliving organic matter. It spreads rapidly, forming the mycelium (fungal body), which is made up of a fine network of filaments (hyphae). The mycelium produces other clusters of root-like hyphae, called rhizoids, which penetrate the organic material, secreting enzymes and absorbing water and the digested sugars and starches.

The nature of the fungi, which creates the molds, is another source of concern. The encyclopedia explains this as reproductive cell known as spores. These are capable of developing into a new individual without fusing with another
reproductive cell. It has been stated that

> Spores are agents of nonsexual reproduction; bacteria, fungi, produce spores…. Fungal spores serve a function similar to that of seeds in plants; they germinate and grow into new individuals under suitable conditions of moisture, temperature, and food availability.

Leather as an organic matter is generally susceptible to the attack of moulds, however, the rate at which this occurs on indigenous tanned leathers as compared to chrome-tanned leathers whenever they are exposed to moisture, is very high. This situation does not augur well for the promotion of indigenous tanned leathers and leather goods, which is not healthy in this competitive market era. The following are samples of leather articles produced with indigenous tanned leathers. Plates 4.27 and 4.28; Indigenous tanned leather that has developed moulds,

Plate 4.27. Mouldy indigenous leather article, 'table mart'

Plate 4.28. Mouldy leather article, 'traditional sandals'

The effect of moulds on indigenous tanned leather after it has been cleaned off with rage. Areas occupied by molds are eaten up leaving patchy spots in their places; plate 4.29 and 4.30.

Plate 4.29. Effect of moulds on the table mart after it had been cleaned

Plate 4.30. Effect of moulds on the traditional sandals (Ahenema) after it had been cleaned

4.7. Selected projects for solving the identified problems

4.7.1. Project 1.

Design and construction of alternate vessels for tanning

A) The schools that offer leatherwork do not have tanning plants so they always buy already tanned leathers from the local tanneries. Students do not have the benefit of acquiring practical skills in tanning as required by the school curriculum. In the light of this, it becomes necessary to adopt and reorganise technologies used by the local tanners to benefit the training of students and the industry.

4.7.1.1. The Designing Stages:

1), The drawing is made of five (5) medium size plastic containers with wide openings, capable of containing fifty (50) to one hundred (100) pelts. Figure 4.1.
2). Drawing is made of two special wooden stands in sets of two and three to hold the plastic containers firmly above ground level.
The following are illustrations of the proposed tanning equipment; Figure 4.1 and 4.2.

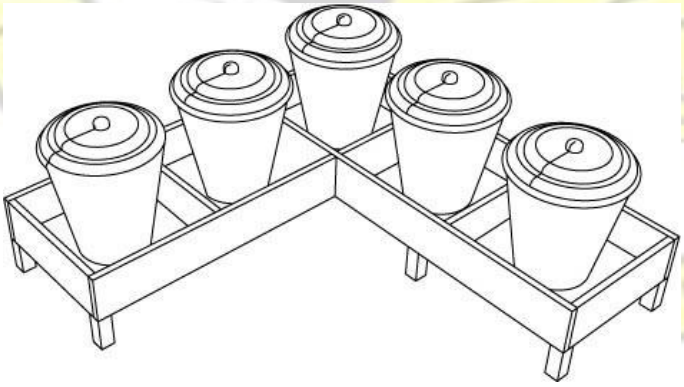


Figure 4.1. Lineal drawing of plastic containers used as tanning vessels.

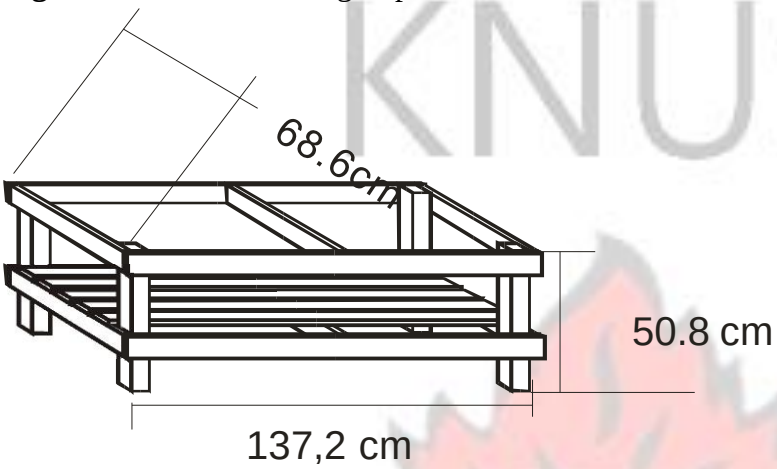


Figure 4.2. Wooden rack for two compartments

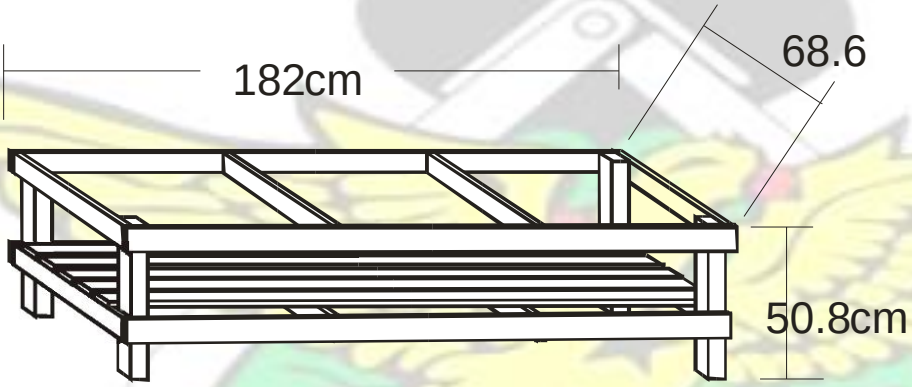


Figure 4.3. Wooden rack for three compartments

Rhinoceros representations of design.

Figure 4.4. Tanning vessel

Figure 4.5 A set of organized tanning vessels.

4.7.1.2 Constructing the equipment;

Materials Tools and Equipment:

The following materials, tools and equipment were used in organising the tanning plant.

Materials:

i. Sanding sealer**,** ii. Sandpapers**,** iii. Acrylic paint**,** iv. ½ inch Plywood

v. red-wood, vi. large size plastic

Tools:

i. Hammer, ii. Pincers , iii. Square, iv. Plane , v. Saw, vi. Nail vii. Tape measure

Equipment;

i. Sanding machines, ii. Planning machine, iii. Combined sawing surfacing and mortiser

Working Process:

Step 1. The plastic containers to be used as tanning vessels were selected and they were of the same make, colour and size (69.9cm x48.3cm × 118.6cm).

Step 2. The procedure for treatment of wood, preparation of the boards, cutting and planning are of the same process as those used for open dryer in page 119 and 120.

Step 3, Two special container guards in wood were produced. They were done by forming short frames, after which horizontal boards were nailed around them and partitioned as in plate 4.33 and 4.34. The first one consists of two spaces (Plate 4.33) to contain two vessels for soaking and deliming whilst the second consists of three spaces (Plate 4.34) for three vessels useful for containing three different strengths of tannins.

The following are the different stages for constructing the wooden guards.

Plate 4 31. Nailing the boards

Plate4.32 Securing the protective sides

Plate 4.33. Rack for two buckets

Plate 3.34. Rack for three buckets

Photographic representations of vessels

Plate 3.35. Plastic bucket as vat

Plate3.36 Plastic bucket 'vat' with cover

Plate 4.37. Vessels to hold three different strengths of tannins

Plate 4.38. Vessels for washing and soaking.

Plate 4.39. Set of tanning vessels in two wooden racks.

4.7.1.3 Testing the usefulness of the plant:

Beaming, (Soaking and Unhairing);

Step 1. Clean water was poured into the first vessel which was used for the soaking of ten sheets of dried skins for twelve hours to make them soft and also to remove salt, blood, dirt deposits, and to replace moisture lost in the curing process.

Step 2. A solution of carbide (lime) and a small amount of sodium sulphide to solubilise the epidermis layers is prepared in the second vessel. Pelts were then immersed in this solution and left for three days and this allowed the chemicals to weaken the hair and flesh. Following this operation, scudding equipment was used for dehairing and fleshing with a dull knife to ensure clear, clean surface of the pelts.
Deliming and Bating:

Step 3. The next operation involves deliming the skins by soaking them in a weak solution of acid which reduces the swelling caused by the lime. Simultaneously,
the skins were treated with a "bating" material consisting of enzymes to give a smoother grain and render the skin soft and flexible. After the deliming and bating operations, the stock was ready to be tanned.

Tanning:

Several tanning processes may be used to treat each type of skin. The process is chosen according to the use for which the leather is intended. The two principal tanning processes are mineral, or chrome tanning, and vegetable tanning. Chrome tanning

often can be completed in a single day, whereas vegetable tanning requires many weeks or months. Vegetable tanning results in firmer leather with greater water and stretch resistance. Chrome tanning shrinks the stock and produces longer-wearing leather with greater resistance to heat. The processes are sometimes combined to derive some of the advantages of each.

In this project, the vegetable tanning technique used by indigenous craftsmen was used. In vegetable tanning, the hides are immersed in vessels containing increasingly stronger tannin solutions called liquors.

Step 4: Three different strengths of tanning liquors were prepared in the plastic vessels and arranged sequentially. The pelts were first immersed in the vessel containing weak tanning liquor. After three days, the pelts were transferred to a second vessel containing still stronger liquor for three days. The pelts were again transferred into the third vessel that had the strongest liquor to complete the process.

Step 5: The tanned leather was transferred to the washing vessel and was thoroughly cleaned with clean water.

The selected vessels proved efficient for tanning, in that all the acknowledged tanning processes were carried out successfully in a smaller and more organized space. Again, the used up tannins could be drained out more easily.

4.7.2 Project 2

Design and construction of scudding equipment for unhairing and fleshing

4.7.2.1. Designing Processes for the Equipment

Initial drawings consist of a trough with four legs; two of the legs at one end are made shorter than the other two and this results in having the trough tilted. The trough has a flat board raised above it, and it has open space all around it A seat is created at the upper side and a receptacle at the lower end to take the residue.

Working drawings with dimensions; Figure 4. 8, 4. 9, - 4. 15.

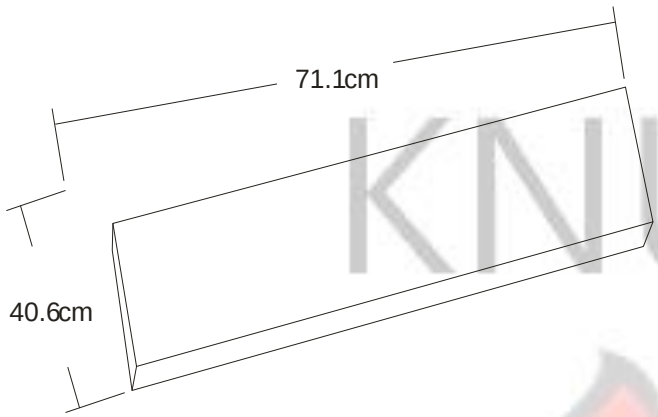


Fig.4.6, The inner board on which scudding is done

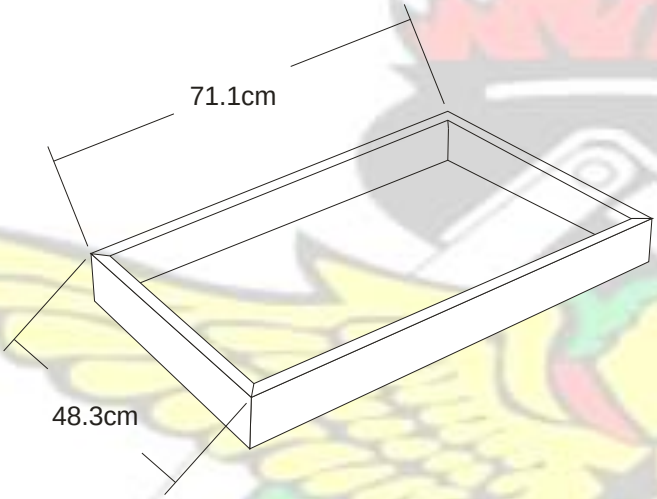


Fig.4.7. The inner working box

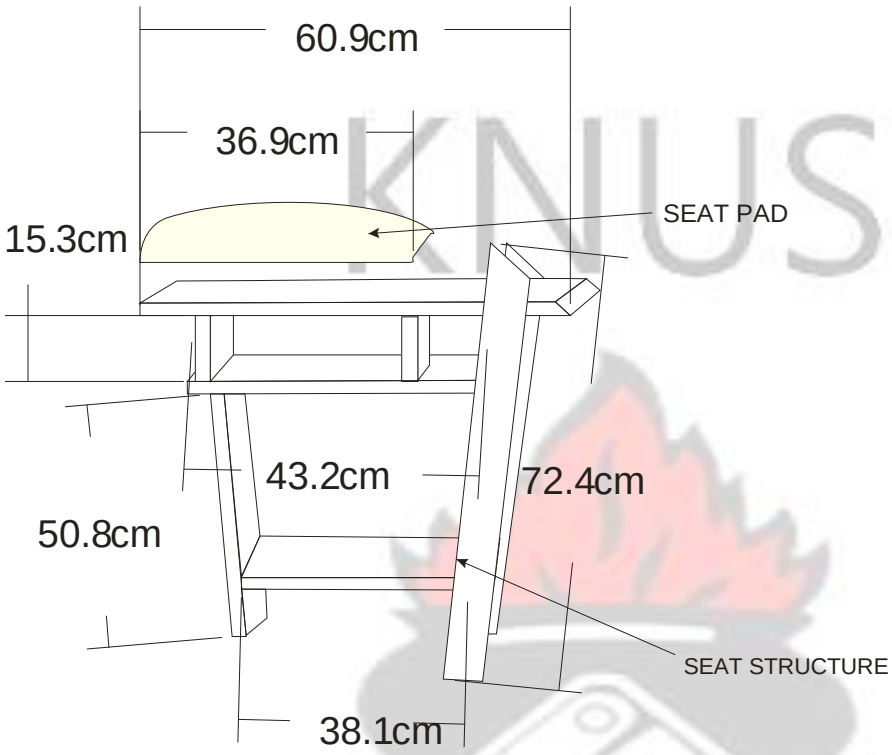


Fig. 4.8 The seating for the scudding equipment.

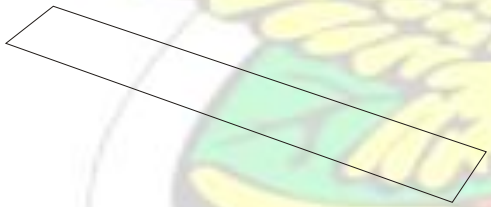
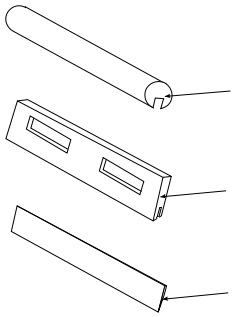


Fig. 4.9. The blunt sheet of metal to be used as scudding blade

PART ONE OF HANDLE

PART TWO OFHANDLE



BLADE

Fig. 4.10. The complete scudding blade

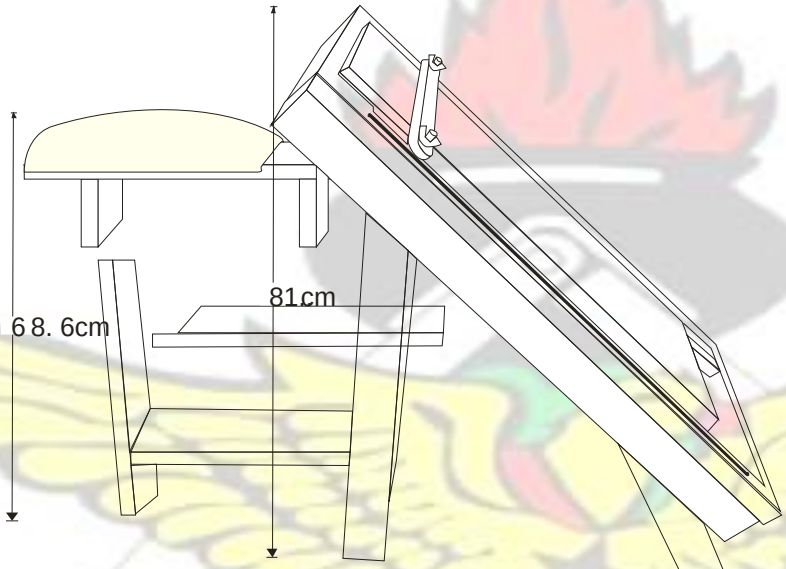


Fig. 4.11. Dimensions from the side view

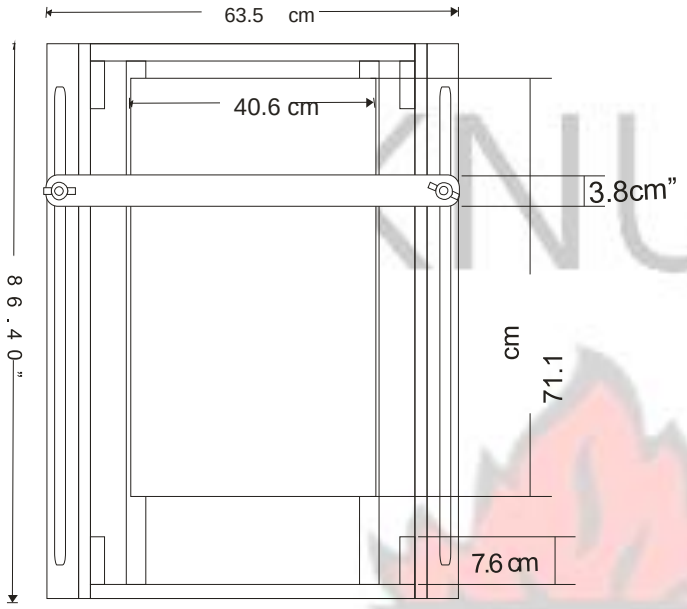


Fig. 4.12. Surface area of equipment lineal view

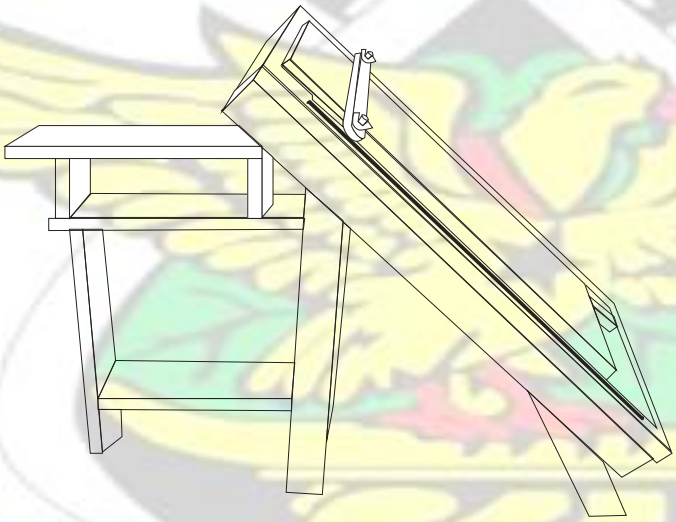


Fig. 4.13. The assembled scudding equipment **Three-dimensional representations of designs using the Rhinoceros software**

Figure 4.14. Three-quarter view of the scudding equipment.

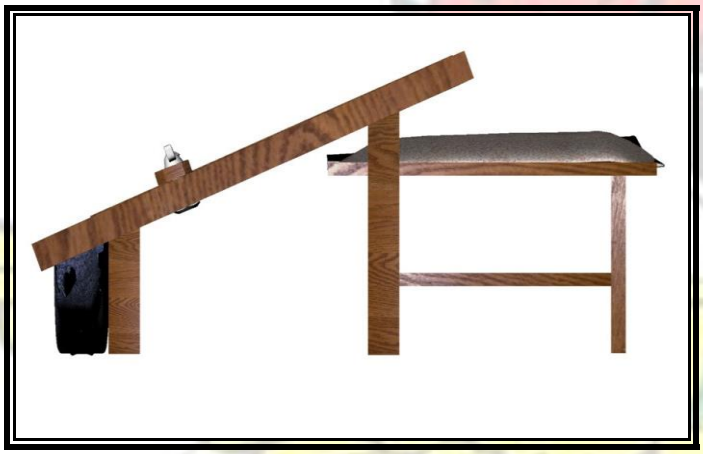


Figure 4.15. Side view of the scudding equipment.

4.7.2.2. Constructing the equipment:

Materials and Tools:

Materials;

i. Sanding sealer**,** ii. Sandpapers**,** iii. Acrylic paint**,** iv. ½ inch Plywood
Tools; i, Hammer, ii. Pincers , iii. Square, iv. Plane , v. Saw, vi. Nail, vii. Tape measure, viii. Orbit Fun
Equipment:

i. Sanding machines**,** ii. Planning machine**,** iii. Combined sawing surfacing and mortiser
Working Process:

Step 1. The various parts of the equipment were cut to sizes and assembled.

firstly, the top frame that support the scudding board was formed, it had a groove at each end through which a wooden fastener moves up and down, (plate 4.40). The fastener is meant to hold the pelt firmly on the scudding board during dehairing or fleshing, (plate 4.42).

Plate 4.40. Wooden frame for scudding area

Plate 4.41. The fastener 'holder'

Plate 4.42. How the holder fixed over the frame.

Step 2. The scudding board is produced by joining two pieces of wood together sideways to from a single broad surface (plate 4.43). This was next planed and made ready to be fixed on the scudding frame (4.46).

Plate 4.43. The scudding board

Plate 4.44 Bolt and nut to fasten the holder

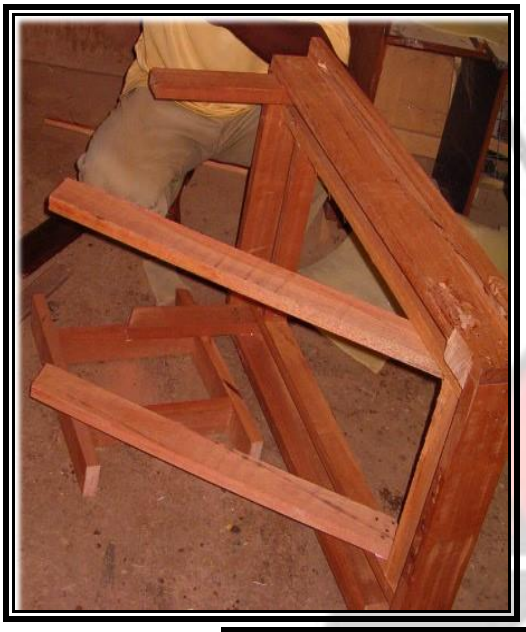


Plate 4.45. Joining parts of the equipment **Plate4.46.** The frame for the equipment The finished product, plates 69, 70 and 71

Plate 4.47. Three quarter view

Plate 4.48 Side view

Plate 3.49. Working with the equipment

4.7.3. Project 3.

Design and construction of equipment for drying pelts, leathers and fur: (a) Open-dryer (b) electric dryer.

4.7.3.1.1 Designing Process of Open-Dryer:

The design indicates a leather dryer that has all of its sides uncovered to allow air to pass through naturally for gradual drying of pelt or leather. Specially designed stretcher boards on which leathers are supposed to be stretched are to be slotted into the dryer.

The design has equally spaced out slots on opposite sides through which the stretcher boards are to be slotted (figure 4.16 and 4.17)

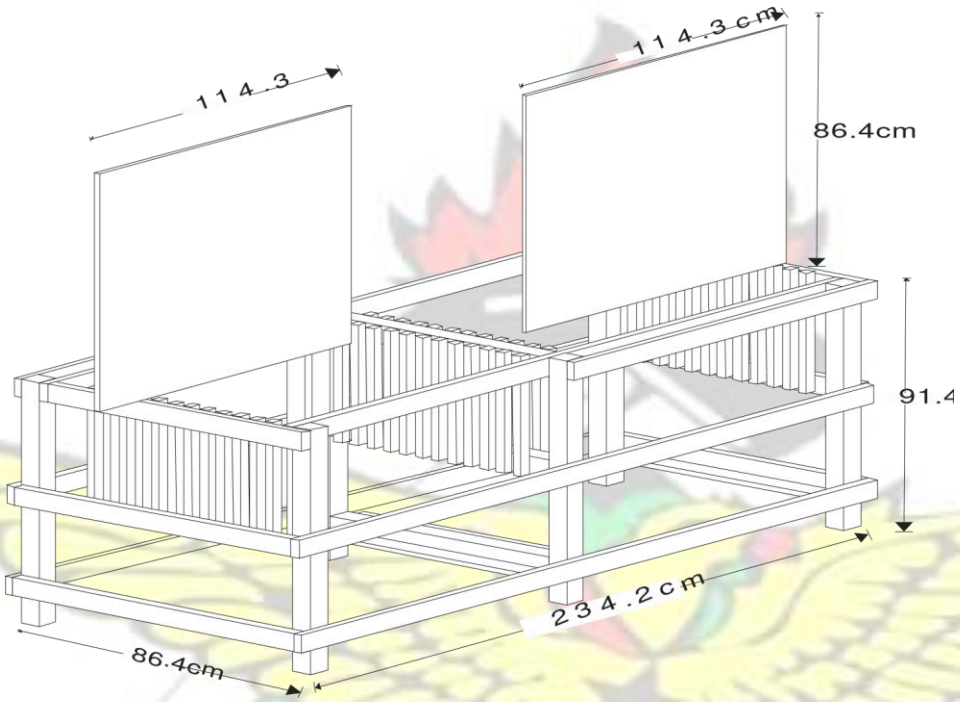


Figure 4.16. Slots for stretchers

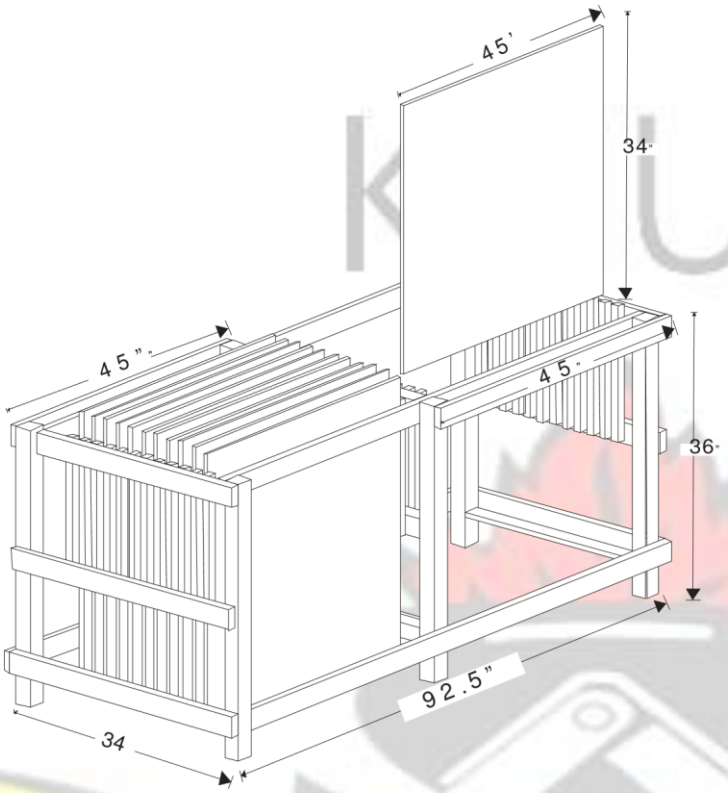


Figure 4.17. Design of the stretcher boards slotted in the dryer.

Pictorial representation of the Open leather dryer in rhinoceros.

Figure 4.18. Side view

Figure 4.19. Three-quarter view

4.7.3.1.2 Constructing the Open-Leather Dryer:

The designer sought for the assistance of two technicians (furniture maker and electrician). Two different sets of equipment were considered for drying pelts, leathers and fur. These were the electric powered dryer and the open-air dryer. The following materials, tools and equipment were used in producing the open-air dryer in wood according to the selected design.

Materials; i. Sanding sealer**,** ii. Sandpapers**,** iii. Acrylic paint**,** iv. ½ inch Plywood

Tools; i. Hammer, ii. Pincers , iii. Square, iv. Plane , v. Saw, vi. Nail, vii. Tape measure

Equipments; i. Sanding machines, ii. Planning machine, iii. Combined sawing surfacing and mortiser, iv. red-wood

Working Process:

Step 1, Treatment of wood; Wood is treated with a chemical known as "desban" to protect it against the attack of woodborers, and afterwards left to dry.

Step 2, Preparation of boards. The boards were planed with mechanical planning machine. This was done to give it a smooth, even surface texture, equal thickness and straight edges, plate 4.50 and 4.51.

Subsequently, the boards are given equal dimensions and sawn into the various widths using the combined sawing surfacing and mortise device.

Step 3. Cutting boards into required dimensions; various lengths and dimensions were cut using the saw. Afterwards the plane is used to give smooth surfaces and straight edge to all cut boards.

Plate 4.50. cutting the various parts **Plate 4.51. Planning the boards**

Step 4. Assembling the stretcher guard;

(a) Frames for the two ends were first to be formed, each had three bars and these were at the top, middle and bottom ends,(Plate 4.52)

Plate 4.52. Forming the side frames and joining the two side frames

(b) The pieces of wood that were sawn for creating slots for the stretchers were fixed on the end frames, linking the top bars to the middle bars on each frame at equal opposite positions,(Plate 4.52)

Step 6. The four main bars joining the ends were fixed and nailed in grooves that have been made in the two opposite frames to give it a firm support to form the upright post (Plate4.53)

Step 7. The full length of the frame is divided into two chambers,(Plate 4.55) one chamber for smaller stretchers and the other for bigger ones.

Step 8 . Two short bars are nailed at the base of the opposite widths below the slots for the stretchers to rest on when they are slotted**.**

Step 9. Two pockets are made at the opposite sides along the lengths of the frame to serve as rooms for keeping stretching pins. (Plate5.56).

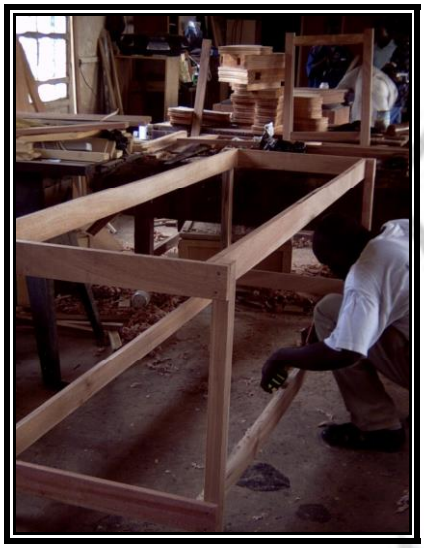


Plate 4.53. Fixing the lower bars

Pate 4.54. Finished stretcher guard

Step 10. The work was subjected to massive sandpapering, three abrasive sheets of different grades (grades 60, 80 and 120) were used to sandpaper the work. The first and the second sandpapering are preceded by the application of sanding sealer. The sanding sealer seals all the pores of the wood for better finish fixing.

Plate 4.55 Trough for stretching pins

Plate 4.56. The painted finishing

The work was finished by painting it with acrylic paint to protect the wood from excessive exposure to the heat of the sun and rain. (Plate 4.56).

4.7.3.1.3 Cutting of the stretcher boards

Step 11. A two quarter plywood is selected for use as stretcher boards. Each plywood is then cut into three equal sizes with the exception of those that are meant for stretching extremely bigger leathers.(plate 4.57) Holes are drilled through the boards as vents. They are then slotted into the various chambers.(Plate 4.59 and 4.60)

Step 12. The stretcher frame is given a tan finish to beautify and protect it.

Acrylic paint is applied to all areas of the leather-stretching frame with a brush.

Plate 4.57. Stretcher board

Plate 4.58. Stretcher guard with boards

Plate 4.59. worker using the drying boards **Plate 4.60**. Drying leather on the dryer

4.7.3.1.4 Test of equipment:

The following test were done under the sun;

Test 1(a). Six sheets of fleshly-skinned pelts that had been soaked and removed from brine were stretched in the dryer and kept in the open- air. It took six hours to dry.
Test 1(b). Six sheets of fleshly-skinned pelts were dried in the dryer and kept indoors. These took twelve hours to dry.
Test 2 , Six indigenous tanned leathers that were under-going secondary treatment were stretched and dried in the dryer for three hours
Test 3. Six tanned fur from goats were dried in the dryer in the open air and these took three hours to dry.

The following test were done in-doors;

Test 1(a). Six sheets of fleshly-skinned pelts were dried in the dryer and kept indoors. These took twelve hours to dry.
Test 2(b). Six indigenous tanned leathers that were under-going secondary treatment were stretched and dried in the dryer for three hours.

Test 3(b), Six tanned furs from goats were also stretched in the dryer and keptindoor. These took eight hours to dry.

4.7. 3.2 Electric dryer

4.7.3.2.1 Designing Processes for Electric- Drying Equipment;

The design for the dryer indicates the construction of a rectangular shaped object with two compartments to hold a number of lightweight stretchers in vertical directions according to the shape of the main equipment. The stretchers are supposed to have holes drilled in them for air to pass through, and the outer end of the dryer is also meant to have holes made through it to allow air that has been blown into the device to pass out. The entire part of the device is meant to be covered except the top portion which is meant to be transparent and can be opened and closed whenever necessary. The front part of the device has is to be fitted with two fans; these are meant to mechanically induce the movement of fresh air into the drying device for air-drying of the pelts or leathers. The fans are to be powered by electricity.

Working drawings:

Lineal drawings of the electric powered leather dryer. Figure 4.19, 4.20, 4.29, 4.30, 4.31.

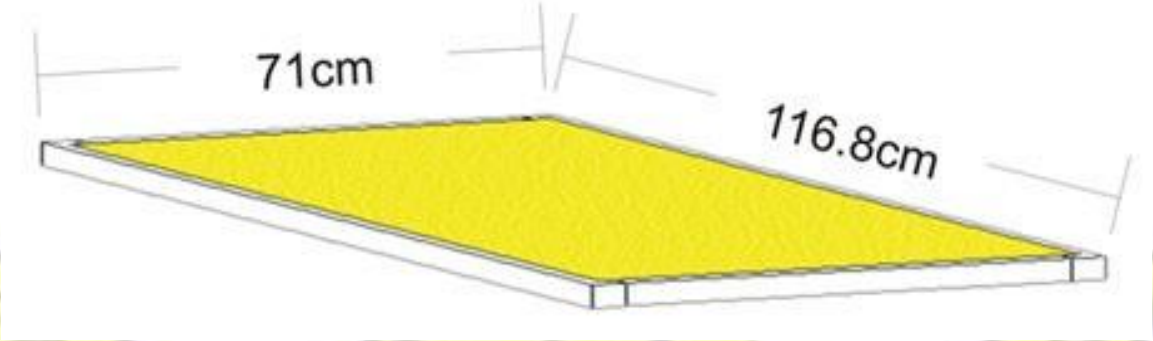


Fig.4.19. Top Perspex cover

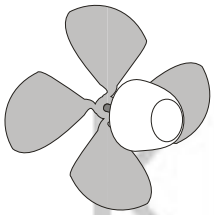


Fig. 4.20. Fan

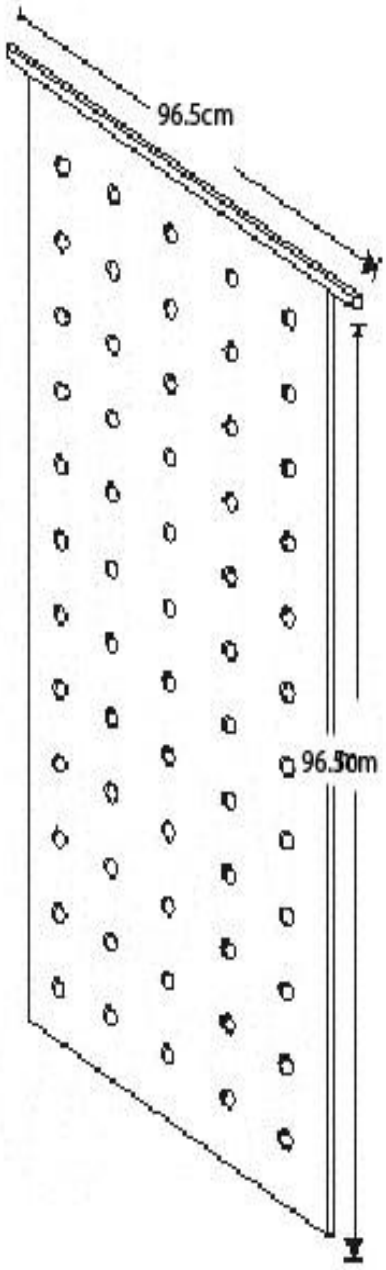


Fig 4.21. Stretcher board

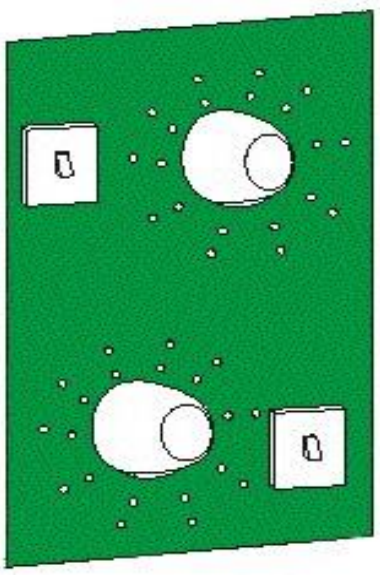


Fig. 4.22. Control switches and motor of the fans

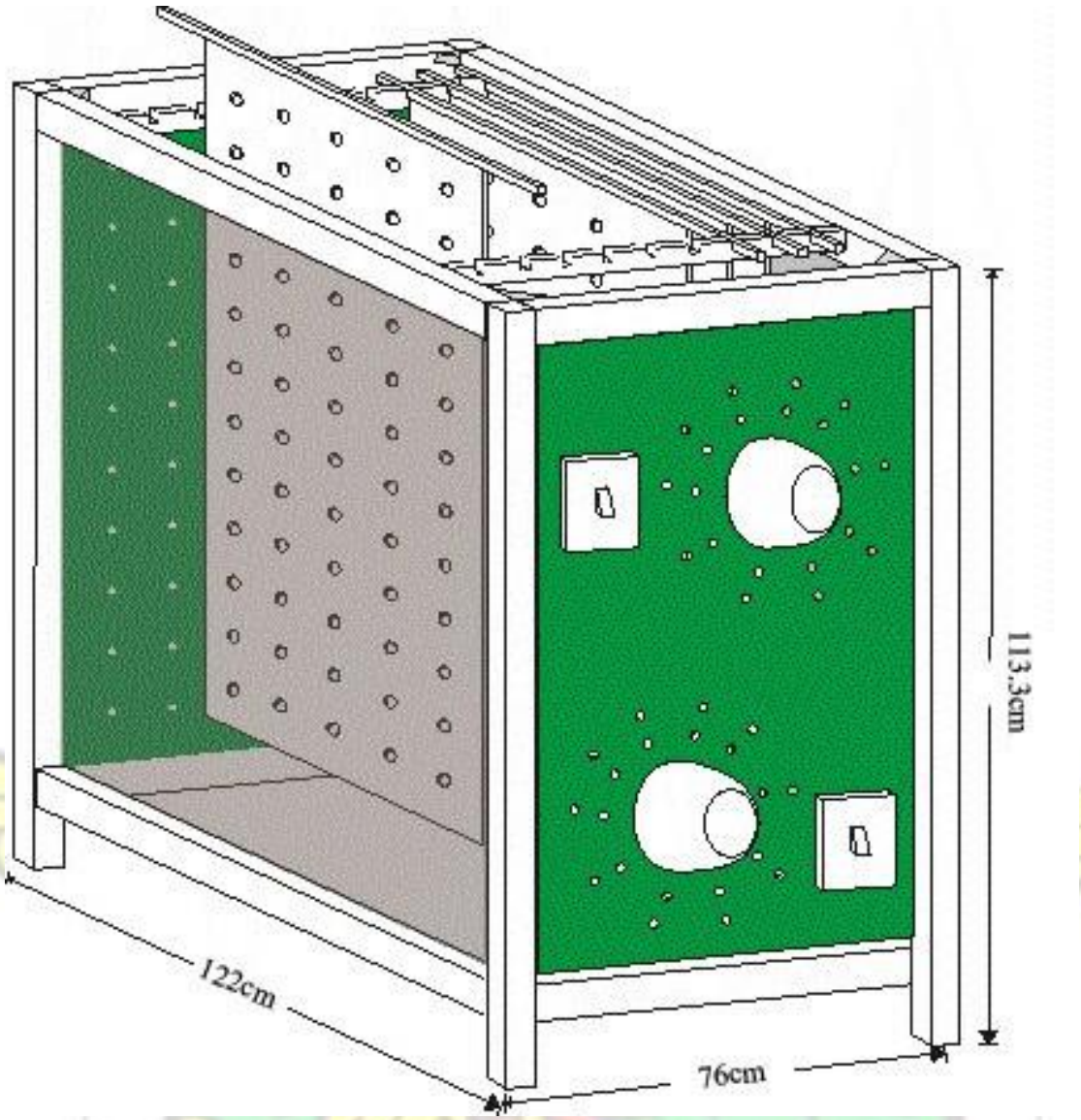


Fig. 4.23. Main drying case

Figure 4.24. Front view indicating the outer areas occupied by fans and the control sockets, as well as the top opening. **Figure 4.25.** Three quarter view from the front shows slotted dryers

Figure 4.24. Side view with control knobs

Figure 4.25. Three quarter view

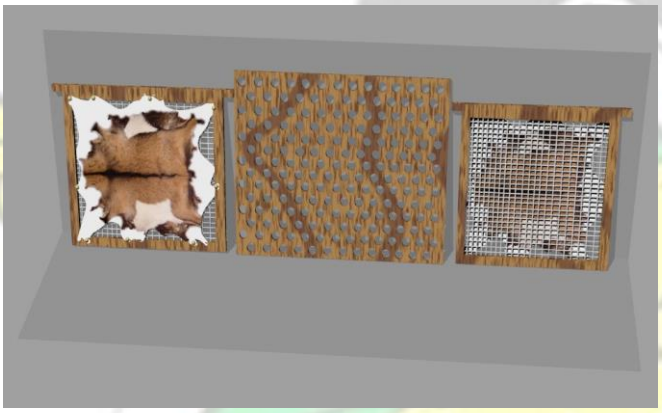


Figure 4.26. Stretchers and Ventilation end.

4.7.3.2.2 Constructing the equipment:

Working Process;

Materials and Tools:

Materials: i. Sanding sealer**,**ii. Sandpapers**,**iii. Acrylic paint**,** iv. ½ inch Plywood Tools: i.Hammer, ii. Pincers , iii. Square, iv. Plane , v. Saw, vi. Nail, vii. Tape measure, viii. Orbit Fun
Equipment i. Sanding machines**,** ii. Planning machine**,** iii. Combined sawing surfacing and mortiser

Step 1, Assembling;

(a) Frame for the dryer was first formed; which consisted of four horizontal bars for the width, four for the length and four poles for height. (Plate 4.61 and 4.62) A rectangular shape was formed after joining the various parts (b) One-quarter plywood was used to cover the back and two sides. (Plates 4.65 and 4.66)

(c) The top cover consisted of a wooden frame and Perspex; the base was also covered with Perspex through which holes have been made to enable water that have dripped from the pelts or leathers to drain out. The holes additionally, serve as ventilation point for the equipment.

Step 2. Stretcher holders were made and fixed at the top edges of the two opposite short sides.

Step 3. Two-quarter plywood was used for the stretcher boards and pieces of wood which extended beyond the boards were nailed at the top end to enable them to hang loose on the holders.

Plate 4.61 Forming the frames

Plate 4.62. Covering the sides

Plate 4.63. Drying box with stretchers **Plate 4.64.** Finished electric dryer with fittens

4.7.3.2.3 Test of equipment;

The equipment was tested at different times with the following items; six sheets of pelts, six sheets of fur and six sheets of leathers

The fans were switched to the maximum speed during each testing.

Test 1. Pelts: These took four hours to dry

Test 2. Fur: These also took two hours to dry.

Test 3. Leathers: These took one hour to dry.

4.7.4 Project 4

Design of Tumbling equipment useful for softening and boarding leather

with oil

The idea for developing an equipment capable of primarily softening leather relates to what the Encyclopedia Britannica has described as tumbling barrel (ca. 1890): a revolving task in which objects or materials undergo a process (as drying or polishing) by being whirled about. The design for the equipment is meant to perform dual functions of softening which are drying and boarding leather with oil.

4.7.4.1. Designing processes for Tumbling equipment;

A revolving hollow drum is to be made with sheets of metal plates and its inner part is to be fitted vertically with strips of flat metal blades which have blunt edges. An opening is designed on the gusset of the drum through which the leather or pelt will be put for processing. The drum is to revolve by being powered with electricity through the use of a motor, a switch, a pulley and a fan belt. When switched on, the motor turns the drum with the aid of a fun-belt which is supposed to draw air from an intake protruding opening on one side of the drum. The opposite side has also been designed with similar openings (vents) through which the air exits from the drum.

The drum is supposed to revolve for its contents to hit its inner sides which are to be fitted with the blunt metal blades. By the continuous tumbling of the leather or pelt inside the drum, the fibers are suppose to loosen up resulting in securing softened leather. The temperature inside the drum is suppose to be at a lower level, and this will allow leather which is sensitive to excessive heat to dry.

Working Drawings; figure 4.27, 4.28 - 4.32

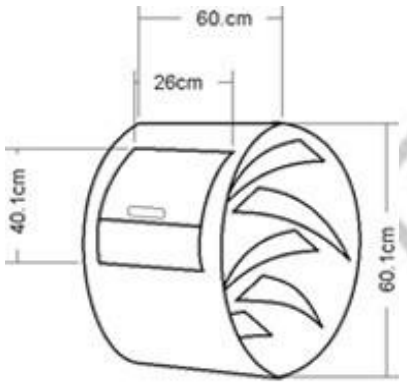


Fig. 4.27 Brakers inside the drum

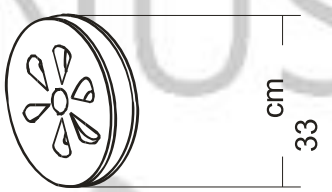


Fig. 4.28 Pulley

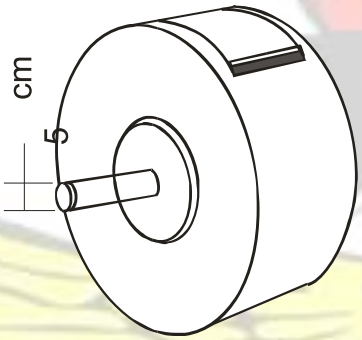


Fig. 4.29 Drum fitted with shaft

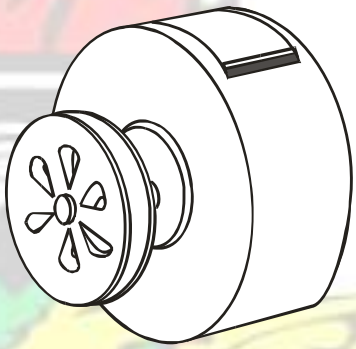


Fig. 4.30 Drum with pulley

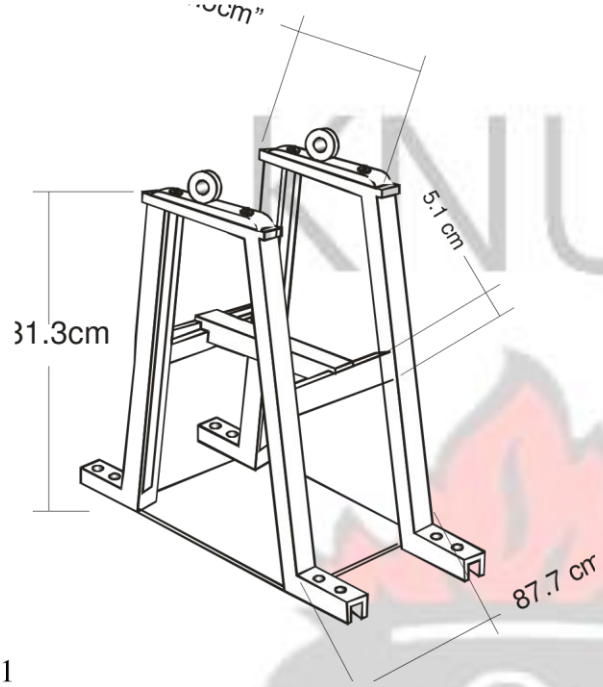


Fig.4.31

Fig. 4.32 Fan belt

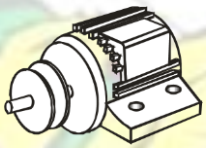


Fig. 4.33 Electric motor

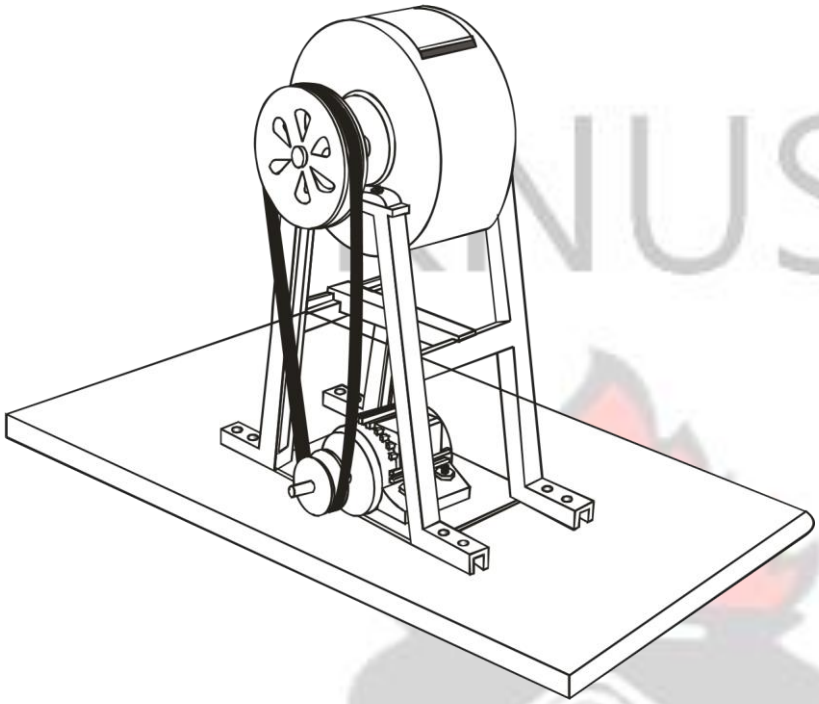


Fig. 3.36 Final drawing of the equipment

Rhinoceros representation of the tumbling equipment from different angles.

Fig. 4.37 Back view

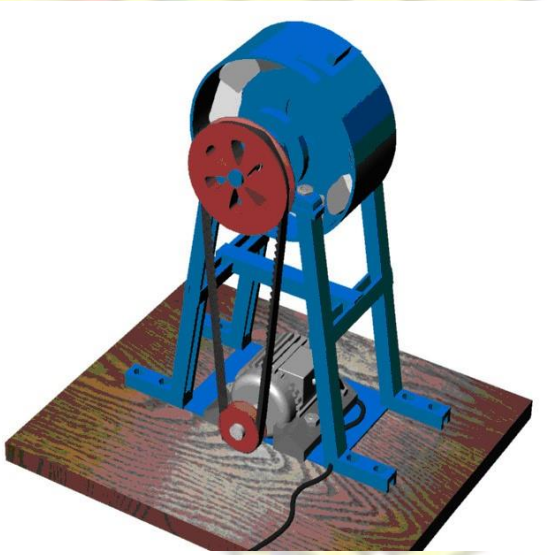


Fig. 4.38. Front view

4.7.4.2 Constructing the equipment:

Materials and Tools:

Shaft (two), Bearings ,Hardener (a carbon solution for hardening soft metals),Metal rod,“L” metals, Motor belt, Motor, Metal plate, Pulleys, Wood, Bolts and nuts, Oil

Working process:

Step 1: The various parts of the drum were cut out from a sheet of metal according to the design.(plate 4.66) Firstly, the two side circular plates measuring 40cm in diameter were cut out,(plate 4.67). Next, the gusset plate measuring 80cm x 40cm was also cutout(plate 4.68).

Step 2: An opening with a sliding-cover was created on the gusset-plate. The circular sides had ventilation holes made on them to lead air in at one side, and out at the other. (Plate 4.67). Two shafts with bearings in their holders were welded at the center of each of the two sides. A puller was also fixed on one of the shafts.

Step 3: The circular sides and a gusset were welded together to form holders for the drum .

Step 4: Angle-iron was cut into different sizes and welded to shape to hold the drum(plate 4.68). The bearing holders were bolted to the iron stands and the two stands were joined together in the middle with a piece of iron by bolting.

Plate 4.65. Fullsheet metal plate.

Plate 4.66. The sheet was cut to size

Plate 4.67. one side of the drum

Plate.4.68. The supporting metal bars

Plate 4.69. The bearing holders

Plate 4.70. Welding the supporting bars

Plate 4.71. The finished tumbling equipment

4.7.5. Project 5

Construction of a thong cutting equipment

It has been noticed that during the cutting of leather thong, the artisans have trouble. Normally the thong cut for the work is not of equal size in terms of width and length. This makes the leather article unattractive when used in the execution of the work. The thought then is to design equipment that will help subdue the difficulties in the thong cutting process and enable the artisan to cut more thongs in a short time.

4.7.5.1. Working drawings:

The idea for developing the thong cutting equipment was based on the mechanism used by computer printers in lifting papers during printing. In pursuing this, the following procedure was followed.

1. Two cylindrical rollers were drawn. These were intended to roll in different directions. (Figure 4.43 and 4.44).the top one is supposed to contain sharp circular blades equally spaced apart, whilst the bottom roller is to be made of hard rubber which is meant to pick the leather for the blades to cut.
2. Two short poles were drawn to hold the rollers at opposite ends as they revolve.(figure 4.45).These have screws fixed on them to help depress the top roller to the lower one and drawn at one of the poles is a hand roller to help turn the device manually.
3. A sketch is made of two plates at the front and back of the equipment to feed it with the leather and receive the cutout strip of thongs.
4. The entire device is designed to be on a flat surface and besides the cutter is an electric motor which is connected to the cutter. It is to move with the aid of a small iron chain.
5. A design is made of a case to cover the cutter and the motor.
6. A special wooden support with a receptacle to receive the thongs has been made for the equipment to be fixed on. .

Identified components of the equipment, figures 4.39, 4.40,4.41, 4.41,4.42,4.43, 4.44.

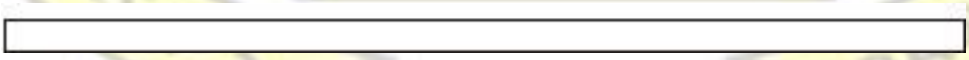


Fig. 4.39 Shaft

Fig. 4.40 The hard rubber

Fig. 4.41 Spacers

Fig. 4.42 Blades.

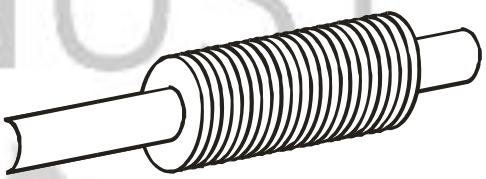


Fig. 4.43 Blades fixed over shaft.

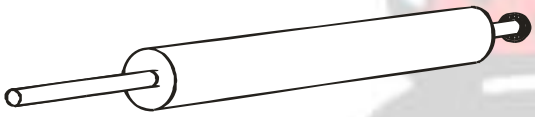


Fig.4.44 Roller

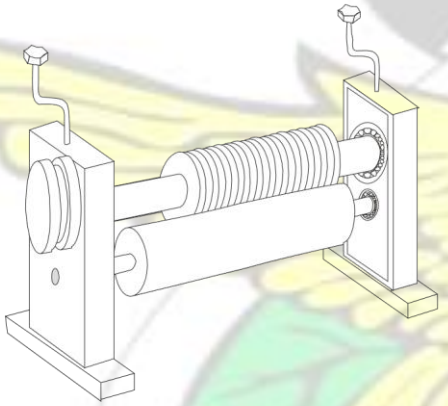
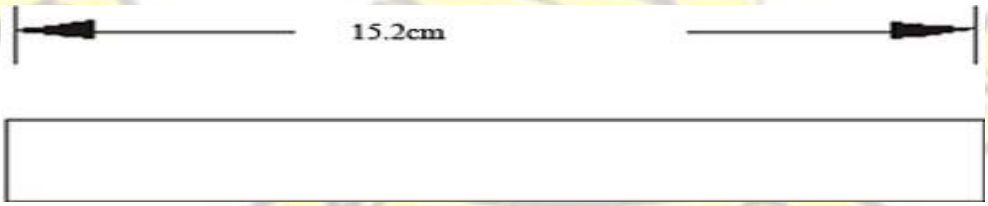
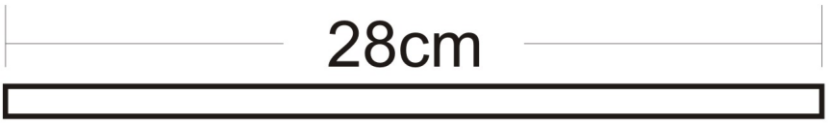


Fig 4.45 The holders with the rollers and blades.

Parts of the Thong cutter drawn to scale (figure 4.46 a, b, c, d, e, f, h, I, j, k, l, m. n);

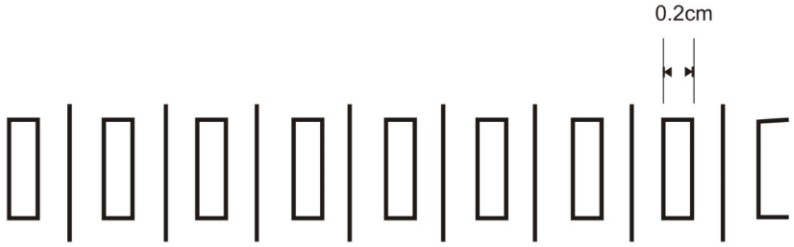


a). The hard rubber

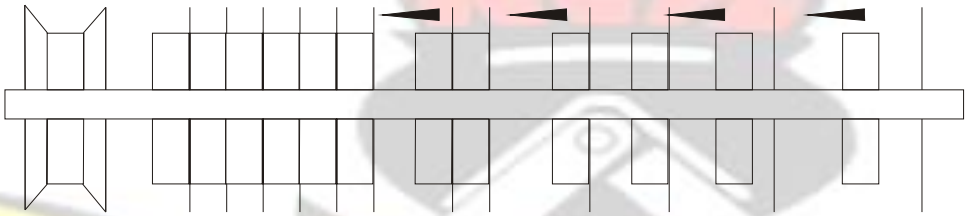


b).

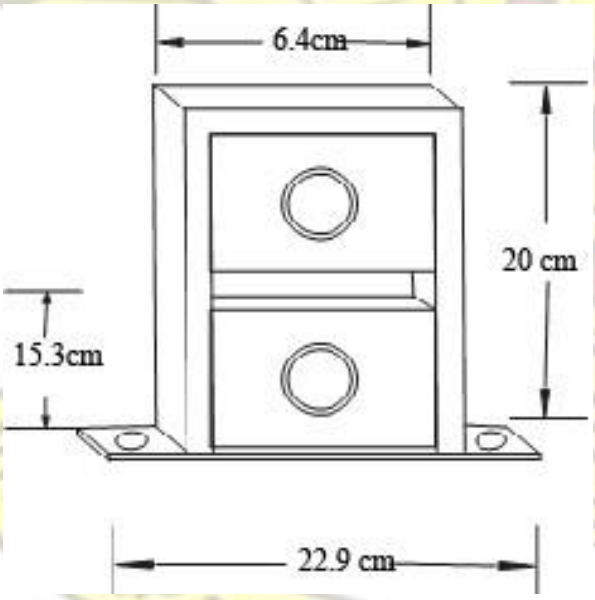
Shaft



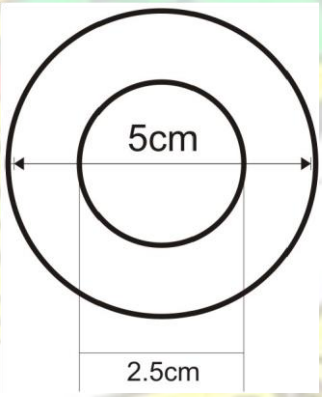
c). Spacers together with blades



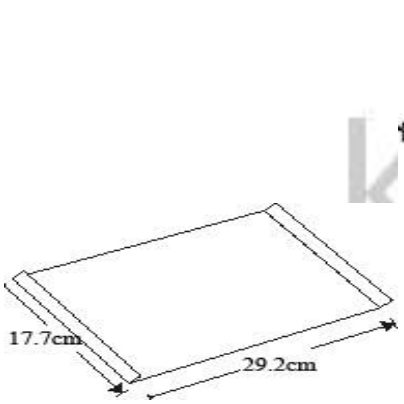
d). Spacers and Blades fixed together over a long shaft.



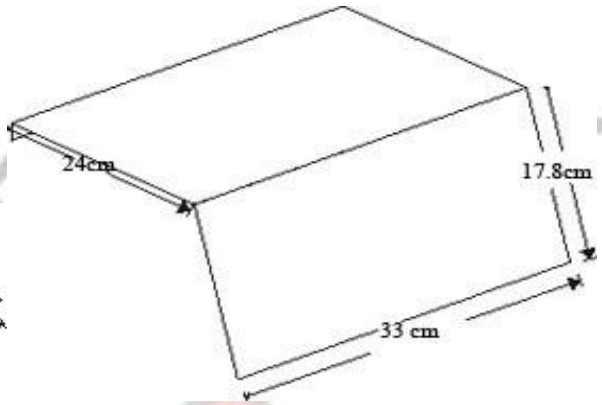
e). The Stand.



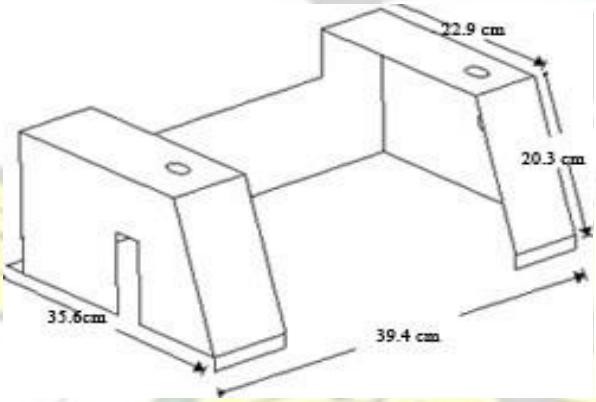
f) Blade



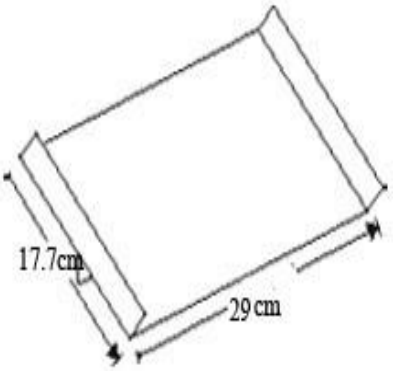
h) the receiving plate



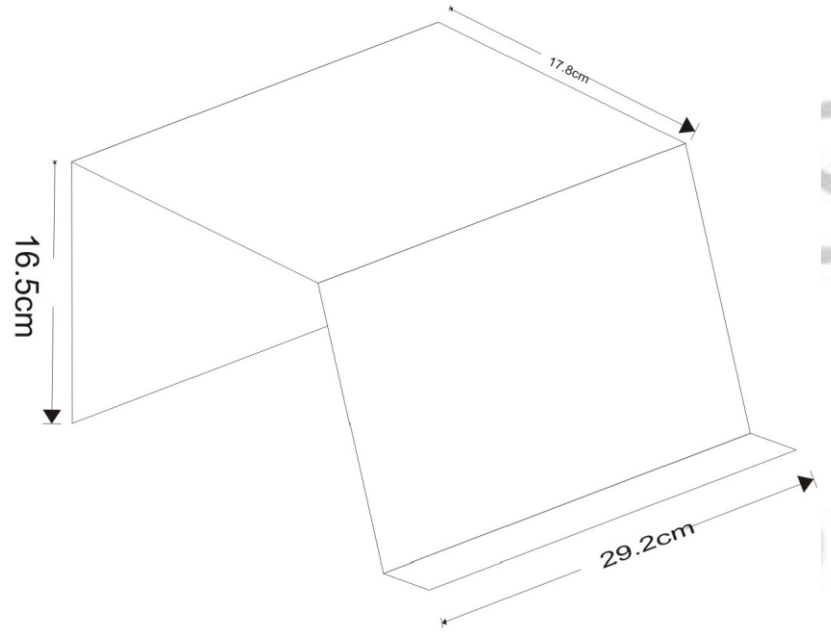
i) The cover plates



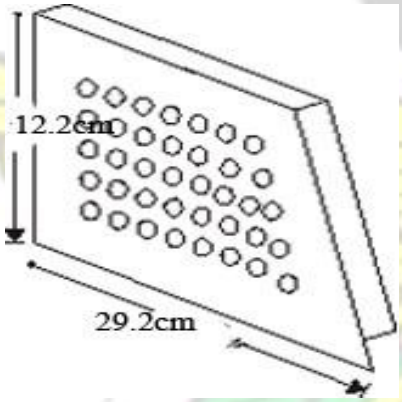
j) the main frame for the cutter

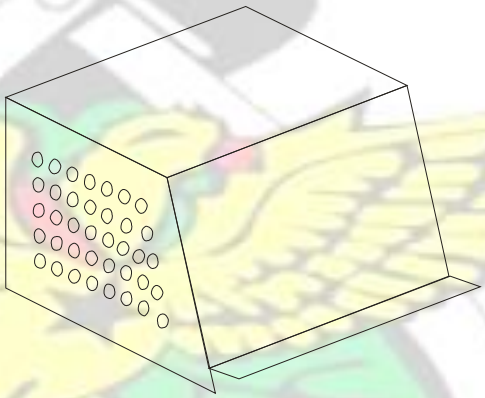


k) The feeding plate



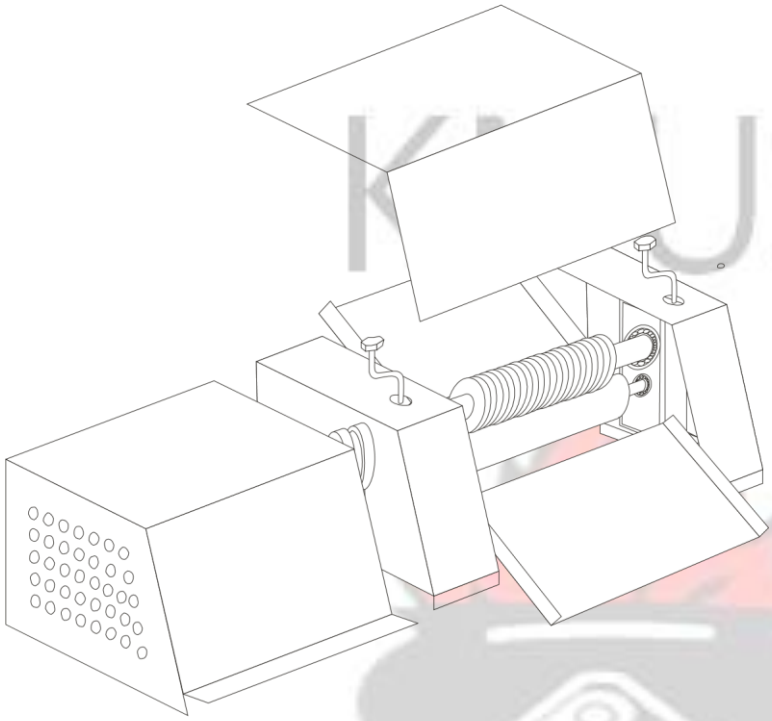
l) The top cover for the motor



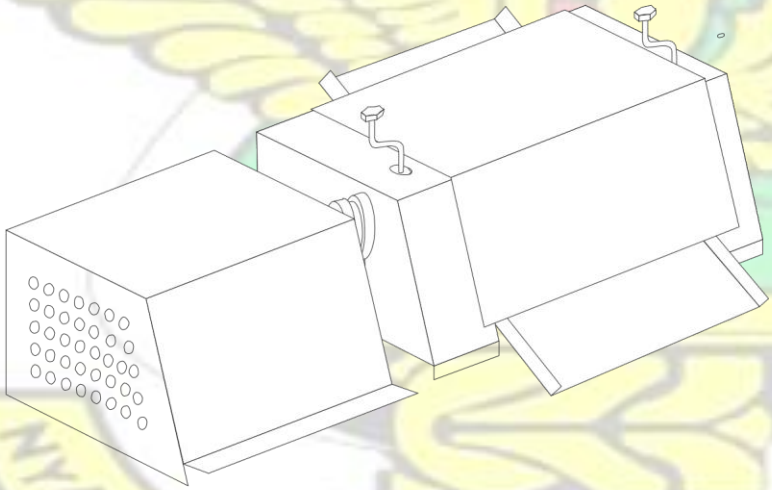


m) the side cover for the motor n) the full cover for the motor

Assembled drawing of the cutter, figure 4.47



a)

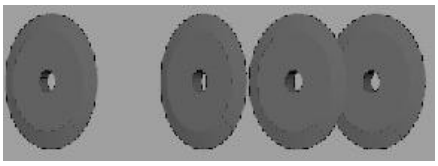


b)

Three-dimensional representation of design in Rhinoceros;

Figure 4.48 a, b, c, d, e, f, h.

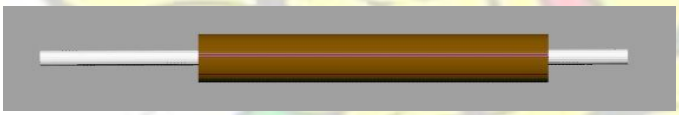
a) Spacers



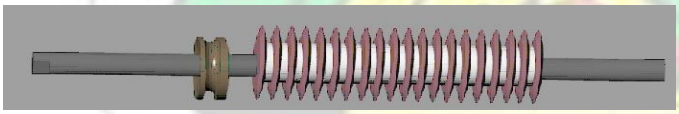
b) Blades

c) Shaft

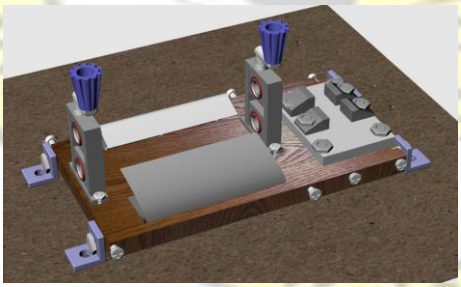
d). Hard rubber



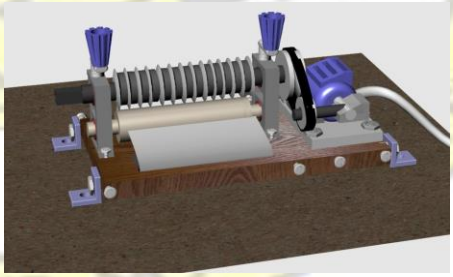
e) Hard rubber over a metal shaft



f). Shaft that been pushed through spacers, blades and a pulley



g).



h).

g) The two opposite stands which are to hold the hard rubber and the cutting shaft.

The positions of the feeding and receiving plates are also indicated.

h) The illustration for positions of the puller and motor.

Figure 4.49. How the machine would cut the thongs from leather. Figure 4.50.

Three quarter view from the left side.

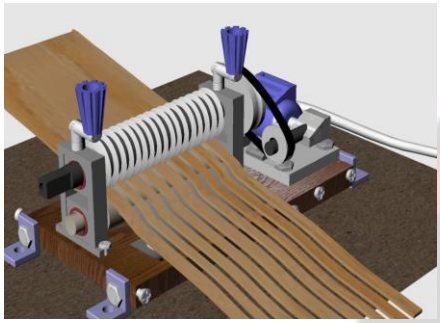


Figure 4.49. The cutting process

Fig. 4.50. Three quarter view from the left side.

Figure 4.51. back view of cutter

Figure 4.52. Side view of cutter

4.7.5.2 Construction Process:

Materials and Tools:

Materials: Hard rubber (combo), Shaft (two),Bearings, Hardener (a carbon solution for hardening soft metals),Metal rod,“L” metals, Motor chain ,Motor ,Metal plate, Screws, Pulleys, Blades, Wood, Bolts and nuts, Oil,

Hand tools; Screw driver, Spanners (Adjustable spanner,
Center punches, Hacksaw and blades (Machine Type), Calipers (inside and outside), Venire caliper, Tape measure, Electrode, Dividers, Protractor, 60°c triangle Compass,
Tool (made of high steel with diamond at the edge), Bench Vice.

Machine Tools: Lathe, Shaper, Planer, Mailing machine, Drilling and Boring Machine, Grinder, Cutting Tool and Fluids,

Step 1: The various components of the equipment were cut to size

The materials for the project were measured and machined to the required shapes with the use of Lathe and the Shaper. The material used here is a mild steel metal with carbon content of about 20%. Beginning with the execution of the rollers (spacers), the rod was fixed into the lathe machine that spine the rod clockwise and with the help of a machine tool (a hard metal that is shaped to cut other metals), the metal rod was shaped into the measured shape. After getting the shape, a hole was bored in the shaped rod with the use of a drill of about 81/2 in size to create a space where a shaft of the same size could be fixed.
The shaped metal rod was marked according to the width of the thong to be cut. The marked area of the metal rod was then cut into small rings which will serve as spacers within the blades. In all forty-four (44) blades and spacers were cut.(Plate 4.72) The rollers (spacers) was made in such a way that it gripped the blades firmly together to aid the blades to cut easily.
The rollers (spacers) were shaped to the required size and the edges leveled up with the use of the shaper machine.

Plate 4.72. Spacers

Plate 4.73. metal blades

A hard rubber through which is fixed a long shaft Plate 96. Plate 4.75. Metal blades over a long shaft for cutting.

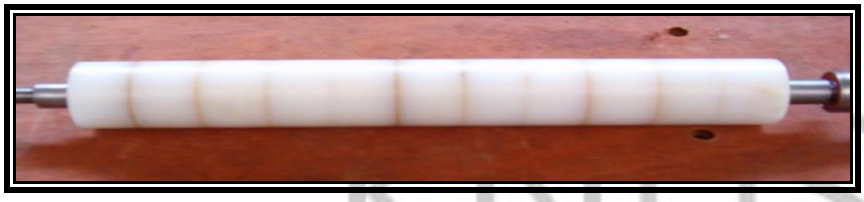


Plate 4.74. Rubber rolled over shaft

Plate 4.75. Blades over shaft

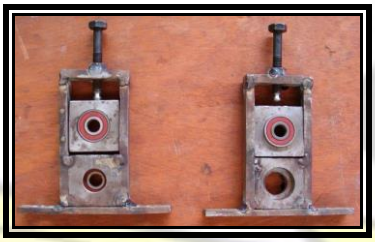


Plate 4.76. The 'stands'

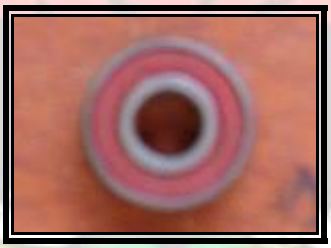


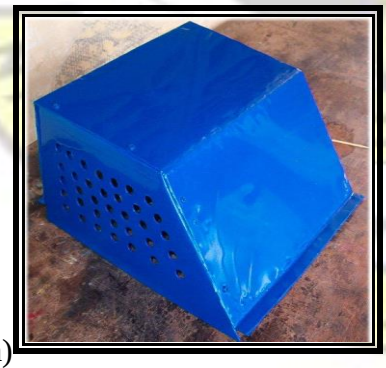
Plate 4.77.Bearings

a,

b,

Plate 4.78. Feeding(a) and receiving (b), metal plates (shaped to fit)

a)



b)

Plate 4,79.(a)and (b) the cover plates

Plate 4.80. The rubber with shaft are fixed into the 'stands'

Step1: Assembling the equipment;

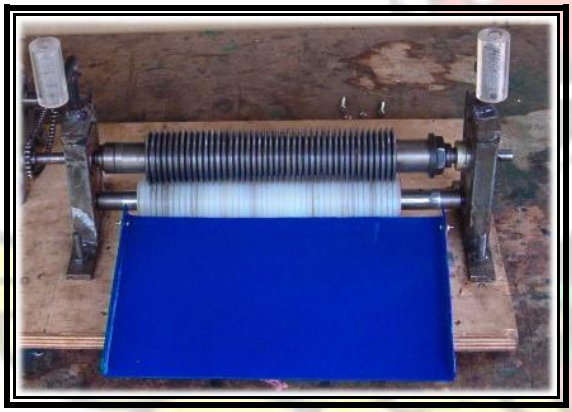


Plate 4.81. The metal plate is fixed at opposite sides slightly over the rubber

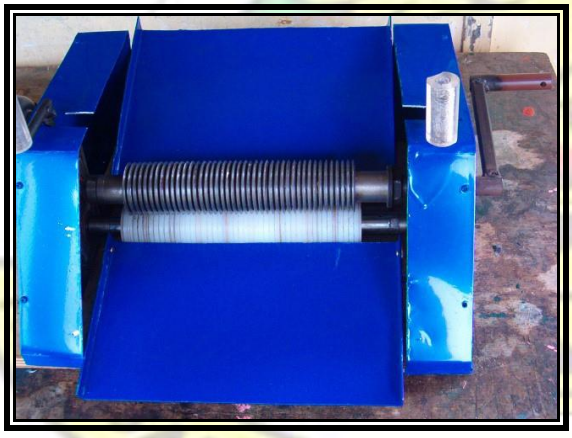


Figure 4.82. The shaft with blades is fixed above the rubber.

Plate 4.83. A metal chain and a puller required to turn the equipment once it is connected to the electric motor.

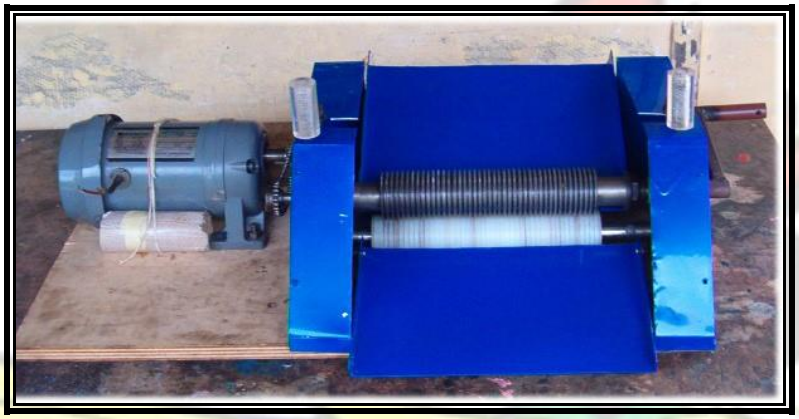


Plate 4.84 Electric motor was fixed beside the main case to turn the shafts

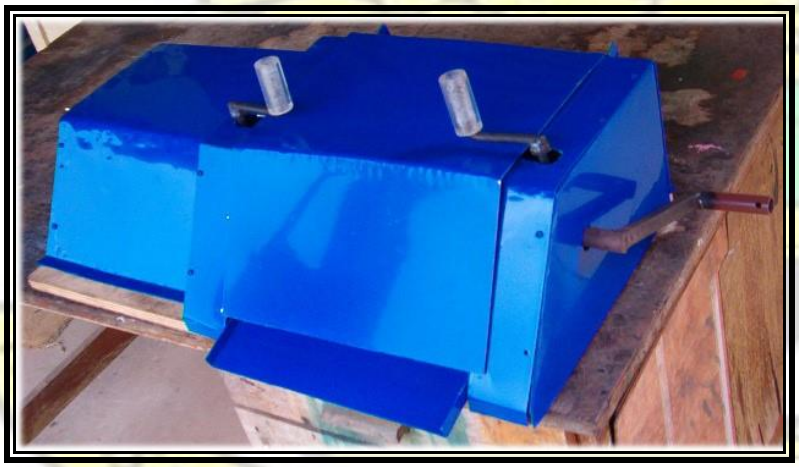


Plate 4.85. The equipment is encased in molded metal to cover

4.7.5.3 Testing the equipment.

The tests were in two forms, (a) Electric powered (b) Manual rolling

(a) Electric powered: The machine worked efficiently when it was turned on, as a result a sheet of leather that was inserted led to the production of long strips of leathers for thronging or weaving.
(b) Manual rolling: The machine has been designed to cut through leather manually. It was able to cut through the sheet of leather resulting in the production of long strips of leather for thonging or weaving.

The machine was developed to the standard that will be appropriate for the leather industry. The tests have proved to be effective and useful for cutting strips of leathers.

4.7.6. Project 6

Exploring the use of alternate locally available dyes and pigments for dyeing or colouring leather

Dyeing has been described as a process of colouring materials such as textile fibres and leather so that the colouring matter becomes an integral part of the fibres. Dyes or dyestuffs are soluble compounds that can be either absorbed and retained by the fibres or chemically combined with it. Dyes are generally fast— that is, they retain their colour in the fibre throughout the textile-making process and under exposure to normal wear including; sunlight, water, and detergent for washing.

To improve the colourfastness of some fabrics, substances called mordants are added to dyebaths. Mordants combine with the dye molecules and fix them firmly in the fibres. Vat Dye is the most common fabric dye with the above-stated qualities that is available on the local Ghanaian markets and therefore it has become necessary to experiment on its usage on leather as an alternative dyeing agent. Suede dye is also common on the local markets but they are not fast when used on fabrics but rather they are used in dyeing straws. A successful experiment on its usage on leather will be helpful to education in leather and the leather industry.

Pigment is described as any intensely coloured compound used to colour other materials. Unlike dyes, pigments do not dissolve and they are applied as fine solid particles mixed with a liquid. In general, the same ones are used in oil and waterbased paints, printing inks and plastics. They may be inorganic compounds (usually brighter and longer lasting) or organic compounds. Natural organic pigments have been used for centuries, but today most are synthetic or inorganic. Acrylic and Oil paints are pigments that have been wildly used as colourants on surfaces such as paper and fabric.

Indigenous leather articles come with limited range of colours and do not adequately meet the consumer taste for them. There is the urgent need to identify alternative dyes that are common to the industry and can be obtained without much difficulty and at reasonable prices. Currently the colour ranges used by the indigenous tanners are limited to brown, black and white. The popular, natural cream colour of leather is the basic colour that pelts assume before dyeing. The red dye is the most common of all the dyes and it is obtained by pounding guineacorn husks which is mixed with water and then leached to obtain the dye solution. Unfortunately, this dye bleeds and fades when exposed to sunlight. Plates 4.21,to 4.26, illustrate the preparation of dye from guinea-corn husks and its application on leather as done by local tanners.

4.7.6.1. Adopting Vat dye as alternate dyeing agent for colouring vegetable tanned leather:

The problems encountered in the use of vegetable-based dyes on leather discourage the development of leatherwork education and the indigenous leather industry in Ghana. It is in the light of this that the vat dye, (a popular dye that are made insoluble and fixed by oxidation after being absorbed by the fibres) common to the textile industry in Ghana, particularly craftsmen and women who are in the small scale tie dye, and batik fabric industry were identified. Vat dye is a dye that is applied by reducing the it to a base-soluble form , applying the dye, then regenerating the insoluble dye by oxidation in the material, used for dyeing cotton. The dye is remarkably fast to washing, light, and chemicals.

Vat and sulphur dyes are not used on protein fibers because of the strong alkaline nature of their leuco-compound solutions. These dyes are best used on cellulose fibres, to make them fast especially where frequent and hard washing is required. These dyes are the most common dyes found on the local market. They have several ranges of colours and are used mostly by the local textile industries for dyeing cotton fabric. It is therefore expedient to research into and find convenient means of using these dyes on leather.

4.7.6.1.1 Dyeing Techniques:

This research explored four methods for dyeing leather and that calls for four different experiments: Using dye marbling technique consisting of one colour (monochrome), then using different colours (multicolour), and developing new formulae for dyeing leather with vat dyes.

Using the new formula to dye leather: several dyeing techniques would be employed. These include the single colour and multicolour methods then the plain dyeing method.

Experiment one.

The Formula for dyeing cotton fabric was experimented on leather with a single colour by using the marbling technique. In so doing, the dye solution was prepared by the following procedure:
In the first instance, one tablespoonful of green vat dye, one tablespoonful of caustic soda and four tablespoonful of sodium hydro-sulphide, were mixed with a hundred and fifty milligram (150ml) of hot water in a small size plastic container and stirred; it was then left to dry (Plate 4.86, 4.87).

Plate 4.86. Dyeing agents

Plate 4.87. Mixed dye solution

In the second instance a sheet of leather was rubbed in with olive oil, wetted and pounded, plate 4.87 (the oil penetrates the fibres to soften it); this makes the leather more workable. A working table was covered with synthetic leather and made ready for use. The wet leather was spread on the working table and dragged in such a way as to crumple it, (Plates4.87, 4.88). Dye was poured all over the crumpled leather with a plastic spoon (Plate 4.89). The dyed leather was spread out for 15 minutes to enable oxidation to take place as in Plate 3 and allowed to dry as in Plate 4.91, 4.92.

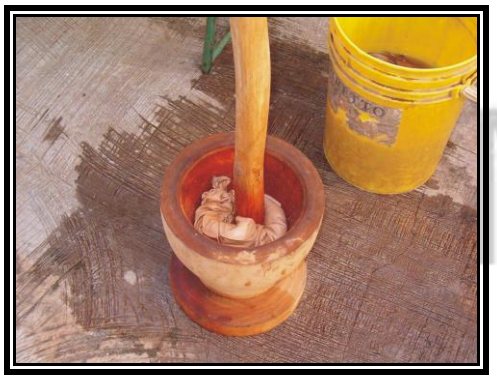


Plate 4.88. Pounding of leather leather

Plate 4.89. Dragging and Crumpling wet

Plate 4.90. Crumpled leather

Plate 4.91. Pouring Dyes on leather

Plate 4.92. Marbled leather after dying.

Plate 4.93. A closer view of the marbled leather.

The leather assumed a dark, burnt sienna, and instead of showing the green colour that was expected, the entire marbled area showed dark, burnt out, hardened spots.

4.7.6.1.2 Alternative formula.

Experiment two:

Three formulae are involved in this experiment

(i) Dye marbling with a single colour.

(ii) Dye marbling with two colours

(iii) Plain dyeing.

(i) Dye marbling with a single colour.

The dye solution was prepared by adding one tablespoonful of green vat dye, one teaspoonful of caustic soda, four table-spoonfuls of sodium hydro-sulfide were poured into a plastic container, containing hundred milligram (150ml.) of hot water stirred and poured over the dye crumpled leather which was afterwards left to dry, plates 4.94, 4.95. Plate 4.96,shows a closer view of the marbled leather The processes for dyeing leather as stated in experiment one were followed, except that the quantity of caustic soda was reduced to one teaspoonful.

Plate 4.94. Crumpled leather is spread out for oxidation to take place.

Plate 4.95. Marbled leather after dying.

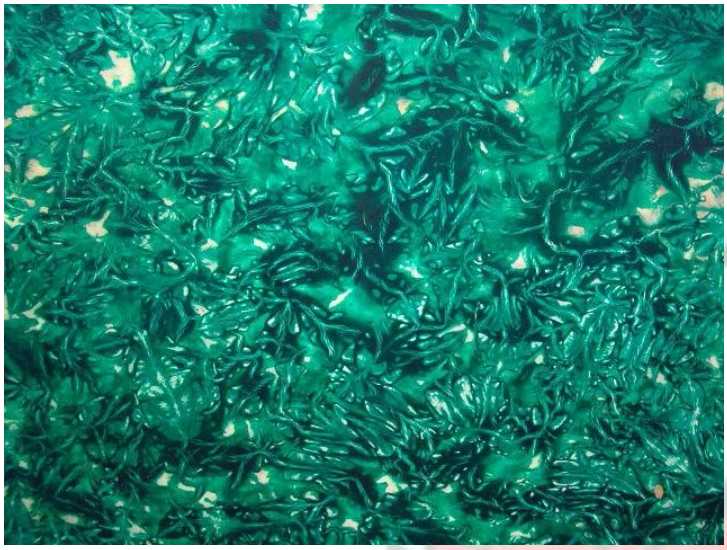


Plate 4.96. A closer view of the marbled leather

The experiment resulted in the successful use of the vat dye in the production of green marbled leather.

(ii.) Dye marbling with two colours.

The leather was crumpled as in the first experiment, in a more regular manner (Plate 4.97) after it had been pounded to soften it. Two different colours red and green were used to achieve a multi colour effect (Plate 4.98). This was done by first, pouring the warm colour (red) over the crumpled leather followed by the cool colour (green).

The leather was left on the working surface for thirty minutes, after which it was rinsed in clean water. The rinsed leather was next stretched on a stretcher board to dry. (Plate 4,99 and 4.100). Plate 4.101 is a close-up view of multi-coloured dye-marbled leather.

Plate4.97. leather is crumpled in vertical formation

Plate 4.98. Red and green dyes are poured on crumpled leather

Plate 4.99. Dyed leather is spread out for oxidation to take place

Plate 4.100. Full sheet dye-marbled leather

Plate 4.101. A close-up view of multi-coloured dye- marbled leather.

(iii). Plain Dyeing (one colour)

The dye solution was prepared by mixing one and half tablespoonful of green vat dye, one tablespoonful of caustic soda and four tablespoonful of sodium hydro-sulfide in two hundred liters of hot water and stirred; it was then left to dry.

In the second stage three litres of clean lukewarm water was poured into an an

eight litre plastic container.

The sheet of leather was soaked and pounded as in Plate 4.88. The dye was

poured into the two-litre container and stirred, the leather was immersed in the dye solution and was turned over several times and then left in the dye solution for about fifteen minutes (4.102). At the end of fifteen minutes, it was removed and spread out in the open air for five minutes for oxidation to take place.

Later the leather was rinsed in clean water and then stretched on a stretcher board for drying. Where a deeper shade was required, the dyeing process was repeated.

The dried leather was rubbed over with a smooth, a burnishing tool, to give it a shiny and smooth surface value. It also helped to soften the leather as it broke up the compressed fibres.

Plate 4.102. Leather is dipped into dye

4. 7.6. 2. Exploring the use of Suede Dye on leather

The need to improve on the indigenous art forms for national development has necessitated the exploration of existing local materials and technologies to improve upon them to meet contemporary needs of society. The researcher desired to find alternate dyestuffs that can be obtained in different colours and can be used on leather without disturbing its surface quality. It is in the light of this that the use of suede dye a local dyestuff that is easily available and can be found in almost every market in Ghana was chosen for this research.

Every dye may be dissolved in some solvent to make it useful, and Suede dye is water soluble. It is known to be used locally to dye raffia, straw, and sometimes cotton. Unfortunately it bleeds and stains easily; therefore dyed articles are not brought into contact with water nor moisture. It is not known in the Ghanaian leather industry as a fast dye for leather.

Selected Techniques

a) Plain dyeing

b) Marbling (single colour).

Experiment 1:

Plain dyeing

Two different suede dyes, red and blue, were applied separately to two sheets of leathers by following a common dyeing procedure as described below:

The Leathers were dampened with clean water and each one was pounded for ten minutes, in a mortar with a wooden pestle to loosen up the fibers (Plate 4.88). It became very soft and the fibers opened up to enable easy absorption of dyes.

One tablespoonful (10 gram) of red suede dye and six tablespoonfuls (60 gram) of alum ($KAL(SO_4)_2.12H_2O$), (Alum is very soluble in hot water and serves as mordant in the dyeing process) was mixed with four litres of warm water in a plastic container in the first instance. Afterwards, the pounded cream coloured sheet of leather was immersed in the dye solution and stirred for about five minutes; this allowed the dye solution to penetrate the fibres of the leather. It was left in the solution for about fifteen minutes.

There after the dyed leather was removed and left in a shade for ten minutes. It was then rinsed in clean water to clear the excess dye solution. The leather was pulled taut on a stretcher board and allowed it to dry slowly in a shade.

A burnisher was used to rub over the surface of the dried leather to give it sheen and soft, smooth surface value. The Suede nature of the leather was achieve after the fleshy side was rubbed gently with rough abrasive paper to achieve a regular fluffy surface. Finally, the leather was exposed to sunlight continuously for fourteen days (plate 4.103).

Plate 4.103 Grain Side –Red leather

Experiment 2:

Following the procedure in Experiment 1**,** blue and green suede dyes were used to test how different colours would behave by following the similar experiment.

Six tablespoonfuls of common salt (sodium chloride) were mixed with blue dye and warm water instead of alum for preparing the dye solution, after which a sheet of leather was immersed in it (plates 4.104and 4.105). The same method was repeated, by using green suede dye (plates 4.106 and 4.107).

Plate 4.104 Grain side, blue dyed

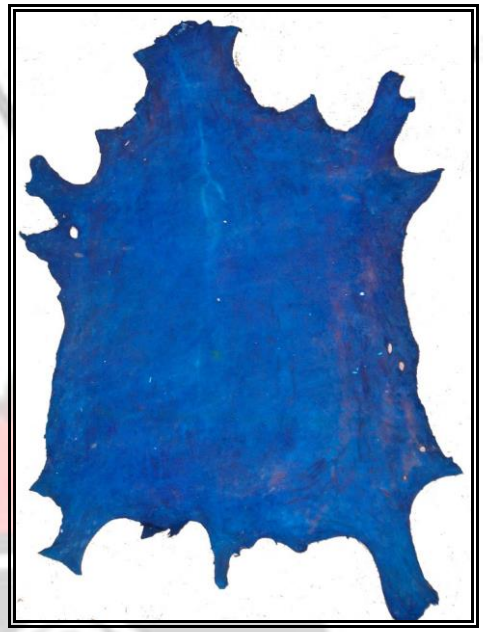


Plate 4.105 Flesh side, blue dyed

Plate 4.106 Grain side-green dyed

Plate 4.107 Flesh side – green dyed

Experiment 3:

The processes for preparing the dye solution for experiment one was used.

However, in this instance, red and brown dye solutions were used.

The leather was loosely and randomly crumpled and dyed in a red dye solution for about fifteen minutes and then allowed to dry.
Some parts of the leather were tied with raffia before being immersed in a brown dye solution. After fifteen minutes, it was removed, rinsed in clean water and then dried in a shade. The dried dyed leather was burnished with the burnishing tool, to give it a glossy effect. See plate 4.108.

Plate 4.108. Effect of the tie-dye technique on dyeing leather.

4.7.6.3 Exploring the use of pigments as colourants on leather (a) Acrylic (water based pigment), (b) Enamel Paint (oil based pigment), (c) Printing Paste as colourants on leather.
Technique through which pigments are applied; Marbling (Control and Uncontrol)

General preparatory stages for the controlled Marbling.

Methodology;

A wooden trough to hold the (size) starch. 65cm x 4cm x 59cm.(Plate 4.109.) was secured. Two kilogram of cassava starch was prepared with hot water (plate 4.110) and was poured into the wooden trough, it was made to spread evenly in the trough, plate 4.111 and 4.112.

Plate 4.109. Wooden trough

Plate 4.110. Preparing the starch

Plate 4.111. Pouring starch into trough

Plate 4.112. Starch is left to settle

4.7.6.3.1 Using Acrylic (water based pigment) as colourant on leather

Experiment one:

Selected technique, controlled marbling:

White and black acrylic pigments were selected and mixed separately to the required consistency. Each colour was stirred up with brush and placed beside the

trough for easy accessibility. The first colour to be dropped was white and then followed by black. These were dropped all over the surface of the starch, (Plate 4.113). When all the colours had been dropped serpentine lines are drawn with a stylus point and then drawn from front to back of the trough, (Plate 4.114). The comb is then drawn evenly across, from left to right, with the teeth just touching the surface of the starch.

The piece of leather was held at the middle of the bottom and at the top edge, it was laid gently upon the surface of the starch gradually, starting from the bottom end and then lowered towards the top end until the leather lie perfectly flat upon the surface of the starch, Plate 4.115. The back of the leather was tapped gently to make sure that every part touched the pigment beneath, Plate 4.116, 4.117 and 4.118. The leather was lifted up at one end and pulled gently over the edge of the wooden trough. Plate 4.119. Excess pigment and starch on the leather were carefully washed off with water under a gently running tap. The leather was next dried in a shade.

Plate 4.113. Dropping the pigments

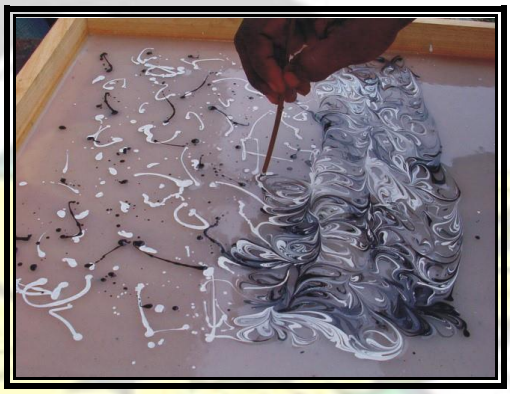


Plate 4.114. Stirring the drops of pigments.

Resultant pattern that was created after stirring the surface, plate 4.115. A piece of leather is dropped gently over the created pattern to pick the design.

Plate 4.115. Creating patterns on the size **Plate 4.116.** Dropping the leather

Leather was pressed down firmly on the pigment to pick the created pattern, plates 4.117 and 4.118.

Plate 4.117 Leather was pressed down firmly

Plate 4.118. Lifting leather from the size **Plate 4.120.** Drying marbled leather

Plate 4.121. Finished Acrylic Marbled leather

4.7.6.3.2 Enamel Based Marbling (i. controlled, ii. Uncontrolled)

Experiment Two:

i. Controlled Marbling:

Following after the procedure used for water based controlled marbling, enamel (oil) paint was also used resulting in the production of oil based controlled marbling on a red sheet of leather as shown in plate 4.122.

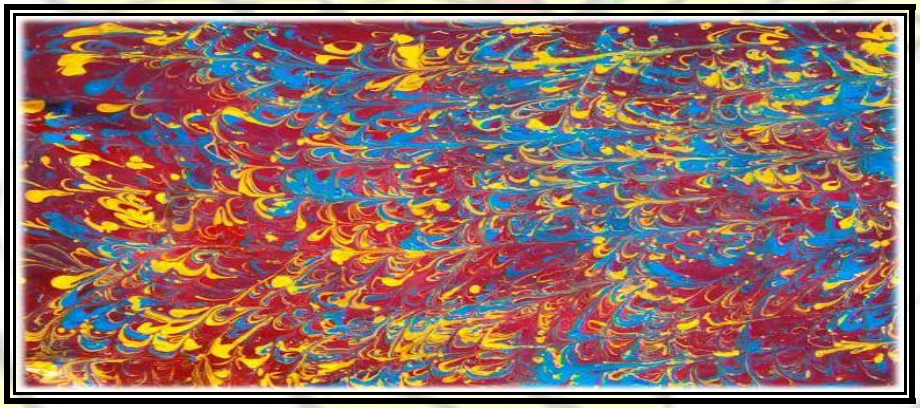


Plate.4.122. Transferred pattern on leather (oil based uncontrolled marbling)

ii. Uncontrolled Marbling (Oil Marbling):

This is done mostly with oil-based pigment. Water is then used as the size, since oil is insoluble in it.

Working process:

Leather and colours (yellow, red, blue) were prepared in small containers and placed beside a large plastic bow (36cm in diameter x 30cm) that contained the size.

Yellow was dropped all over the surface with number six sable brush, followed by red and then blue, for three colour work. A stylus was swirled in a great variety of ways, producing many different patterns as in Plate 4.123 and the piece of leather was laid gently upon the patterns, and then tapped gently at the back, making sure that every part of it touched the colours as in plate 4.124.

The front edge of the marbled leather was lifted from the size, plate 4.125 and placed on a flat support to dry it as final finished product, plate 4.126.

Plate 4.123 Creating patterns on the size **Plate 4.124.** Picking pattern with leather

Plate 4.125. Lifting leather from the size.

Plate 4.126. Uncontrolled oil based marbled leather

4.7.6.3.3 Using Fabric Printing Paste for colouring leather

Experiment 3.

Selected techniques for the application of paste (i) Controlled Marbling

(ii) Dabbing

i. Controlled Marbling:

Red and Black fabric printing paste were selected and mixed separately to the required consistency. Each colour was stirred with a sable brush and placed beside the trough for easy accessibility.

The first colour to be dropped was red and then followed by black, these were dropped all over the surface of the starch. Serpentine lines were drawn with a stylus point and then drawn from front to back of the trough. The comb (cardboard comb) was then drawn evenly across from left to right, with the edge of the prongs just touching the surface of the starch. Plate 4.127.

The piece of leather was held at the middle of bottom and the top ends(Plate 4.128), it was laid upon the surface of the starch gradually, starting from the bottom and gradually lowered towards the top edge until the leather rested perfectly flat upon

the surface of the starch, plate (4.129). The back of the leather was tapped gently to make sure that every part touched the pigment beneath,
(plate 4.129).

The leather was lifted up gently, beginning from one end to the other. Excess pigment and starch were carefully washed off with water, (plate 4.130). The marbled leather was next laid flat on a level surface to dry, (plate 4.131).

Plate 4.127. Comb patterned design

Plate 4.128. Lowering leather on design

Plate 4.129. Tapping the back of leather

Plate 4.130. Washing off excess paste

Plate 4.131. Drying the finish printing paste marbled design

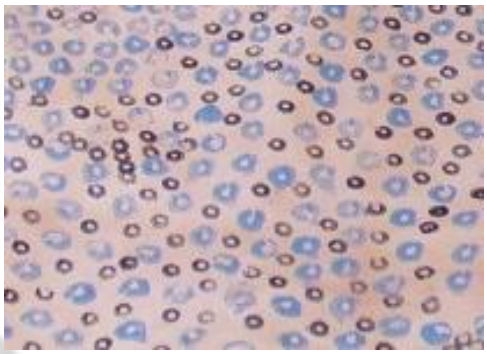
ii. Dabbing:

The glossy nature of the grain side of vegetable tanned leather does not allow fabric-printing paste to penetrate the fibers easily; therefore, the act off dabbing was tried on it.

A sheet of cream coloured leather was prepared by sanding the grain side, then soaked and stretched on a stretcher board to dry. The dry leather was laid on a flat board to work on .

Two colours of printing paste, brown and blue were poured onto two separate plastic plates and placed on the printing board for easy transfer onto the leather.

The flat edge of plantain stalk was used by dabbing it first into the dye then unto the leather. The light blue paste was first applied all over the leather to dry; thereafter the brown paste was also applied in likewise manner (plate 4.132), this resulted in a decorative pattern as in the figure below, (plate 4.133).



(Plate 4.132) Dabbing with plantain stalk **(Plate 4.133)** decorative dabbing design

4.7.6.3.4 Developing printing paste from cassava starch and vat dye for colouring leather.

Experiment four:

Selected technique for the application of paste;

Vat dye was prepared separately in the following procedure.

In the first instance, one tablespoonful of brown vat dye, one tablespoonful of caustic soda and four tablespoonful of sodium hydro-sulphide, were mixed with eighty milligram (80ml.) of hot water in a small size plastic container and stirred. The dye and accompanying chemicals were poured into the hot water and stirred; it was then left to dry.

Preparation of paste: Cassava starch was used for this project.

In the second instance, thick paste of cassava was prepared with hot water that was boiled on the coal pot; the paste was poured into the one-liter plastic container. The dye was poured into the paste and stirred to mix thoroughly.

Application of paste : selected technique (screen-printing).

In the third instance, the brown paste was made ready and used for the project.

A screen with a developed design was used. The selected piece of leather was sanded slightly on the grain side with emery paper to provide smooth soft surface for easy absorption of paste. The leather was spread on a printing table and the screen placed on it for printing. Printing was done by pouring the paste on the reserve side of the screen and with the aid of squeegee, the paste was dragged over the screen to transfer the design onto the leather. The leather was dried under a shade (plate 4.134)

Burnishing was done by spreading a plain sheet of paper over the dried printed surface**,** thereafter a smooth surface bottle was used to rub over it for burnishing.

Plate 4.134. Vat dye print on leather

4.7.7. Project 7

Controlling the development of moulds and offensive odour affecting indigenous tanned leathers

The search for a means of controlling mould and offensive odour cannot be separated because it has been observed that their causes are similar and the elimination of one means a solution to both. The primary cause is the presence of flesh and fatty substances that are left after tanning. These begin to decay and develop moulds when they are exposed to moisture. Besides these excess tannins left after tanning and the use of organic substances, such as leftover of locally cooked food, contribute to the offensive odour on finished items.

Selected experiments:

The following experiments are meant to explore means of solving these problems. Indigenous tanned leather is taken through a post-tanning process after it has been purchased from the local tannery, before it can be used in processing leather articles.

Experiment 1:

The fleshy side of indigenous (vegetable) tanned leather was sanded by using coarse sanding paper wrapped around a piece of wooden block. The indigenous tanned leather was then soaked in water and later washed to get rid of the excess flesh and tannins.

The washed tanned leather was dried on a stretcher board, making sure that the wet leather was tautly stretched out with the aid of three-inches nails and allowed to dry in a shady area avoiding the effect of direct sunshine.

A smooth round bottle was used in burnishing the grainy side of the dry leather after which an abrasive paper was used to create buffy surface on the flesh side. Finally the leather was left hanging in a cool humid room for thirty days to observe the effect of such condition on it.

Experiment 2:

Leather procured from the indigenous tanneries was sanded to remove the excess flesh and fatty substances left after tanning. It was soaked in clean water up to about thirty minutes, after which it was tautly stretched over a stretcher board until it dried. Drying was done under room temperature.

When it completely dry bee wax was boarded on the flesh side of the leather. In order to achieve a soft sheen on the grainy side, the waxed leather was burnished with a smooth round surface bottle. This also helped to make it suppler.

Lacquer was sprayed thinly over the grainy surface to make it impervious to water rubbed over the grain surface.

The secondary treated leather was kept in a damp humid room for thirty days to observe the effect such condition will have on it.

Experiment 3:

Controlling offensive odour in indigenous tanned fur

The indigenous tanned fur was sanded on the fleshy side with sand paper to remove the excess flesh and fatty substances left after tanning.

It was then soaked in clean water for an hour and then washed thoroughly on the fur side with perfumed toilet soap.

The leather was pulled taut and held firmly with three inch nails on a stretcher board, and then allowed to dry partially under room temperature over night.
The partially dry fur is put into the tumbling machine and after tumbling for thirty minutes it was removed. It was then brushed and made ready for use, (see plates 4.135 and 4.136).

Plate 4.135: Finished tanned fur (sheepskin)

Plate 4.136. Finished tanned fur (goatskin)

CHAPTER FIVE

RESULTS AND DISCUSSION

5.1. Project 1: Design of alternate vessels for tanning

The use of plastic vessels for beaming and tanning proved effective. The vessels had covers to prevent dust from settling on their contents, and rain from filling them up to weaken the tannins or wash them away as it often happens to those tanners who work closer to river side. A typical example is the Asawasi Tannery. The plastic vessels can also have their contents easily drained off and replaced with fresh liquors.

The wooden stands also help to protect the plastic vessels and help in getting them closer together to promote rapid transfer of pelts from one vessel to the other without wasting much time and energy. The wooden stands also reduce the space required for tanning. It also makes it possible for tanning to be done indoors.

The plastic containers are easily available in the local markets in Kumasi and other parts of Ghana, and any furniture-worker or carpenter locally can always do wooden stands. Wood is also available at the various wood markets in Ghana.

5.2. Project 2:

Construction of a scudding equipment for fleshing and unhairing

This equipment marks a complete departure from the known indigenous technology for scudding. The designer, some students and two tanners from Asawase, a suburb of Kumasi tested the efficiency of the device. Reports from all of them were positive, the device was found to be comfortable to use and made scudding easier and faster.

Although the primary objective for the equipment was for fleshing and dehairing, it was realized that it could also be used to hold leathers firmly to make sanding easier.

Wood is the main material used to construct the equipment; since it is largely available in the country it will be easy for one to acquire it. Beside, the design is simple such that any local furniture maker would be able to reproduce. The bolts and nuts were manufactured at the local lathe -turner's workshop. There will be no difficulty in moving it from one place to another because of its compactness and size. The receptacle provided also enable students to work both indoor and outdoor without

making the studio, workshop or tannery dirty. It will help in the teaching and learning of scudding since it forms part of the syllabus.

It is worthy to note that during the period of trials the equipment was found to be useful alternatively as a support for sanding, and that the top holders held the leathers firmly for effective movement of the sanding block from top to bottom.

5.3 Project 3:

Construction of equipment for drying pelts, leathers and fur.

(A) Open-leather dryer

The equipment was tested at different instances, which are outdoor under the sun and indoor with different materials. These are pelts, fur, and leathers.

Leathers dried in the dryer, both indoor and outdoor dried gradually and became smooth and supple. This is unlike the situation where leathers dried directly facing grain side up on stretched.

The dryer is mobile and could be carried to any point. This will therefore make it possible for students and other leatherworkers to dry their materials at all times, particularly during rainy seasons.

The test on the dryer demonstrates the effectiveness of the equipment for drying pelt, leather and fur; and that leather will maintain some degree of softness when allowed to dry gradually.

The equipment again saves space because students and leatherworkers do not need large spaces for drying.

(B) Electric-leather dryer

The various tests tried on the dryer prove its effectiveness as leatherwork equipment. By using this equipment, drying will not be hindered by unfriendly weather conditions, such as during rainy seasons, where previously leatherworkers were not able to meet their production needs at the appropriate times because of the delay in drying their materials.

Students will also be able to work at a faster rate and they will not have any problem with drying period or space.

The equipment is not too bulky and therefore can be moved around without much difficulty, besides the shape has been made in a manner that makes it easy to enter the average doorway.

The design is simple and all the materials are available locally, therefore, it can be reproduced several times.

5.4. Project 4:

Construction of a tumbling equipment useful for softening, drying and boarding leather with oil.

The tumbling machine proved efficient in (a) boarding oil into leather

(b)softening leather and (c) drying leather.

(a) The slightly dried leathers that had been smeared with oil and put into the drum had the leathers effectively boarded with the oil as required after tumbling in the drum for twenty minutes.

(b) The slightly dried leathers that were put into the drum got softened after tumbling in the drum for forty minutes. The tumbling helped to weaken compressed protein fibres (mostly collagen fibres) which constitute leather.

(c) Leathers that were partially dried and were put into the equipment were thoroughly dried after tumbling for one hour. This was because of the air that was directed into the drum through the large crescent holes created on the right side of the drum. The hole had strips of curved metal plates welded at their edges that guide the air into the drum as it revolved.

5.5. Project 5:

Construction of a thong cutting equipment

The machine can cut through the sheets of leathers inserted into strips of equal sizes (length and width).The strips are capable of being used for thonging or weaving. The rate at which the machine works will enable students and craftsmen to produce leather articles at a faster rate and in a better situation than the act of using knives and scissors for cutting.

(a) Electric powered: the use of electricity to power the machine proved successful as strips of leathers could be cut at a faster rate. The equipment will

enable leather workers to take advantage of the extension of electricity supply to most parts of the country to promote their work.

(b) Manual rolling: The hand rolling of the machine resulted in the successful production of strips of leathers for thonging and weaving. The manual will enable strips of leathers to be cut at all times without depending solely on electricity.

The machine saves time, energy, and equal width for thongs, as a result thonged area of leather articles will be neater, and of a higher aesthetic value. Individuals or companies can use the machine. It uses adjustable blades for cutting and these can be sharpened or replaced easily. It is easy to operate and maintained. Besides, it is portable and therefore can be carried easily.

5.6 Project 6:

Exploring the use of alternate locally available dyes and pigments for dyeing or colouring leather.

5.6.1 Adapting vat dye as alternate dyeing agent for colouring vegetable tanned leather.

Experiment 1:

Using the formula for dyeing cotton fabrics with vat dye.

(The marbling technique)

The areas of the leather that should have dyed green, instead, burned to a shade of burnt sienna.

To find out which of the two chemicals reacted negatively to burn the leather to dark brown, the same quantity of each chemical was mixed with hot water and poured into two separate containers. Two pieces of leather were submerged in each of them for fifteen minutes. The sodium hydrosulphite did not give any reaction but the caustic soda burnt the piece of leather indicating that the quantity of caustic soda as an additive was too much and needed to be reduced. Further experiments therefore became necessary.

Alternative formula.

Experiment 2:

(i). Dye marbling with a single colour

Several experiments were conducted, each time reducing the amount of caustic soda used until the right quantity and effect were achieved.

Following the reduction in quantity of caustic soda in the dye preparation, green coloured marbled leather was produced without any burns. The excess dyes were thoroughly washed off with clean water leaving clean dyed leather that did not bleed. This test therefore indicated that vat dye can be used on protein fibres contrary to the assertion made by the Encarta Encyclopedia; that vat and sulphur dyes are not used on protein fibres because of the strong alkaline nature of their leuco-compound solutions. Its further assertion that these dyes perform best on cellulose fibres, especially where fastness to frequent and hard washing is required has been equally proven in the handling of leather through the experiment.

(ii). Dye marbling with two colours

Following the successful application of vat dye on leather, two different colours were also tried on the same type of leather. This also proved successful, indicating that different colours can be achieved effectively with vat dye. The successful application of vat dye on leather makes it possible for students and practitioners to design and produce different leather articles in variety of colours than ever before. This hypothesis was tested when students under supervision, used the new technique to dye some leathers and thereafter produced a variety of leather articles with them as indicated in the Following Plates 5.1, 5.2, 5.3, 5.4, 5.5 and 5.6.

Plate 5.1. A pair of shoes with marbled uppers

Plate 5.2. A set of pouffe and floor mart

Plate 5.3. A traditional Ghanaian Sandals

Plate 5.4. Arm rest.

Plate 5.5. A pair of traditional Ghanaian sandals made wholly with marbled leather.

Plate 5.6. Table mart.

Plain dyeing in single colour

The grain side of the leather could not absorb the dye as expected. The flesh side however was dyed effectively. The result implied that the plain dyeing technique was more successful on the flesh side of leather, where the brilliance of colour is better achieved as compared to the effect on the grain side.

5.6.2 Exploring the use of Suede Dye on vegetable tanned leather.

In experiment one**,** two different colours of suede dyes (red, blue) were used by following the common processes described above.
The suede dye proved to be more effective for colouring leather. The two differently coloured pieces of leather that were produced were very bright. The colours were water-fast and did not bleed. After exposing them to sunlight ninety days there was no evidence of change in the colours on any of the dyed leather, thus indicating that suede dye can withstand the strong tropical weather and sun experienced in Ghana. The working process was very simple and time saving. The dye and chemicals used were not toxic as with some other dyes. The dyes, which come in different colours, are inexpensive and are locally available. It was realized that the warm water makes it easier for fibers to loosen up to absorb the dye solution.
The alum also enabled the development of soft and pliable leather. Dyeing is achieved on both sides of the leather in a distinct manner that provides the leather worker the opportunity of deciding which side to use, either the grain side or the

flesh side. If the flesh side is to be used the leather is termed grain leather, otherwise known suede leather.

In experiment two, the common salt and blue dye were used to prepare the dye solution instead of alum as used earlier in Experiment One, and the same result was obtained as above. However, dyeing substances did not stain the hands of the researcher on contact.

The final experiment confirmed that suede dye could be used effectively as other known leather dyes to achieve myriad effects on leather(see plates 4.103, 4.104, -4.108 and5.7).

Plate 5.7. Article decorated with pieces of coloured suede dyed leathers

5.6.3. Using pigments to colour leather: Exploring the use of (a) Acrylic (water based pigment) (b) Enamel paint (oil based pigment) (c) Printing paste as colourants on leather.

Experiment 3.

(a) Acrylic (water-based pigment)

Control marbling technique;

The pigment worked effectively on leather just as it does on paper, fabric and other surfaces. The very fine grains of the pigment made it possible for the fibres to seep through the grains to make it firmly fixed. Acrylic pigment comes in variety of colours and therefore its successful use on leather has provided students the opportunity of selecting alternate colourant which has varied colour schemes.
The effectiveness of the pigment on leather is demonstrated with the production of some leather articles in the following plates (5.8, 5.8, 5.10- 5.14).

Plate 5.8. Leather article illustrating the use of Acrylic (water-based pigment)

(b) Enamel Paint (oil based pigment)

i. Controlled marbling ii.
Uncontrolled marbling.
The marbling technique proved the usefulness of applying oil based pigment on leather as a colourant. By stirring the pigment on the surface of the sizes to create designs the paint became lighter, therefore when the sheets of leathers were placed on them, thin layers of the designs were transferred onto them. The following plates (plates 3.9 and 5.10) show the effectiveness of using marbling techniques as a means of colouring leather with oil paint for the production of leather articles.

Plate 5.9. Leather article illustrating the use of Oil Based Control Marbling;

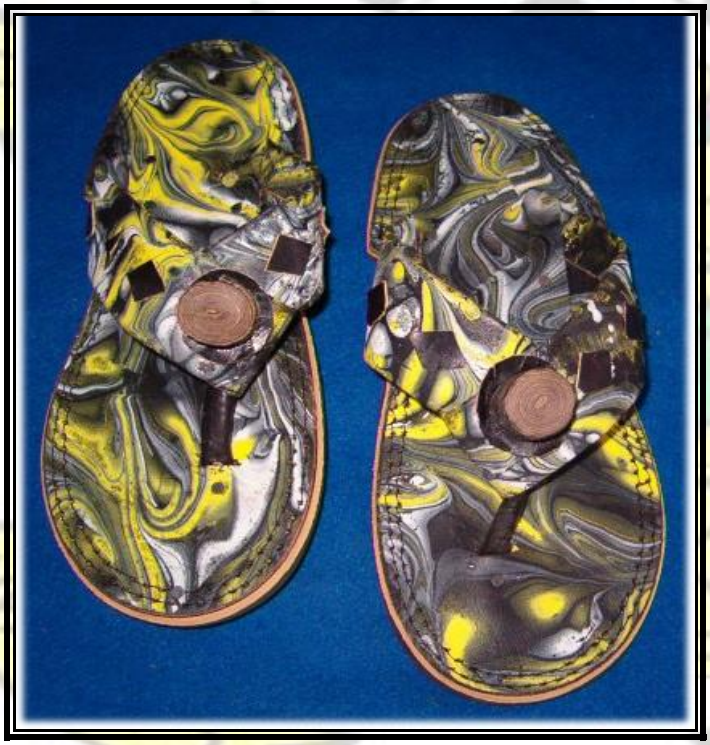


Plate 5.10. Leather article illustrating the use of Oil based Uncontrolled Marbling

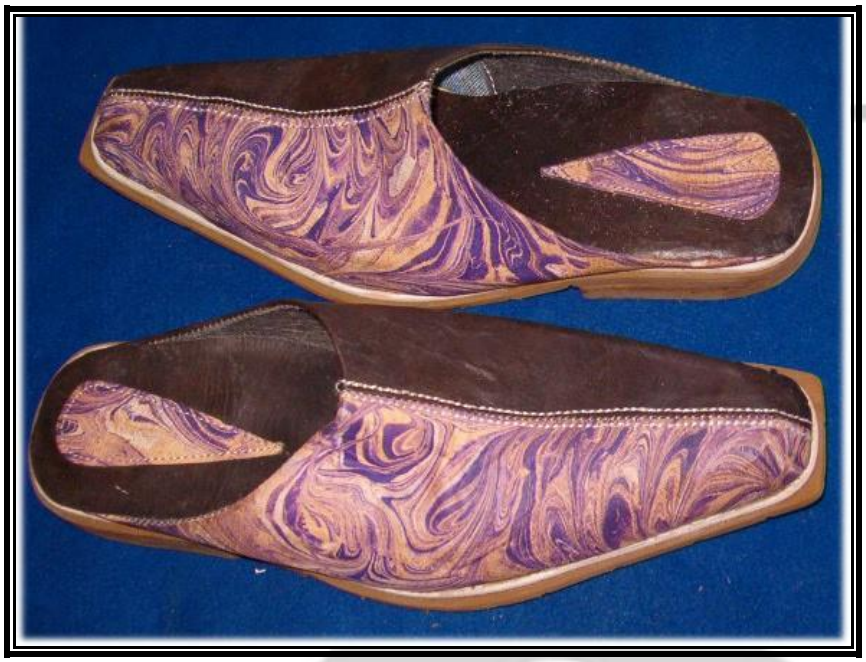


Plate 5.11. Leather article illustrating the use of Oil Based pigment

(i i) Uncontrolled Marbling:

(c) Fabric printing paste as colourant on leather; Using controlled marbling ii.

Dabbing.

ii. Controlled marbling

The experiment was successful but not as effective and easy as the acrylic and oil marbling. The paste is oily, lightweight and the drops that were sprinkled on the size easily mixed up with it. Therefore, it required high degree of fastness and carefulness in applying the paste and stirring it on the size. Leatherwork students and craftsmen can use this technique as an alternate means of applying colour on leather.

ii. Dabbing:

The exercise proved very successful, the pigment had sufficient time to sink into the upper layer of the leather. It makes it possible for artisans and students to discover alternate colourants for leather.

Plate 5.12. Leather bag with decorative dabbing

5.6.4 Developing Vat dye and cassava starch as printing paste for colouring leather:

Experiment four

The experiment proved successful. The dye was able to penetrate the fibres because of the smooth soft surface created by making it slightly dump with water. The prepared dye mixed perfectly with the starch, which was made into a thick paste and used as pigment to drive the vat dye. The printing technique for colouring the leather was effective as in the plate 5.12. It has provided leather workers additional technique for colouring leather.

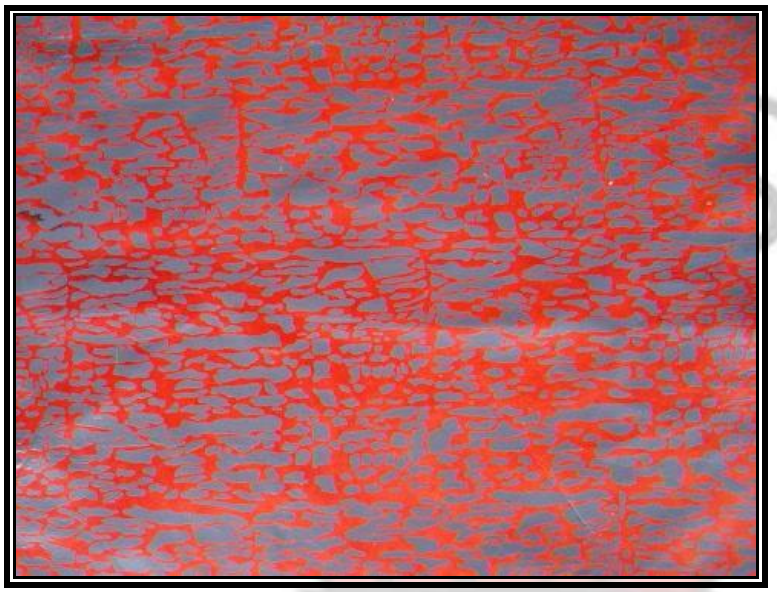


Plate 5.13. Effect of starch mixed with vat dye as printing paste on leather.

Plate 5.14. A pair of shoe uppers made from the leather in plate 5.13.

5.7 Project 7.

Controlling the development of moulds and offensive odour affecting indigenous tanned leathers

Experiment 1:

The odour associated with the indigenous tanned leather was completely subdued after it had dried. The secondary treated indigenous tanned leather that was kept in a damp room did not develop moulds after the thirty-day period. This was as a result of the thorough activities of sanding, soaking and washing. Sanding off the fleshy side helped remove the remaining fleshy and fatty substances left after tanning, and by so doing, moulds and fungi could not develop on the leather to cause continuous decay that causes bad odour.

Drying the leather under shade, coupled with the vigorous activity of burnishing with the smooth bottle softened the compressed fibers into soft, glossy grained leather.

Experiment 2:

The indigenous tanned leather was given a secondary treatment. Sanding removed the fatty substances and flesh left after tanning which absorbed moisture that allowed moulds to develop on leather. Soaking made it soft for easy stretching. The excess tannins left after tanning gave out an unpleasant odour, therefore washing helped to remove it.

The application of bee wax sealed off the pores. Burnishing of the grain side of the leather was done with a smooth bottle. This enabled the bee-wax to penetrate the fibers and pores from beneath. Besides, it caused the natural oils of the leather to spread out producing a soft sheen, making it more compact and impervious to moisture.

A thin layer of spray lacquer was rubbed over the surface. This helped to seal off the surface and remnant pores, making the grain side of the leather water resistant and useful for the production of such articles as table mats, floor mats and coasters. The leather did not develop any moulds after it had been kept in a damp room for thirty days.

Leathers treated in this manner do not emit any unpleasant odour and do develop moulds that cause stains on leathers

Experiment 3:

Controlling offensive odour in indigenous tanned fur.

The experiment resulted in the production of a finished fur that had a pleasant odour and could be kept indoors without any problems of moulds that cause stains on leather.

Sanding of the flesh side of the fur removed the excess flesh that is left after tanning, so that there will not be any decay when the fur comes into contact with moisture.

Animals slaughtered for their pelts are not often bathed, and as a result their pelts give off an offensive smell. Also, blood stains and dirt that affect the fur during tanning often contributes to the offensive odour emanating from them after tanning. Therefore, soaking and washing help to remove these elements, which are the major causes of the development of offensive odour moulds or fungi on indigenous tanned fur.

After going through the tumbling machine, a softly dried pelt was produced and brushing helped the fur to align smoothly.

CHAPTER SIX

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

6.1. Summary

The determination of Ghana government to promote training in indigenous craft vocations to support her effort to reduce the unemployment situation in the country and to save these vocations from dying out was among the major factors for the introduction of the educational reform programme. This good effort has brought into focus some of the problems that do not encourage the training in these vocations and therefore requires serious solutions.

Leather as a material has diverse usage and can be found in every home and on every individual, therefore its promotion will not only be useful locally but also as an export product for foreign currency.

Although leatherwork has been introduced into schools, yet students, at both second cycle and tertiary levels, find the leather processing techniques used by indigenous tanners quite unattractive and unhealthy. It is in this light that the researcher visited some of these local tanneries and identified some of these problems, designed and developed some technologies, that will be more convenient for processing leather in schools and for industry.

To achieve this, specific objectives were drawn for the project as follows:

1. To identify local tanning technologies with the view of developing new ones suitable for processing leather in schools and colleges.
2. To produce sample leatherwork tools and equipment.
3. To explore the use of alternate locally available dyes and pigments for dyeing or colouring leather; and to develop a mechanism through which the offensive odour and moulds, which are associated with vegetable-tanned leathers, can be reduced.

The problems identified were in the following areas:

i. The type of tanning vessels used by indigenous tanners are not convenient for use in schools ii. The technology used for scudding. iii. The means for drying leather iv. The technique for softening leather

v. the mechanism for cutting leather.

vi. the limited colourants and their quality.

vii. the unpleasant odour and development of moulds associated with indigenous tanned leathers.

The identified problems were researched into and solutions were found to them. These are as follows:

i. tanning vessels that would be convenient for use in schools and industry were designed and constructed.

ii. Scudding equipment was designed and produced for use in schools and industry.

iii. Two different dryers capable of being used indoors and outdoors and at all times were designed and produced. iv. Mechanical means for softening leather was designed and produced.

v. An equipment for cutting strips of leather for thonging and weaving was designed and produced.

vi. Some locally available colourants capable of being used on leather were identified and used successfully.

vii. Technique for controlling bad odour and the development of moulds on leather was developed.

These technologies were each tested and were found useful, thus achieving the objective for the research.

6.2. Conclusion.

The problems confronting indigenous tanning have over the years hindered the popularity and market value of leather articles. However, the expanding taste for quality and more aesthetically appealing goods in this economically competitive era requires the development of innovation in the indigenous leather industry as well.

The results from the experiments conducted so far have made available to leather craftsmen and tanners very simple, practical, and easy to follow formulas by which

some basic, but essential equipment, such as tanning vessels, scudding equipment, dryer, tumbling and thong cutting machines could be produced to promote teaching and industry.

Beside, the successful use of some pigments and dyes that are locally available as alternate colourants on leather, would be useful to improve the aesthetic value of leather and leather articles through diversified techniques.

Apart from this, it has also proved that the ordinary dyeing substance that is locally and easily available, and which is environmentally friendly, could be an equally good option for artisans to use.

The hope of the researcher is that equipment, materials and techniques developed through the research for use in schools and the industry will help to raise the popularity and market value of leather articles, both locally and internationally.

Contributions to the leather industry:

The project seek to remove the barriers that have all this while prevented the leather industry from moving forward.

The research intends to make the leather industry an important institution and a major contributor to the nations socio-economic development.

It also makes available organised information on solutions towards identified technical problems that hinder the development of the industry.

6.3. Recommendations.

Workshops must be organised by the ministry of industry or relevant organisations for indigenous leatherworkers to upgrade their knowledge with the findings of the research, in terms of the following

(a). The alternative tanning equipment,

(b). The use of identified locally available colourants

(c). The technology for controlling offensive odour and the development of moulds

A Research Center must be established to support the industry in the areas of design, material and technological development to meet modern needs as well as boost up national development.

The teaching of leatherwork must be intensified in schools with emphasis on design and identification of new uses of leather to meet modern needs. This must be done through the provision of relevant material and technical resources.

Workshops must be organized by the ministry of industry for indigenous leatherworkers to upgrades their knowledge through the teaching and sharing of ideas.

People who rear animals or slaughter them, must always take into consideration the possibility of using the pelts of the animals as secondary materials for the production of leather and other related products. Animals must be protected against skin diseases and insect bites.

It is further recommended that leatherworkers must painstakingly go through the identified processes in the research report to increase the value of leathers.

Environmental measures:

The increasing demand for leather has lead to the use of large quantities of industrial chemicals for tanning. Therefore, there is the need for a cleaner, better and more environmentally responsible leather industry. It has been state by Black Stock that during the 18th and 19th centuries, the chemical industry's attempts to copy naturally occurring vegetable tans using compounds of chromium, zirconium, aluminum and iron and complex machinery produced stable leather.

However, most leather manufactured this way did not have the wonderful feel and other qualities of vegetable tannage. Prior to environmental awareness and subsequent controls, some of these methods were ecologically unsound. Today, however, leading tanneries employ stringent environmental practices to ensure clean air, water and natural surroundings. Howbeit, the best leathers are still created fully or partially with vegetable tanning.

However, in the case of the tanneries in Ghana, about 99% of the chemicals used for tanning are vegetable based and therefore have lesser effect on the environment. The only identified effects have been the offensive odour from soak pelts, decaying flesh and of hair, and heap of tanning residue left after scudding.

To help improve and maintain the environment, the following are recommended.

Regulations should be enacted to guide local tanners on the handling of waste.

That tanning residue must be buried soon after tanning.

That residue, such as hair, flesh and barks could be recycled, by first separating them and then converting them into fertilizers for farming.

Water treatment plants must be built to recycle waste tanning liquor, and that such should not allowed leach into running waters.

REFRENCES

American Educator (1970). *Leather* (p.81) The United Educators, Inc Lake Bluff, Ill. Chicago, N.Y. Toronto, –

Blackstock, *History of Leather*, (page 1) Blackstock Resource Centre History of Leather.htm- http://www.blackstock.com/html/resource/3b.html

Crete Peterson, (1961) *Creative Leathercraft* (p. 11, 12). Blanford Press Ltd. London,

Carlson Marc, (2001). *Medieval leatherworking techniques*, leatherworking in the middle ages. 3 htm.

Dunet, Ruth (1948), *Art and Child Personality*, (p. 3). Methuen and Company Ltd., London.

Down Home Leather, (16-6-2003) "*History of Leather,* http://www.downhomeleather.com/history.htm

Encyclopedia Britannica (1977) *Leather,*(p. –847). Encyclopedia Britannica Inc.William Benton.

Encyclopedia Britannica (1977) *leather*, (p760). Encyclopedia Britannica Inc.William Benton.

Encyclopedia Britannica, (1977). *Leather*, (p761). Encyclopedia Britannica Inc.William Benton.

Harder K.G.(1968),*Leatherwork*, (p26). Cox and Wyman Ltd., London.

Khan Impex Co. (11-7-2003). *Leather Processing Technique,(p3).* www.Inkanpur.com. {kanprucity.8.com}

Matt, R. (2000). *History*. (p. 1). Bark Tanning. http://www. braintan.com/

"Mold (fungi)." (2004) Microsoft® Student 2006 [DVD]. Redmond, WA: Microsoft Corporation, 2006.

Owusu-Ansah, J.V. (1978). *Leatherwork*, (p.51). The Major Ashanti Traditional Crafts. (M.A. Thesis), K. N. U.S.T, Kumasi.

Reed, R. Bark Tanning, (2000). (p.2). *Ancient Skins, Parchments and Leather*, http://www. braintan.com/

Sartan's Working With Leather (22-4-2003). *Techniques*, htm: //www.saroftreve. com/drnewbie. Shtml

The World Book Encyclopedia,(1977). *Leather*, (p760). Encyclopedia Britannica Inc.William Benton.

The World Book Encyclopedia,(1977). *Leather*, (p761). Encyclopedia Britannica Inc.William Benton.

The Encyclopedia Britannica, (1977). *Leather* (p.846). Encyclopedia Britannica Inc.William Benton.

The Encyclopedia Britannica, (1977). *Leather* (p.849). Encyclopedia Britannica

Inc.William Benton.

World Book Encyclopedia, (1972). *Leather* (p.76). Field Enterprises Inc.,

Chicago, U.S.A.

World Book Encyclopedia. (1972). *Leather* (p145). – Field Enterprises Inc.,

Chicago, U.S.A.