CONSTRUCTION OF A TEXTURING DEVICE FOR MANAGING SURFACE DEFECTS OF LOCALLY PRODUCED VEGETABLE TANNED LEATHER

By

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DECLARATION

I hereby declare that this submission is my own work towards the Master of Philosophy Degree in Art Education and that to the best of my knowledge, it contains no material previously published by another person nor material which has been accepted for the award of any other degree of the University, except where due acknowledgement has been made in the text.

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DEDICATION

This project is dedicated to the Almighty God for His unmerited favour and faithfulness towards me. He is good and His enormous mercies endure forever. To my father Mr. Tabi and mother Mrs. Owusu. Not relegating to the background my siblings and all loved ones.

ABSTRACT

Leather surface quality is very vital when it comes to leather artefact production. Leather surface defects reduces the surface quality of leather thereby affecting the value of the leather products on the market. In view of this, this research emphasizes the need to utilize leather surface defect management techniques which is keen as it tends to improve the surface quality of the leather and its products at large.

The study identified various defects and management methods which are currently implored by leather users to manage surface defects. The research further designed, produced and tested the efficacy of an alternative leather defect management device. This intervention was adopted based on the assertion made by Allman (2012-2016), Deines (2014) and Anon (n.d.) that texturing contributes quality to surfaces and their appearance by improving and correcting surface imperfections.

By employing the qualitative methodology to address the problems identified the research used arguments and suggestions to advance the fact that texturing truly improves and corrects surface imperfections in some leather defects. Defects which could be corrected include grain loosening and wrinkled surface defects. Defects like holes and patched remained as they are after the intervention. Cuts, molds, and parasitic infections were slightly nullified. The study further recommended other researchers to take it upon and develop different textures to test effectiveness of varying textures for various leather surface defects.

TABLE OF CONTENTS

Page

LIST OF TABLES

Page

LIST OF FIGURES

Page

LIST OF PLATES

CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

Leather is an ancient material created through a process of tanning raw animal hide and skin to preserve it and make it pliable when dry (Leather Resource, 2008). Leather tanning is without doubt one of the oldest human activities. Many years before recorded history, skins and hides obtained from hunting and livestock breeding could be used for clothing and making of tents, but they became stiff at low temperatures, while they rotted with heat. It was probably then that attempts were made to render the skin and hide more flexible and stronger, marking the beginning of leather tanning process (Leather Resource, 2008). Tanning is a means of treating pelt of animals with chemical astringents called tannis to convert pelt into leather (Boahin, 2005).

Hides from cow, buffalo, steer as well as skins from goats and sheep are employed in the making of leather. Physical properties such as High tensile strength, Resistance to tear, High resistance to puncture, insulating property and permeability to water and air differentiate leather from other materials (Boahin, 2005; Muirhead, 2015). The surface grain structure of leather comes in different variations and these variations differ from leather to leather as found with reptiles, mammals and birds. Variations in skins and hides results from factors such as, animal species, age, sex, skin structure and environment in which an animal is raised. These variations give leather from different animals their special characteristics and uses (Sharphouse 1995; Boahin, 2005).

According to Korney (2004) as cited in Asubonteng (2010), feeding of farm animals is dependent on the farming system practiced and the farming system determines the general wellbeing of the animal as well as the quality of skin. In Ghana, leather is obtained from the southern and Northern part of the country. Leather from these areas are often of low quality because of surface defects associated with such type of leathers (Asubonteng, 2010). These leather surface defects happens during and after the death of the animals. The free range feeding method of the extensive system is commonly used by farmers in the northern and southern part of Ghana to raise farm animals (Iwena 2008 as cited in Asubonteng, 2010). In this system, farmers allow their animal to roam in search of their own food and water where they are exposed to several dangers such as injuries from predators, insects and plant spikes or thorns. Some of the animals are sometimes injured by moving vehicles, insects, pest and human activities such as stone throwing and beatings from nomads or peasant farmers who follow them to graze. Injuries such as cuts and scratches which do not heal go a long way to affect the surface quality of leather and leather products produce from such animals. Leathers from these area show defects such as abscess, blind warble wholes, brand mark, dung damage, eczema, scar mark, grain break, blisters and holes (Asubonteng, 2010).

At the slaughter house as well as the tannery where animals are killed and tanned respectively are other places where surface defects on leather occur. Animals which are slaughtered and are not immediately preserved undergo putrefaction which leaves dark stains under the skins and hides of animal carcass. Unskilled baemsters who do not adopt proper mechanism during defleshing and dehairing equally cause defects such as flay cuts and grain peeling on leather surfaces (Yohannes , et al., 2015). At the leather tannery, the following surface defects may occur (Coxon, n.d.):

a. Grain drawn resulting from Coloring in liquors that are too fresh, too acid, too strong or too warm.
b. Pebbled grain resulting from prolonged drumming.
c. Cracked grain resulting from Careless handling of the raw hides or excessive swollen pelts.
d. Loose grain resulting from prolonged soaking, liming, bating and ageing of animal.
e. Pale Pinholes resulting from overbating.
f. Abrasion cause by drumming.
g. Pale Stains resulting from pools of tan or bleach liquors.
h. Brown Stains resulting from sun burns.

These defect affect the visual quality of leather making it less appealing as well as reducing the potential of the material.

Texturing is a decorative technique employed on surfaces to make them aesthetically pleasing to the eye. Textures render surfaces rough and matt when experienced. Creating textures on surfaces apart from improving on the aesthetic value of surfaces also control surface defects such as marks, stains and imperfections (Deines, 2014). Textures camouflage defects by making them undistinguishable. Textures have been employed in controlling blemishes on walls, metals and polymer clays (Allman, 2012-2016; ConcreteNetwork, 1999-2016).

1.2 Statement of the Problem

Surface defects such as abscess, blind warble wholes, brand mark, dung damage, eczema, scar mark, grain break, blisters and holes which occur as result of parasitic diseases, human errors, flaws and imperfections reduce the aesthetic value of vegetable tanned leather and results in downgrading and rejection of leather and its products (Tesfay, Guesh, Yohannes & Birtanu, 2015). According to Asubonteng (2010), observations made in the various leather shops in Kumasi, Accra and Takoradi show that the vegetable tanned leather is not a material of choice due to various surface defects associated with the leather. Significance of the leather is very limited for products such as footwear, sofas, bags, jackets, gloves, car seats, car seat backs and spare tyre covers which according to Asubonteng (2010) are commonly used by Ghanaians. Imported leather and leatherette are bought at high cost although most of these materials lack the imperative properties of vegetable tanned leather such as resilience breathability, perspiration, durability, tooling and ability to model and form to shape as emphasized by Boahin (2005).

Observation and experience of the researcher during her first degree course in leather is that, students of leather who are required by the syllabus to use vegetable tanned leather for the production of bags, footwear, wall hangings and clothing accessories; however, these leathers usually have unpleasant defects which end up marring the aesthetic and final look of the product made from them. In attempt to manage such defects, students often spend much time and also have difficulty in getting the leather patterns free of surface defects. The delay and difficulty often cause students' inability to meet deadlines set by their instructors. For some students, the entire leather or some portions of them with surface defects are simply discarded and new ones bought especially in situations where defect is excruciating. This results in students incurring additional cost. Indigenous tanners who normally lack good dyeing skills in their attempt to control some of these surface defects (pale stains, brown stain from sun scorch and grain cracks) often dye leathers but due to their inexperience, instead of attaining evenness, the effect is a patchy dyeing (Asubonteng, 2010).

Inspiration for the possibility of a texturing device on vegetable tanned leather is obtained from Man's (2010) assertion of tooling ability of vegetable tanned leather where large quantity of less expensive vegetable tanned leather are embossed with artificial grain textures in stimulation of more expensive skins such as, crocodile, snake, Yak, whale, Kangaroo, deer, ostrich, seal and stingray. In view of this, the study seeks to designs and construct a texturing device for managing locally produced vegetable tanned leather surface defects.

1.3 Objectives

Objectives of the study are:

1. To identify and document surface defects associated with locally produced vegetable tanned leather.
2. To examine the methods employed by locally produced leather users in managing leather surface defects.
3. To design and construct a texturing device and test it's efficacy for managing surface defects on locally produced vegetable tanned leather.

1.4 Research Questions

1. What are the surface defects associated with locally produced vegetable tanned leather surfaces?

2. How do users of the locally produced vegetable tanned leather manage leather surface defects?

3. How will a leather texturing device be designed and produced to manage surface defects on locally produced vegetable tanned leather?

1.4 Delimitation

The study is limited to the concept of texturing, as a managing method for locally produced vegetable tanned leather surface defects. The study is as well limited to the production of texturing device with metal scraps, abandoned machine parts, metal bars, pipes, plates and sheets which can be operated manually and electrically.

1.5 Definition of Terms

The following terms are defined and explained according to their appropriate applications and implications to the study conducted.

Texturing device: A simple machine for registering texture print on vegetable tanned leather surfaces.

Vegetable tanned leather: Leather produced in Ghana with natural compounds.

Surface Defects: Imperfections that degrades the value of vegetable tanned leather.

***Tactile defects*:** Leather surface defects that are experienced through the sense of touch and sight.

***Visual defects*:** Leather surface defects that are only experienced through the sense of sight.

***Structural defects*:** leather surface defects that affect the entire structure of the leather and are experienced by the sense of sight and touch.

Artefacts: Products produced out of leather

1.6 Importance of the Study

First and foremost, this study provides vital knowledge on various methods of managing vegetable tanned leather surface defects. These methods which have been highlighted in this study contributes to the knowledge of the locally produced leather users including students of leather about how various leather surface defects can be managed to enable them produce leather products with outstanding surface quality. Producing leather with outstanding surface quality would enable products produced by local leather users to be appreciated and valued. Students of leather would avoid challenges they go through when using the locally produced vegetable tanned leathers for their course works.

This study contributes to the development of the local leather industry by improving on the surface appearance of locally produced leathers which would attract both local and foreign leather users. Acceptance of locally produced leathers will revive the local leather industry from collapsing. The local leather industry would reduce the number of leathers which are rejected because these leathers would have their surfaces managed to enhance their appearance and value.

1.7 Arrangement of the rest of the Text

Chapter Two deals with literature related to the research. Research design, population studied, sample and sampling techniques, data collection techniques, data collection tools and procedures as well as data analysis plan employed in the study are discussed in chapter three. Chapter Four presents the analysis of the main finding and the test result of the texturing device designed for vegetable tanned leather surface defects. Chapter Five the final chapter discusses the summary, conclusions and recommendations for the study.

REVIEW OF RELATED LITERATURE

2.1 Overview

This section of the thesis aims at bringing to light related theoretical and empirical studies and writings by scholars and researchers. The chapter traces intellectual progressions related to the problem under study by quoting, summarizing and providing new interpretations combined with old interpretations.

2.2 Concept of Leather

Leather is animal skin or hide that has gone through chemical treatment to make it flexible and resistant to decay (Boahin, et al., 2011). Leather is obtained when the fibrous protein collagen of vertebrate skins or hides are chemically stabilized through a process called tanning (Haines & Barlow, 1995-2003). Tanning skins and hides preserve physical properties which are lost when an animal dies or is killed (Chase, 1921 as cited in Bekman, 2007-2016). In tanning, animal pelt which is treated with chemicals retains natural flexibility, softness, toughness, wearing and perspiration properties without decaying or becoming stiff when exposed to heat and sunshine respectively (Mann & McMillan, n.d). "Essentially, the purpose of tanning is to permanently fix the fibers apart by chemical treatment, and to lubricate them so that they can move in relation to one another" (Mann & McMillan, n.d, p. 2). Various groups of animals such as mammals, reptiles and birds are used in the production of leather (Boahin, 2005).

2.3 History of Leather

Long before the digital age, leather played an important role in the development of civilization and creation of a global village. As humans learned to tame cattle, horses, sheep, goats, and pigs, the availability of raw materials for leather production swelled. Leather became essential to daily life around the world, in clothing, shelter, transportation, communication, commerce and weaponry as affirmed by Blackstock Leather Inc., (2016). Before early humans mastered the art of weaving, skins from animals slain for food with or without the fur were utilized for garments, footwear, headgear and protective clothing (Whitley, 2006-2016). In recorded history, as asserted by Rubel (nd.), bits of leather dating from 1300 B.C. have been discovered in Egypt. The ancient Egyptians used leather for their wooden chariots cases, harnesses, gauntlets, bow case and quiver (Marchant, 2011). Primeval societies in Europe, Asia and North America all advanced the technique of converting skins into leather goods independently of one another (Rubel, nd.). In about 1200 B.C the Greeks used leather garments in the age of Homeric heroes. Greeks made armor for their soldiers by modeling wet leather into shaped body armor mould (Wallis-King, 2016). The use of leather as well spread throughout the Roman Empire where the Romans improved the art by boiling the leather in oil which hardened the surface to weapon permeation. This technology gave the Roman army an edge over its enemies (Wallis-King, 2016; Phishtrader, 2002). During the middle ages, the Chinese were knowledgeable in the art of making leather. The Indians of North America also had developed great skills in leather before coming to the white man (Rubel, nd.). Excavations of Sumerian people at Ur of the Chaldees revealed extraordinary leather tyres used on wooden wagons. In the early 2000s, the Masai women of Africa were dressed in cloaks and petticoats of leather, which can be linked back to the earliest years (Whitley, 2006-2016).

According to Whitley (2006-2016), it would not be an exaggeration to call leather the first human industry, since the wearing of animals skins goes back to the beginning of human existance when the usefullness of animal skins and hides were discovered.

Paleolithic cave paintings portray human images clothed in skins and furs, and diggings at these sites have bore an active leather industry. Flint tools in the form of knives, scrapers, and awls used for removing flesh, have been found with beams and wooden poles used for beating and draping hides (Boahin, 2005). Later Neolithic and Bronze Age sites have yielded complex leather dagger sheaths, scabbards, shields, footwear, and jerkins that designates that leather manufacture was mastered early in human history (Whitley, 2006-2016).

2.4.2 Constituents of Hides and skins

Hides and skins which are raw materials employed in leather production are obtained from endoskeleton animals the raw materials from which leather is made (Boahin, et al., 2011). The outer covering of big domestic animals like cow, buffalo, horses, donkeys, camels, deer, whales and elk are called hides where as those of small domestic animals like sheep, goats, calves and foals are called skin (Hides and Skins, 1970-1979; Elliott, 1985). Hide or skin in the living organism forms a physical protective barrier to abrasion and infections caused by microorganisms. The skin or Hide also helps in the secretion of certain body waste substances and partial regulation of body temperature (Mclaughlin & Theis, 1924). The thickness of the skins and hides varies with species, sex, age and the different regions within the animal skin or hide (Ockerman & Hansen, 1999). According to Zelikovitzleathers (2009) animal leather thickness ranges from 0.4mm-4.8mm. The Sizes and shapes of hides and skins also vary from animal to animal just as their thickness. The average size of a whole hide is 50-55 sq. ft. and that of skins, 6-9 sq. ft. (Moore & Giles, n.d.)

According to Rubel (n.d), the chemical constituents of hides and skins can be divided into four main groups which are, protein, fatty materials, water and mineral matter. The chemical constituents of fresh hide or skin on the green weight falls approximately within the following limits (Ockerman & Hansen, 1999; Asubonteng, 2010; Singh, 2014):

Water	60% - 70%
Protein	19% - 33%
Fatty materials	2% - 30%
Mineral matter	0.36% – 0.5%

The proportions of these constituents differ from skin to skin dependent upon species, age, breed, feeding and other habits of the animal as well as the fat level of the animal and treatment the hide or skin receives after being removed from the carcass (Rubel, n.d; Ockerman & Hansen, 1999).

Of these constituents, the most important for leather making is the protein component (Asubonteng, 2010). The protein is also made up of four different types which are the keratin, collagen, elastin and the Reticulin proteins. Among these types, the collagen protein is the most important protein in hides and skins and occurs in them in the largest amount forming about 30.33% of the weight of a fresh hide or skin (Singh, 2014). Collagen fibers provide strength to the tissue preventing it from being torn or separated from surrounding tissues (Boundless, 2016).

The hair root and the epidermis of skins and hides are made from a protein called keratin. It is the most stable part of the skin, but has to be removed during manufacture, to expose the grain layer which lies beneath it (Lanning, 1996-2016). In situation where hair is needed, keratin protein (protein of the hair) is considered (Asubonteng, 2010; Boahin, 2005). The keratin which is the chief constituent of hair, wool, horn and the epidermal structures (Anon., 2016) accounts for 6-10% of the total hide or skin protein (Ockerman & Hansen, 1999).

The presence of connective fibres which consist of yellow fibres and is composed of the protein elastin is of great importance (Boahin, 2005). Elastin protein is composed of long and fine fibers capable of stretching to one and one half of its length and contracting to its original size and shape. The elastin protein makes the leather flexible, resilient (Boundless, 2016; Elliott, 1985) and also the presence or absence of this protien in a finished leather has a great influnce on the physical character, particularly as to the grain the leather possesses (Boahin, 2005). In situations where grain elastin fibers are numerous and thicker, a wrinkle grain leather surface may occur resulting from too much flexibility (Elliott, 1985). The Reticular fibers which is composed of Reticulin protein consist of thin strands of collagen that form a network of fibers to support the tissue and other organs it is connected to (Boundless, 2016).

2.4.3 Anatomical Structure of Skins or Hides

The collagen fibres of skins and hides are arranged into fibre bundles in a woven network running through the thickness of the skin or hide. Fibres are arranged into three distinct layers common to all mammals; the epidermis or upper layer, dermis or corium and the hypodermis or flesh layer (Boahin, 2005; Singh, 2014; Vidler, 2015).

The epidermis is the outermost layer of the skin which forms 1% of the total thickness of the skin (Boahin, 2005). This layer of the skin is very thin in comparison with the dermis and the hypodermis. The epidermis consists of many component layers of different types of cells which is characterized by the presence of high level protein keratin with little or no collagen (Leach, 1995; Sharp & Corp, 2009-2015).

The epidermis serves to protect the dermis which is the most important part of the skin from foreign substance (Rubel, n.d; Sharp & Corp, 2009-2015). The epidermis and all its attachments such as the hair which is composed of keratin protein is normally removed and disposed during leather production except in situation where hair is needed (Leach, 1995; Boahin, 2005). "When the epidermis is carefully removed, a smooth layer is revealed–sometimes known as hyaline layer–which gives the characteristic grain surface of leather" (Asubonteng, 2010 pp 35).

The dermis is much thicker layer of connective tissues which constitutes the true leather (Rubel, n.d). The dermis forms about 85% of the total thickness of the skin or hide (Boahin, 2005) and constituent of a network of interwoven collagen fibers which are tightly woven at the top layer and loose at the lower layer (Asubonteng, 2010). Dermis of fresh hide or skin is composed of 25% collagen and 70% water. The dermis' interaction with water is as a result of hydration, diffusion swelling, wetting and capillary condensation. Structural elements of the dermis increase in volume when swollen in water with intervals between the structures compressing (Volfkovich, et al., 2014).

According to Ruble (n.d), the dermis or corium is composed of two layers, the corium major or reticular layer and the corium minor or grain layer. The corium major is made up of large, strong and loose fibre bundles which lie at varying angles to the grain layer above it. This angle which is termed as 'angle of weave' affects the physical property of the leather (Lanning, 1996-2016). The corium minor also the papillary layer consists of more densely woven fibre bundles, which have a much finer construction. Towards the top of this layer, next to the epidermis, the fibres are extremely fine and form the layer called, 'the grain' which is different for each type of animal (Jennifer, Cara, & Melissa, 2012; Lanning, 1996-2016). Surface of fibers of the corium minor is made up of glands which collects and circulate perspiration in the form of vapour and transfers it to the outer surface of the skin (Boahin, 2005).

Between the connective tissues of the dermis or corium are fat cells which are interspersed between the collagen fibers of the dermis. These fat cells are disposed during leather production resulting in the production of soft spongy leather resulting from the empty spaces left when fats are removed (Boahin, 2005). The strength and elasticity property of leather is composed in the dermis. Corium is the basis of leather making, since it contains the strength properties of leather (Asubonteng, 2010).

The second most important protein in the skin is the elastin protein. In the corium or dermis is the elastic tissue which is made up of elastin protein that contributes greatly to the physical properties of the leather such as leather's tensile strength and pliability (Boahin, 2005). "The elastin tissues are centered on the hair follicles with course fibers running parallel to the skin surface and finer fibers running at right angles to the skin surface" (Covington & Covington, 2009, p. 39). Elastin tissue controls the elasticity of the grain layer making the leather flexible, resilient and stretchable (Boahin, 2005; Sharp & Corp, 2009-2015). The grain layer in itself is weak (Covington & Covington, 2009) and for that matter, cannot stretch to accommodate stresses in the skin. The elastic tissues centered on the hair follicle located on the grain side of the leather enable the grain layer to accommodate stress when stretched. The grain adopts a convoluted, wave form, which compresses as the corium in which elastin protein is embedded stretches. The mechanism by which it returns to its convoluted state when a stress is removed is through the action of elastin fibers which extends when the skin is stretched and then contracted to resting position when stress is removed (Covington & Covington, 2009).

The hypodermis also the flesh layer located below the dermis is composed of the subcutaneous tissue and is approximately 15% of the thickness of a raw hide or skin. This tissue is composed of loose fibrous connective tissues packed with many cells specialized in the storage of fats. The hypodermis functions as an insulating layer to reduce heat lost through the skin when the animal is alive. It also serves as a protective and a storage organ for fat (IvyRose, 2013; Singh, 2014). This portion of the skin or hide is not needed during leather production.

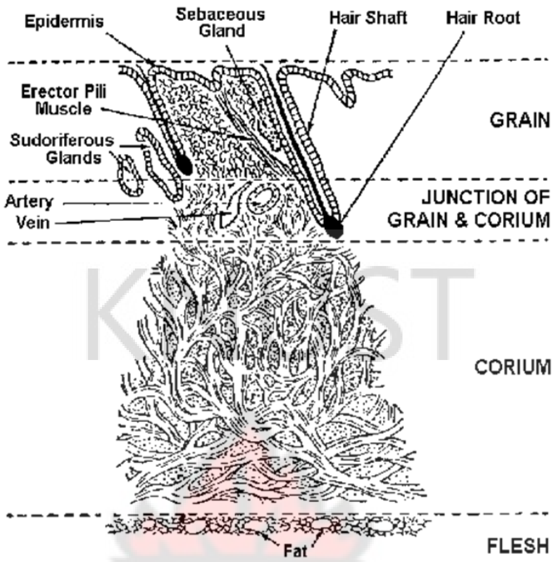


Figure 1- Graphical representation of anatomical structure of hide or skin

(Source: Lanning, 1996-2016)

2.4.4 Fiber Variation in Different Sections of Skins and Hides

Leather fiber structure of every leather varies in different parts of the animal skin or hide. Leather from different parts of hide or skin of an animal varies in it characteristics which needs to be taken into account when using leather into products (Boahin, 2005). Mammalian skins and hides for leather have varying regions that specify the arrangement of the leather fibre during the life of the animal and the final leather properties. The more flexible areas are where the animal's skin stretches during movement and weight increasing at the neck, legs and belly areas. The less flexible areas are more stable which include the shoulders and butt (Vidler, 2015). Below are the individual characteristics of the different parts of a hide or skin described by Lanning (1996-2016) and Hannan (2017).

Butt – The butt is the central area and the best part of the leather. The butt is the back of the leather without the shoulder and belly as indicated in figure 2. Fibers in this part of the hide or skin are tightly packed and hence the strongest part of the hide or skin.

Shoulder – The shoulder region is thick and strong but creases easily as it is affected by movement of the head. It is the second best part of the leather with thickness thinner than the butt area. The shoulder sometimes contain grow marks with strong and excellent durability. The shoulder are regions above the butt including the neck and fore legs.

Belly – The belly is the lower half of a side. Belly region of the leather is thin and has much looser fibre structure than the butt and the shoulder and stretches well under stress.

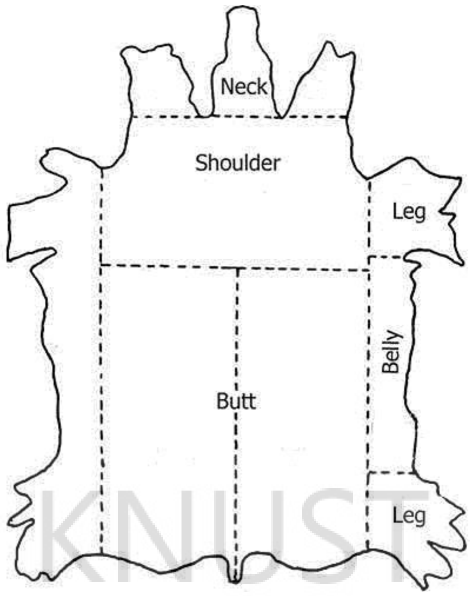


Figure 2- Varying parts of animal skin or hide

(Source: Vidler, 2015)

2.4.5 Grain Structure of Hides and Skins

The hair that shields the skin before its transformation into leather grows from tube-like structures known as the "hair follicle". These tubes open out at the surface of the leather (grain layer) generating an arrangement known as the "Grain pattern" (Harris & Veldmeijer, 2014). "The appearance of the grain is essentially the result of cavities left by the removal of hairs" (Leach, 1995, p. 25). Various animal species usually have their own characteristic grain pattern that can be used to distinguish leather of different species. The grain layer of younger animals have finer pores and older animals relatively, coarser pores (Buster, 2009).

2.4.5.1 Aesthetics of Cattle Hide Grain Layer

The grain layer embedding hair follicles makes up about one fifth of the total thickness of cattle hides. The corium comprises of large interweaving collagen fiber bundles which give the leather its strength. The relatively great thickness of the corium allows the hide to be split into layers (Asubonteng, 2010). The full thickness of a mature cattle hide is approximately, a centimetre thick or more in varying areas of the hide. This accounts for the ability for cattle hide to be split into layers of more manageable thickness (Harris & Veldmeijer, 2014).

The grain layer of cattle hide on its own is relatively weak when split to required thickness for use, it is essential that sufficient corium is left to give the leather enough strength (Harris & Veldmeijer, 2014). A careful examination of the cattle hide revealed that, the fibers near the flesh surface are thicker and predominantly horizontal, while those near the grain side are thinner and more vertical. This means the first split from the flesh side of a cattle hide would tend to be stronger than the last one from the grain side (Leach, 1995). To make a thin leather, Harris and Veldmeijer (2014) are of the view that, it is advisable to select a hide that has a thin grain layer to ensure more strength given corium. Despite the weakness of the grain layer, cattle hides are generally considered to be good raw material for leather manufacture. The principle attraction is the conformation of the collagen fibre which are large, thick and strong forming a dense compact network (Leach, 1995).

According to Thorstensen (1997) and Sarkar (2005) as cited in Asubonteng (2010, p. 40), “In cattle hides the hair follicles are of fairly uniform size, they are closely packed together and there is no distinct patterns to their alignment” when viewed especially under a microscope as indicated in plate 1. Among all the types of skins and hides, cattle is the most commonly used hide for leather making and about 65% of leathers produced are from cattle (Buster, 2009). Cattle hide is used for virtually every leather product including handbags, and can be natural or dyed in an array of fashionable colours (Morin, 2014).

Plate 1- Hair follicle of a cattle leather (Magnification: x45)

Source: Asubonteng, (2010)

2.4.5.2 Aesthetics of Sheep Skin Grain Layer

Sheep skins account for about 20% of leathers used in the world (Buster, 2009). In comparison, sheep skin is very different from cattle in terms of size, fiber structure and strength. The size of sheep skin and the collagen fibre in the corium layer are smaller compared to that of the cattle. This enables a finer suede to be made from sheepskin than can be achieved with cattle hide (Asubonteng, 2010).

Sheepskin to certain extent is difficult to describe because of varying fat content, size and general quality of the dermal network in the individual skins. The proportion of adipose tissue to collagen fibers in sheepskin varies widely according to the feeding of the animal (Roberts & Etherington, 2011; Vidler, 2015). There is frequently an almost continuous layer of fat cells separating the grain layer and the corium layer. Because much of these fat cells are destroyed and removed in the liming, bating and scudding operations, a space is created between the grain and the corium layer. This space results in a particular problem in sheep skin leather called loosening where the grain and the corium layer become separated sometimes over a wide area (Asubonteng, 2010; Roberts & Etherington, 2011). Tanners sometimes after liming, separates these two layers by splitting, and then tan the grain layer for bookbinding purposes and the reticular layer for chamois (Roberts & Etherington, 2011).

The grain pattern of the sheep skin is arranged in groups with spaces in between as indicated in figure 3. The grain layer of sheepskin occupies more than a half of the total thickness of the skin unlike cattle hide which is only one fifth of the total thickness of the hide (Buster, 2009). Fibre bundles of sheepskin are smaller and the ratio of grain to corium is greater making leather much weaker than cattle leather. Sheep have a loose and porous skin characterized by a clusters of large guard hairs and small fine hair follicles (Vidler, 2015). The numerous fine wool fibers, as opposed to the lesser number of coarse fiber of the sheep skin, cause the skin to be more open and loose. Again, the wool follicles which are associated with extensive glandular structures consisting of sebaceous and sudoriferous glands also interrupt the dense packing of the connective-tissue fiber network in the papillary layers, as well as the dermis itself (Roberts & Etherington, 2011). Consequently, it is not suitable to use sheepskin where a high degree of strength is required such as in footwear. Because sheep skin leather drapes well, it is often used to make high-end leather garments, as well as handbags (Morin, 2014).

Figure 3- Hair follicle of a sheepskin leather

Source: (Vidler, 2015)

2.4.5.3 Aesthetic of Goat Skin Grain Layer

Goat leather accounts for about 5% of all leathers produced in the world. The grain pattern of goat skin comprises cluster of large guard hairs arranged in trios and little fine hair follicles arranged around larger ones as indicated in plate 2. Hair run in wide pathways over the surface of the skin (Vidler, 2015; Buster, 2009).

The grain layer of goatskin commonly occupies about 24 to 54% of the total thickness of the skin. The grain layer of the goat skin is comparatively more compact because of the lesser number of glands and cellular components than the sheep skin. The entry of the guard and fine hair follicles are evenly spaced throughout the skin (Vidler, 2015). Goatskins have short and tight fibre structure and are easily recognized as opposed to sheep skins, which are short, loose and difficult to recognize. The tight strong internal structure allows its use in the more durable type of applications in the manufacture of gloves, footwear, bookbinding purposes and even for upholstery (Buster, 2009; Asubonteng, 2010; Vidler, 2015).

Plates 2- Hair follicle of a goat skin

Source: (Asubonteng, 2010)

2.5 Vegetable Tanning

Vegetable tanning, a 4,000-year-old method of producing leather, was broadly used over the world by antiquated people who made use of their own nearby vegetation. Plants containing tannins when soaked in water were found as right on time during the Paleolithic time for preserving skins and hides. Tannins according Boahin (2005), are bitter substances obtained from plants extracts such as the chestnut, hemlock, oak wood, mimosa, Myrobalans, mallet bark and Quebracho extract. Oak bark, nuts, and irks have been used for tanning in Europe for all intents and purposes until the approach of synthetic procedures in the nineteenth century (Whitley, 2006-2016). In Northern Ghana, the indigenous tanner utilizes tannin from the seedlings of the sumach tree

(Bagaruwah) (Boahin, 2005). Vegetable tanning was the dominant way of making leather until 1900 (Thrive, 2016).

This method of tanning is accomplished by soaking the pelt in leached plant extract or tanning liquor and stirred continuously for a uniform distribution in a pit. Before tanning, the hair or fleece is expelled from the pelt, normally by using chemicals which destroy the hair roots. Treatment with lime is done to open up the fibres for easy removal of undesirable material from between the fibres, the grain layer and the adipose tissue such as fat, hair and flesh (Boahin, 2005; Powershut, 2016).

In time past, vegetable tanning was done in a progression of pits with various groupings of tannins often of different concentration as asserted by Boahin (2005). Today numerous tanners make leather utilizing systems of drums and pits and some work with drums alone, which can enormously lessen the time required as the drum activity speeds the infiltration of the tan into pelts. Tanning begins with an infiltration procedure leaving the mix until the tan is well through the pelt. The preliminary tanning done to achieve the leather must be weak in fixation and soft to effectively tan the surface at the early stage of the tanning process. In achieving this, a setup of varying concentration of tanning liquor is made that moves from a lower concentration to a higher concentration (Whitley, 2006-2016).

After tanning, the leather goes through the process of currying. The action may include treating the leather so the tannins do not leach or drift to the surface. Drying is done in a stove, with pelts usually dangling from hooks. Wooden slatted windows might be utilized to roughly adjust temperature and give airing. Rolling controls quality of leather desired. Rolling wet makes the leather hard and rolling dry makes it soft. Substantial rolling machines of various weights are utilized relying upon the sort of leather (Powershut, 2016).

Vegetable tanning do not contain toxics that are harmful to the human health or the environment. The characteristic appearance of the leather before colour is changed, is somewhat tannish tinge over a beige shading, with a woody and natural smell (Fernandes, 2014). The exact colour of veg tan leather often depends on the mix of tannins and colour of the pelt. Pelts which are treated with vegetable extracts embedded with tannins which slowly combine with fibres causing them to swell and having the tendency of filling the interfibrillar spaces results in firm, hard, well filled and in measure, water resistant leather (Bowker & Geib, 1935). Vegetable tanned leather is of high durability, strength, being even far more efficient than majority of synthetic materials. Another remarkable character of veg tan leather is leathers ability to stand the test of time by improving with age and developing patina (Fernandes, 2014). It is the main type of leather reasonable for use in leather tooling or stamping, and thusly the main type of leather conceivably utilized as a part of embellishing certain boards on tube and Yoke armours (Conyard, 2015). The time and skill involved in production of vegetable tanned leather makes it expensive with less demand despite its qualities (HQ, 2015).

2.5 Leather Surface Defects

The surface grain structure of various animal skins and hides gives leather an outstanding surface qualities which makes the material unique and aesthetically pleasing to the eye. These surface qualities are unique and varies from leather to leather depending on the type of animal used. Even to this day, people have yet to find a better substitution for leather due to its special characteristics such as appearance (Ligo Leather Ent. Co., LTD, n.d.; Boahin, 2005). Leather surface defects are discontinuities on leather surfaces leading to regions with different intensities and texture than background resulting from several factors such as the environment, human errors, disease, pest and improper tannery practices. Leather surface defects are negative influence to the natural grain structure of some leathers in the tannery and on the markets (Krastev, et al., 2003). According to Yeh & Perng (2005), defects on skins and hides usually cannot be elliminated during leather processing. These surface defects remain and reduce the aesthetic quality of various leathers and their products resulting in their rejection and downgrading, Yohannes et al. (2015) asserts. Defects which affects the surface quality of leather can occur at any stage that is, during the life of the animal and after its death (Skyward, n.d.). Some of these factors are inherent to the production structure and animal husbandry practices, whereas others arise from the dispersal of the slaughter facilities, unfavorable marketing structures, poor handling (e.g. presentation and transportation) of the raw stock, and insufficient collection and preparation for further processing and export (Yohannes et al., 2015).

According to Perng and Yeh (2001), Zelleke (2009), Yohannes et al. (2015) and Habib et al. (2015), defects that affect the surface quality of leather can be categorized as pre-slaughter, slaughter and post-slaughter defects. While many of the defects can be prevented with improvement in some tannery practices and cured with medical and chemical treatments, some remain permanent even after tanning processes (Asubonteng, 2010; Skyward, n.d.).

2.5.1 Pre-slaughter Defects

Pre-slaughter defects are imperfections that may have arisen during the life of the animal. These defects pose a great threat to the leather tanner because unlike slaughter and post-slaughter defects which are controllable to certain extent by the tanner, pre-slaughter defects are not (Habib et al., 2015). Another threat pre-slaughter defects may pose to the tanner is in the aspect of recognition. Some defects remain unseen and the quality of the hides and skins is seen only after additional costs have been incurred for the removal of hair or after the tanning process has been completed (Yohannes et al., 2015). Damages caused during the life cycle of animals are as follows;

a. Scars

Scar damage results from scratches (thorn and sharp objects), cuts and brand marks for ownership purposes. Scar damage are common in animals raised under the extensive system of housing farm animals where animals are allowed to move about in search for food and water. Farmers who raise their farm animals under this method for purposes of recognition and identification brand of animals with hot iron rods damage the skins of the animals (Gerhard, 1996). Animals are also exposed to predators and thorn scratches which equally damage animal skins by leaving cuts and scratch marks as they move around (Asubonteng, 2010). Scratches may also occur when animals rub against barbed wires or rough surfaces (Singh, 2014). When cuts, scratches and brand marks are healing, the fibers grow densely packed together, and the healed skin is often hard, raised, and lacking hair follicles (Faport, 2009).

b. Defects Cuased by Dung and Urine

This kind of defect is as a result of unclean indoor livestock husbandry. Eching of the grain layer occurs in soiled parts of the animal particularly, near the claws and the belly. This produces a matt blind or rough grain layer. Defects caused by dung and urine according to Gerhard (1996) as statistics record still represent a considerable percentage of skin defect in animals.

c. Wrinkle Marks

Wrinkle marks are growth marks influenced by nature and come as a result of advancement in the age of the animal or undernourishment as explained by Bhavan and Marg(2011). Wrinkle defects affect animal skin by disrupting the grain structure of the affected animal skin. In many instances wrinkle marks contribute to the aesthetic appeal of leather surfaces when marks are evenly disperse across the entire surface of the animal skin, but in situations where they are unevenly dispersed, they reduce the aesthetic appearance of the leather surface.

d. Defects Resulting from Diseases

Common diseases which occur as a result of viral, fungal and parasitics infestation affect the quality of skins and hides for leather. Some of such diseases are:

Lumpy Skin Disease

This is a highly infectious skin disease of cattle caused by a herpesvirus and characterized by the sudden appearance of knots on all parts of the skin. During the course of the disease, the affected portion of the skin becomes hard and dry, and separates from the surrounding normal tissue (Gerhard, 1996). Lumpy skin disease is found in southern and eastern Africa, but in the 1970s it extended northwest through the continent into sub-Saharan West Africa (Gibbs, 2013).

Smallpox

Smallpox is a severe, transmittable disease caused by the variola virus (Hussain, 2015). Small red spots at the outset appears on the more tender parts of the skin such as the inner thigh, the abdomen and the sides. The red spots develop into blisters from pin point to pea sized and turn in to sores. The animal is urged to scratch or rub the sores on rough surfaces and secondary infection may develop. Mostly sheep and goats suffer from smallpox with the grain surface of the skins showing hollow resembling tiny dots (Gerhard, 1996).

Ring Worm

Ring worm is a parasitic disease caused by the fungus Trichophyton and Microsporum. The fungus grows on the skins of animals leading to patchy crusted circular bald spots as well as affecting the animal's growth. Ringworm is highly transmissible and not only does ringworm spread from animal to animal, but to humans as well. It can cause very severe skin lesions to any animal or human who comes in contact with the infected animal. Ringworm infection can be treated but the lesions remain on the leather with characteristic circular lesions on leather surfaces that appear either shiny or dull (Gerhard, 1996; Muia, Dorrel, & Pohle, 2001).

Tick-damage

Tick-damage is caused by blood sucking parasite-ticks. They usually adhere to the inner part of the hide such as the dewlap and inner parts of the legs. The defect has the shape of tiny holes or unhealed scars. "In most cases, damage reaches down into the corium" (Gerhard, 1996, p. 24). These holes can be seen on the grain surface of the finished leather resembling tiny spots and hollows. The male ticks while growing into adult organism move about rapidly causing the host animal to rub and scratch. The damage to leather caused by tick is so deeply seated that even with grain correction the scars will persist (Teferi, 2010).

Sheep Ked (melophagus Ovinus) Defect

Sheep Ked is a flat brown or reddish wingless insect which sucks the host animal's blood. The adult is between 6mm and 7 mm long covered with short, bristly hairs. The head is short and broad, and the legs are strong armed with stout claws. Sheep ked is commonly found on sheep. Its life cycle is spent entirely on the host and spread by contact between hosts. To feed, sheep ked pricks the skin with its mouthpart and sucks blood. Sheep ked usually feed on the neck, breast, shoulder, flanks, and rump leaving the back where dust and other debris are collected in the wool (Gerhard, 1996; Hendrix, 2013).

Parasite's existence on the host causes irritation with resulting scratching and biting, damaging the wool and skin of the host animal. Further damage by the fleece of the ked is staining of the host animal's skin and wool. The excrement of the sheep ked causes a permanent brown stain, which is likely to reduce the value of the wool and skin (Hendrix, 2013). Heavy infestation causes skin blemishes which reduce the marketable value of the skin and of any leather made from it, Teferi (2010) cites.

Lice Infestation

Lice infestation arises from a wide range of louse species on cattle, horse, sheep, goats and pigs. These pests include both biting and sucking types such as lignognathus, solenoptes, haematopinus spp. (Sucking lice) and damalinia (biting lice). Lice are obligate ectoparasites and depend on the host to complete their life cycle although lice may survive off the host for a period of time. Lice live within the microenvironment provided by the skin and hair of the host animal, and are transmitted primarily by contact between hosts (Thomas, 2015). Irritation caused by the pests leads to scratching, rubbing and licking by the infested host. The lesions caused by the louse infestations are often almost circular and small size and the extent of damage to the eventual leather depends on the presence or absence of a secondary infection (Teferi, 2010).

Manges

Manges are parasitic caused diseases of the animal skin which cause severe skin and hide damage. These damages are as a result of several varieties of scabies such as follicular, demodectic, sarcoptic or psoroptic. These mites proliferate inside the dermis and the grain layer of the host animal. The affected hides and skins present defects like coarse grain lesions and scratch scars making skins and hides unbefitting for the production of good quality leather (Teferi, 2010).

White Spots

Often finished leathers are reduced in quality by a defect referred to as white spots. Dyed and finished leathers exhibit small whitish spots lighter in shade compared to the rest of the leather. Investigations on this defect according to Bhavan & Marg (2011) have revealed that certain parasitic diseases like ticks and Demodectic manges are responsible for this defect. The lesion-affected areas of hide and skin undergoes certain structural changes that affect the leather’s dye holding capacity. White spots on leather surfaces can also result from the breakdown of fats to fatty acids by certain mould species. This also result in uneven dying in the subsequent processing (Bhavan & Marg, 2011).

2.5.2 Slaughter Defects

Slaughter defects are damages caused during animal slaughtering and flaying activities. Examples of these defects are:

a. Bruises

Bruising is the escape of blood from damaged blood vessels into the surrounding muscle tissue. This is caused by a physical blow by a stick or stone, animal horn, metal projection or animal fall and can happen anytime during handling, transport, penning or stunning. Bruises can vary in size from mild (approx. 10-cm diameter) and superficial, to large and severe involving whole limbs, carcass portions or even whole carcasses (FAO, n.d).

Bruises caused prior to slaughtering by yard beating of animals with sticks and ropes by driving them so that they jam in door ways or knock each other, and also by throwing them down heavily on hard floors, appears on the meat and so does blood accumulation of extravasations under the hide or skin over the bruised area. Unless the reddish area on the flesh side of the fresh hides and skins are carefully cleaned without delay, local accumulation of the blood quickly causes putrefaction and results in blemishes or weak spots on the final leather (Teferi, 2010). Strappini, Frankena, Metz, Gallo, & Kemp (2012) affirm that, animals with increased fat coverage have the likelihood of reducing severity than animals with low fat.

b. Rubbed or Dragged Grain Damage

Rubbed or dragged grain damage which is abrasion of the grain, is as a result of dragging a living animal or carcass over rough ground. Teferi (2010) suggests that, animals should not be dragged on the floors of slaughter house or against any hard surface in the course of moving or flaying. In situations where animals cannot be flayed while hanging, they should be removed gently and flayed immediately where the animal falls. The pulling of carcass on the hide abrades and removes a large area of the grain as well as allowing sands or other abrasive particles to be embedded in the depth of the hides and skins.

c. Vein Marks

Vein marks are traces of blood vessels which appears on the grain layer where the blood was not completely drained (Yohannes et al., 2015). Blood residue which remains in the veins encourage the growth of micro organisms which increase putrefaction along the blood veins resulting in a vieny appearance on the leather surface (Gerhard, 1996). The leather defect called "veiny" or "prominent blood vessel" or "vein marks" arises from the eating away by bacteria of the fibrous region surrounding the veins and blood vessels remaining vissible on the flesh side of the skin (Teferi, 2010; Bhavan & Marg, 2011). When the leather is glazed, it receives less pressure in the channeled areas and the blood vessel show up (Teferi, 2010).

d. Flay Cuts or Holes

Flay cuts or holes are cuts or complete perforations into skins or hides resulting from a knife or flaying appliance (Bhavan & Marg, 2011).

2.5.3 Post Slaughter Defects

Post slaughter defects are defects that occur after the animal is slaughtered and the skin is flayed. Defects of this kind occur at the slaughter house where skins are preserved and transported to the beam house where skins and hides are stablelised for tanning processes, and at the tannery where skins and hides are converted into leather (Gerhard, 1996; Boahin, 2005; Yohannes et al 2015). Post slaughter defects are:

a. Putrefaction

It is important to preserved skins and hides right after flaying to avoid bacterial and enzymatic breakdown (Yohannes et al 2015). According to Gerhard (1996), a skin should be cured before 12 to 24 hours depending on the climatic condition otherwise decomposition of the skin will occur. Protien component which forms a higher constituent of the skin easily decomposes when exposed to bacterial infections. Putrefaction may occur as a result of delay in preservation, improper curing, or when dried skins are exposed to rain during transport or storage. Putrefaction affects the quality of the leather by decomposing the grain layer of skins and hides (Zelleke, 2009).

b. Damage Caused by Preservation

Iron Stains : Iron stains result from the contact of skins and hides with iron parts of preservative vessels or rusty iron compounds that may find their way in preservatives. Iron stains produce brownish colourants on both flesh and grain surfaces of skins and hides which are further intensified by liming chemicals or tanning agents containining phenol (Gerhard, 1996).

Flesh Side Discolouration : This is a red, blue or violet discolouration on the flesh side of skins due to bacteriological defects (Bhavan & Marg, 2011). These stains results in matt to rough grain surfaces (Gerhard, 1996).

Salt Specks : Salt specks are small to large patches of elevations with size of a pinhead resulting from incrustation of curing salt contaminated with calcium and magnesium compunds. Salt specks occur mainly on the grain layer of skins and hides (Gerhard, 1996; Bhavan & Marg, 2011).

Mould Stains : Mould stains are coatings of different curing materials of different colours over long period. Stains of varying colours such as red, green, black, white, brown, orange and yellow occur in patches or over large areas of skin and hide surfaces. Mould stains often remain on leather surfaces after tanning especially in the case of prolong infestatation (Gerhard, 1996).

Sunburn : This defect occurs when surfaces of skins and hides are altered as a result of a direct sunshine or drying at a high temperature where resoaking of the damage areas becomes impossible. As a consequence, the leather becomes hard and thin at the affected areas (Gerhard, 1996; Bhavan & Marg, 2011).

Damage Caused by Beetles and Insects : Infestation of pelts with vaying types of beetles, insects, flies, moths as well as their larvae produce a considerable defects on pelt surfaces including drilling of holes (Gerhard, 1996).

Breaking patches: Improper handling of rawstock in warehouses and during pelt transportation may result in cracked grain defects which remain even after considerable stretching and working on leather (Gerhard, 1996). Other damages of this nature are the frost damage where skins become sensitive to grain crack when frozen and pressure folds where pelts cracks when folded and stored in large drums for a prolong period of time.

2.6 Leather Surface Finishing Treatments

All skins and hides have natural healed wounds or scratches or blesmishes which attest to the genuiness of leather (Carolinaleatherworks, 2016; Asubonteng, 2010). However, to improve on the final appearance of the leather, it is desirable to pass the leather through finishing treatments. Leather surface finishing treatments are operations carried on leather surfaces to make improvement and sometimes change the natural surface appearance for aesthetic and functional purposes (Carolinaleatherworks, 2016). Treatment operations for leather surfaces comprise series of processes aimed to advance leather surface appearance in terms of aesthetic value and quality to resist chemical and mechanical effects. Leather surface treatments often hide defects as well as contribute to leather beauty and properties. Leather surface treatments make changes by improving on the leather by omitting grain faults, defects and improving upon the leather's surface appearance in terms of lustre, texture and colour towards the attainment of properties ideal for various leather finished products (BIP [Oldbury] Limited, 2016).

Leather surface treatments provide leather with the ability to resist external mechanical stresses like surface abrasions as well as atmospheric conditions such as rainfall and excessive sunshine, and at the same time give the desired appearance to leather surfaces.

These operations often mark the final stage in leather production by giving the leather a final texture and appearance (Leather Sellers company, 2016). The various treatments given to leather surfaces have resulted in several types of leather with varying strengths and weaknesses. Leather surface treatment operations can be classified under mechanical and chemical processes (BIP [Oldbury] Limited, 2016).

Chemical leather surface treatment operations involve the application of a natural or synthetic film by means of coating. Resins, pigments, dyes, handle modifiers, fillers, dullers and other chemicals are applied in layers onto leather surfaces by spraying, roller-coating, curtain-coating or by hand. These chemicals render leather surfaces the value and characteristic desired by leather craftsmen, technicians and users. These chemicals provide craftsmen and technicians the opportunity to show their creativity while adding value and quality to leather surafaces.

Chemical leather surface treatment operations are often required to hide defects which reduce the aesthetic quality of leather surafaces to contribute to the leather's beauty to provide fashion effect.

Vital issues that often trigger the use of a chemical for leather surface treatment is the desired outcome; that is, to adjust leather colour, hide defects or render the leather an appearance for a particular purpose. In situations where the leather's characteristics such as the grain structure and colour are to be highlighted, transparent coats without pigments are applied that give the leather its shine and texture. On the contrary, if the leather's imperfections need to be corrected,the grain surface is remain or removed and covered with thicker coats to hide the natural surface appearance of the leather. Pigments are generally added to leather coating chemicals to adjust the colour achieved in the previous stages such as in the case of chrome tanning where colour is dependent on the tanning chemical used (CGS; Fundacion comunidad Valenciana Region Europea, nd.; Native Art in Canada, 2006-2015).

Mechanical leather surface treatment operations involves the use of devices, machines and tools by Polishing, Surface Plating, Embossing, Tumbling, Buffing and Splitting (PlaNet S.r.l. Sistemi Informatici, 2016).

Polishing: Polishing is the process of rubbing leather surface with a velvety wheel to creat a shiny surface.

Surface Plating: This is the process of pressing leather under a heated plate to mask imperfections on leather surfaces and obtain a flat smooth surface.

Embossing: Embossing is the process of stamping leather with a geometrical or funcy designs to artificial textures under very high pressure often done to imitate more expensive leather such as crocodile and alligator skin as stated by Boahin (2005). A design is produced in relief by raising it from the underside of the leather. The process is often applied to pigmented and aniline leather.

Buffing: Buffing is the process of removing the top or grain layer of leather by means of abrasion.

Tumbling: Tumbling is the process of rotating leather quickly in a drum to create a more evident grain and smooth surface.

2.6.3 Forms of Leather Obtained by means of Chemical and Mechanical Leather Surface Treatments

The two forms of leather surface treatments have resulted in varying types of leathers apart from the type of animal skin or hides employed in the production of the leather (Buster, 2009). These types of leather are as follows;

a. Top Grain

Top-grain leather is the second most popular type of leather that is obtained from the outermost layer of a hide. The only difference that sets leather without surface finishing treatment from top-grain leather is the removal of blemishes by sanding and buffing of surfaces in the top-grain side (Adams, n.d.). Heavy amounts of pigments are used to cover the newly sanded surface of the hide. An embossing is then done on the new surface by passing the pelt through a machine possessing an engraved plate or roller. There will be no natural aging or patina formation on the surface of a top grain leather because of the pigment finish, instead the surface cracks and wears off with time (Boahin, 2005).

b. Corrected or Embossed Grain

Corrected or embossed leather is a full grain leather whose surface has been corrected due to excessive scratches and scars. After splitting to the required thickness, this natural grain is buffed or sanded and replaced with an embossed artificial grain and finish to simulate various hair cell patterns. This resultant effect will look flawless with no natural scars showing, but this is no longer the real or natural grain. The original feel or hand of the natural skin and its durability is reduced with a synthetic grain finish (zelikovitzleathers, 2007).

c. Aniline Leather

Aniline leather is the type of leather that is coloured all the way through with tansparent dye which is accomplished by immersing the leather in a dye bath. Because the finish is transparent, the unique surface characteristics of the hide remains visible but less resistant to soiling (AAALeatherDoctor, n.d.; Boahin, 2005).

d. ***Nuback Leather***

Nuback is a type of aniline leather that has a velvet like texture and extremely lush appearance. The grain surface of the nuback leather is lightly abraded to create a nap or velvety finish. The surface of nuback will change shade when hands are run across it. The grain of nuback leather is of a slightly higher quality than suede, which is actually the inner side of the skin that gets buffed into a soft velvet nap (Boahin, 2005). The difference that lies between nuback and suede leather is, while nuback is created using the grain side of the leather which gives the strength and durability, suede is created from the flesh side leather (AAALeatherDoctor, n.d.).

e. Antique Leather

Antique leather is a type of leather dyed with one colour over another to create rich highlights and artificial aged appearance. This surface finishing treatment is done to mimic the unique worn out appearance of traditional leathers. This effect is achieved by applying contrasting top-coat unevenly or partially rubbed off to expose paller underlying colour (AAALeatherDoctor, n.d.; Boahin, 2005).

f. Glazed Leather

Glaze leather is aniline leather which is passed through a glass or steel rollers to give the leather a high polished lustre (AAALeatherDoctor, n.d.).

2.6.4 Leather without Surface Finishing Treatment

Apart from full grain leather, all other types of leather have surfaces treated either by chemical or mechanical means. Full grain is a type of leather which has not been altered beyond hair removal. This is the most genuine leather as it retains all textures and blemishes of the original hide or skin (AAALeatherDoctor, n.d.). Full-grain leather is formed just by removing the hair present on the epidermis of the hide. The grain remains in its natural state with best fiber strength and greater durability. Full grain leather has breathability, resulting in less moisture from prolonged contact. (Leathernet, n.d.).

According to Kulkarni (2015), full grain is the most natural form of leather. No form of finishing is done or applied to the grain obtained. By virtue of the leather's strength and durability, full-grain leather remains a popular choice of high end leather products.

2.7 Surface Texturing

Surface texturing is the process of rendering surfaces rough or smooth when experienced by sense of tough or sight. Textures are created on surfaces through the multiplication of individual marks or forms (Anon., n.d.). On surfaces of leather, textures can be achieve by stamping, embossing or application of pigment. According to Boahin (2015) surfaces of leather are textured by means of embossing to imitate a particular surface appearance. According to Boahin (2005), the economic value of less expensive leathers are raised by passing leathers through machines plates and rollers with textures of more expensive skins and hides such as kangaroo, snake and crocodile to imitate them.

Surface texturing can either make the surface of a body rough or smooth when touched which is referred to as tactile texture (Adjei, 2006). Surfaces that feel rough when touched are surfaces which have their surface orientations disrupted by texturing mechanisms such as embossing and stamping whereas surfaces that appear smooth when touched have surface orientation not disrupted despite the rough textured appearance (Saw, 2002). This type of textural effect is obtained by the application of pigments through the process of dyeing, spraying and brush or palette painting. This type of surface texturing is referred to as visual texture (Adjei, 2006). Textures contributes to quality of a body's surface appearance by improving and correcting surface imperfections as asserted by Allman (2012-2016) and Deines (2014). The multiplication of individual marks or forms on surfaces with imperfections improve and correct surface imperfections by fusing together the individual marks or forms thereby reducing the visual clarity of the surface imperfections (Anon., n.d.).

2.7.1 The Influence of Textured Surface on Illumination

The ability for an object to emit its own light or reflect light from its surface makes it possible for the object to be seen. Reflection involves two rays, the incoming light called the incident ray and the outgoing light called the reflected ray. Reflected light from all surfaces (smooth or rough) obey the relationship that the angle of incidence equals the angle of reflection (The Optical Society, 2016). The only difference that exists is that, angle of incidence strikes and reflects at different regions on rough surfaces and same region on smooth surfaces as indicated in figure 4. Reflection from a rough surface is called diffused and that of a smooth surface is called specular. Rough surfaces minimize reflection by increasing the chances of reflected light bouncing back onto the surface, rather than out to the surrounding air as in the case of a cracked mirror and a disrupted water surface. The incident rays strike different regions which are disposed at different angles to each other. Consequently, the outgoing rays are reflected at many different direction and the image is blurred or disrupted (Girard, 2016). Reflection from rough surfaces gives matte and blur surface appearance as compared to smooth and shiny surfaces. Light reflected from smooth and shiny surfaces such as plane mirror and stable water produce clear images of their surrounding environment. On the contrary, when the surface of a mirror is cracked and stable water shaken, both surfaces become irregular and instead of producing a clear image, a blur and distorted image is produced (The Optical Society, 2016).

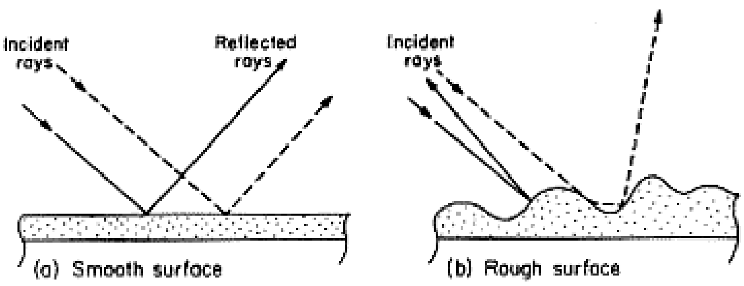


Figure 4- Light reflection from a smooth and rough surface

Source: The Optical Society (2016)

2.7.2 The Influence of Surface Texture on Detection of Defect

Ultrasonic non-destructive testing, a technique of utilizing sound wave frequencies to detect flaws such as shrinkage cavities, blowholes, pores, inclusions, segregations, cracks in the casting industry has been discovered to be ineffective on cast pieces with rough surfaces and irregularities (Palanisamy & Nagarajah, n.d). "Defects which possess rough surface can greatly affect ultrasonic wave scattering behaviour and in particular, significantly reduce the signal amplitude compared with that of a smooth surface defect" (Pettit, et al., 2015, p. 1797). Non-destructive testing using ultrasonic measurement is used to ensure the quality of die-casting products. The quality of casting depends greatly on the absence of defects such as pores and blow holes on the die cast product but unfortunately, discontinuity occurring on the surface of the cast structures with irregular surfaces scatter the ultrasound waves making ultrasonic testing very difficult to obtain a satisfactory result (Palanisamy & Nagarajah, n.d). The surface roughness of a cast piece such as grain size and their dimensional variations scatter the sound pulse and make detection of flaws difficult.

Flaws such as bumps which is the result of fold air bubbles often visible in clay during baking, finger prints and fingernail dings are prone to occur when working with polymer clay. These flaws make working with clay polymers very frustrating due to their unavoidable nature to certain extent. Building a uniform texture is an easy way to hide flaws in polymer clays after moulding. Applying uniform textures to a surface hide a lot of flaws and make work appear professional and well finished. Textures hide flaws by camouflaging the flaws and making them invisible or close to invisible (Allman, 2012-2016).

2.8 Aesthetics Theories

Aesthetics is a branch of philosophy concerned with the nature and appreciation of art, beauty and taste (Mastin, 2008). Physical beauty was once the only criterion for judging the quality of art. Today, artwork is judged by a different set of criteria called aesthetics theories. Instead of a work of art being called “beautiful,” or “pretty”, it may be referred to as successful because it response to an aesthetic theory from a viewers’ point of view (Delaune, n.d.). Theory has been central in aesthetics owing to inadequacies of theories which resides in the fundamental misconception of art (Weitz, 1956). The term aesthetics has evolved through the years and has been studied by different schools of thought from different viewpoints with different meanings and thoughts (Lavie & Tractinsky, 2013). When Alexander Baumgarten introduced the term “aesthetic” in the 18th century into the philosophy of art, it seemed to be taken up with the aim of recognizing, as well as unifying, certain practices, and perhaps even the concept of beauty itself, but several judgements have been passed on this concept from the time being (Scruton, 2014).

Considering the different theories that have evolved as a result of judgements passed on Baumgarten's concept of aesthetics, Puu (2013) and Ray (2007) are of the view that, art must be judged and looked at with all theories (Imitationalism, formalism, emotionalism, contextualism and instrumentalism) because, individual artists are relatively free to make the art they choose, according to their own conceptions. Again, knowledge about aesthetics exists primarily due to the fact that the world carries a special class of objects which is reacted and read upon selectively (Scruton, 2014).

2.8.1 Imitationalism Theory

Imitationalism theory applies to artworks that look realistic. These artworks contain recognizable, realistic looking objects and scenes that closely imitate what is seen in the real world. The keen purpose of imitationalist art is to represent the subject matter as realistically as possible (Hevel, n.d.). According to Karen & Jane (2000), there have been art movements that defined the best art as that which presents something as it looks in nature (naturalism) with others considering the most important purpose of art to be presenting an image in its realistic social context. Others have appreciated art works that emulate something that appears the way viewers would really like it to be in terms of what the mind concedes (idealism).

There is as well an art called surrealism where the Surrealist artists channels the unconscious as a means to unlock the power of the imagination by presenting images from one's dreams that look real but are physically impossible in the real world (Karen & Jane 2000; The Art Story, 2016). Their emphasis on the power of personal imagination puts them in the tradition of Romanticism, but unlike their forbears, they believe that revelations could be found on the street and in everyday life (The Art Story, 2016).

On the contrary, to Islam, human works of art are inherently flawed compared to the work of Allah, and to attempt to depict in a realistic form any animal or person is insolence to Allah. This has had the effect of narrowing the field of Muslim artistic possibility to such forms as mosaics, calligraphy, architecture, geometric and floral patterns (Mustin, 2008).

2.8.2 Formalism Theory

Formalism as a critical stance came into being in response to impressionism and post-impressionism where unprecedented emphasis was placed purely on visual aspect of a work. The term was derived from the painting by Claude Monet titled, "impression sunrise". The aim of the impressionist was to achieve ever greater naturalism by exact analysis of tone and colour and by trying to render the play of light on the surface of object (Adjei, 2006). Formalism is of the view that, theoretical information about an object is derived from attention to its form rather than its subject matter or content. The artist aimed at painting what the eye sees other than what the brain interprets form visual cues by stressing on the visual qualities of an artwork where focus is on the effective arrangements of the elements and principles of design (Hevel, n.d.)

Formalism, to add, mainly describes the critical position that the most important aspect of a work of art is its form thus, the way it is made and its purely visual aspect rather than its narrative context or its relationship to the visible environment or world. In leather work for instance, the formalist would focus exclusively on the quality of leather surface, form, shape and composition other than external factors such as culture and religion (Tate, 2015).

The Ancient Greek philosophers initially felt that aesthetically appealing objects were beautiful in and of themselves as the formalist has propounded. Plato felt that beautiful objects incorporated principles of design like proportion, harmony and unity among their parts. Aristotle found that the universal elements of beauty were order, symmetry and definiteness (Mustin, 2008).

According to Grant (2002), the most influential formalist theory was set out by Clive Bell in his 1914 work, Art. Bell argued that it is wrong to try and identify art in terms of what it represents or expresses. This simply misses the point of what much art is about. Bell begins with a premise shared by many theories of art, which is that "the starting point for all systems of aesthetics must be the personal experience of a peculiar emotion". In order to find the vital property of any work of art, it is necessary to identify this specific emotional response. Bell recognizes the cause as "Significant Form", which he believes to be present in all art from Mexican sculpture to the works of the French Impressionists. In each, colours, lines, forms and form relations joined in a particular way to stir aesthetic emotions. These relations and combinations of lines and colours and aesthetically moving forms, Grant calls, "Significant Form" (Grant, 2002).

2.8.3 Contextualism Theory

Contextualism examines a work of art in the context of the world within which it was created. A work of art is examined in the context of its time and consideration of religious iconography and temporal symbolism (Ogino, 2007). According to Tu (2011), aesthetic contextualism denies the Formalism theory of aesthetics that a work of art is a completely self-governing object and that the work's value is in its possession of some inherent quality. Aesthetic contextualism is the claim that a work of art is a special kind of artsfact, namely one that is always historically entrenched. Such works of art can only be understood when the background facts are considered. Contextualism does not limit art analysis to the mere examination of the intrinsic features but rather recognizes facts about the work‘s contextual background (Tu, 2011).

2.8.4 Emotionalism Theory

The emotionalism theory of aesthetics stresses on expressive qualities in an art work. The key drive of an emotionalist artwork is to vividly converse moods, evoke a feeling and express an ideas to a viewer. Whatever the method or form, the main point of the artwork is to attract viewers' attention in a dramatic as well as to impact the viewer's emotions (Hevel, n.d. & Maria, 2013). Hevel further states that, an artwork would usually not be classified under the emotionalism theory unless the emotion, feeling or idea being expressed was the primary purpose of the artist irrespective of art form and method (realistic or abstract). Emotionalist decisions about the success of an artwork is based on the message confined within the work. In other words, this theory is concerned with the content of a work of art. A work of art, according to the emotionalist, must arouse a response of feelings, moods or emotions in the viewer. In view of this, critics are of the view that, no object can be considered art if it fails to awaken an emotion or feeling within the viewer. Critics believe that, expressive qualities are the most important and requires that a work of art must arouse a response of feelings, moods and emotions in the viewer (Maria, 2013). Tolstoy, Ducasse and any of the activists of this theory discovered that, the requisite defining property is not a significant form as the formalist propounds rather, the expression of emotion in some sumptuous public medium. Without projection of emotion in some piece of object, there can be no art. These critics claim that, art is really such an embodiment (Volt, 2002).

2.8.5 Instrumentalism Theory

Instrumentalism is the methodological view in Epistemology and Philosophy of Science, advanced by the American philosopher John Dewey (Mastin, 2008). Epistemology narrowly defined instrumentalism as the study of knowledge and justified belief (Steup, 2005). It analyzes the nature of knowledge and how it relates to similar notions such as truth, belief and justification whiles Philosophy of Science is the study of the assumptions, foundations, and implications of natural science (Mastin, 2008).

Instrumentalist is of the view that, concepts and theories are merely useful instruments, and their worth is measured not by whether the concepts and theories are true or false or whether they correctly depict reality, but by how effective they are in explaining and predicting phenomena. Instrumentalism denies that theories are truth-evaluable and requires its proponents to explain or explain away the apparent commitment of theories to an observable entities, properties, states, events, processes and conditions (Rosenberg, 1994). It maintains that the truth of an idea is determined by its success in the active solution of a problem, and that the value of an idea is determined by its function in human experience (Mastin, 2008).

2.9 Theories of Value

According to the Research Institute for the Integration of World Thought (2008), value is the worth of an object that satisfies a desire in a person. That is, when an object, for instance leather has a quality that satisfies a desire of a user and which is recognized as such by the user, then that special quality of the leather is called value. In other words, value is something that belongs to an object yet, unless it is recognized as value by the subject, it does not become tangible. For example, even though there may be a leather bag or footwear, unless someone perceives the beauty of this leather product, the value of the product does not become tangible.

All experiences of the natural and social worlds come valued as to their worth that is, how attractive they are or how much they should be avoided. Every item is experienced as a complex of feelings. These complexes of feeling distinguish one experience from another (Anon., 2005). For example, an experience that a subject will have with leather will vary from a leatherette due to their varying properties. An experience another subject will have with leather void of surface defects will be different from leather with surface defect. It is based on these experiences the subject makes a choice.

Axiology, also called “Theory of Value” is the philosophical study of goodness, or value which originally meant the worth of something (The Editors of Encyclpedia Britannica, 2015). In General Theory of Value (1926) as cited in The New World Encyclopedia (2005), an American philosopher Ralph Barton Perry (1876–1957) contends for a naturalistic account of values, defining value as “any object of any interest” in that, there is no such thing as value until a being desires something, and nothing can have its value considered apart from all desiring beings. Perry argues that interest is "the original source and constant feature of all value" which belongs to the motor-affective life of instinct, craving, and emotion. Perry’s naturalism is objective despite the fact that his argument on value was based on a being’s desire. He recognizes the interests of different individuals’ conflict, and perceives morality as the means of reconciling such conflicts. Perry argues that, for an object to have value does not depend on the desires of any single individual (Singer, 2016). Even if one desires a leather for some values, another will shun it because of the same values. Perry believes that it is based on his theory that the greatest value is to be found in whatever leads to the harmonious integration of the desires or interests of all beings (Singer 2016).

According to Friedrich Nietzsche (1844 – 1900) a German philosopher, essayist, and cultural critic as cited in Kranak (2014), values, firstly, are hierarchical, a ranking of things in order of their importance. Secondly, Nietzsche believes that, values are not independent of themselves but rather requires to be determined by valuing beings. Value requires the interaction of living things with the world and without this interaction, the world in itself is valueless. In the same regard, leather is dependent on its users to be valued as good or bad. Thirdly, Nietzsche describes value as completely relative and can only be tangible when it is put in relation to something else to be determined as less or more valuable to what it is compared. Nietzsche believes that, "becoming" has no value at all because there is nothing there to be measured against.

The Existentialists, a group of philosophers who share the common view that, humans define their own meaning in life, and try to make rational decisions despite existing in an irrational universe define value as a feeling that accompany all experiences (Mastin, 2008). By experience, the existentialists mean all experiences of which the human being is aware including the natural and the social world. Existentialists tend to emphasize the conventionality or groundlessness of values, their "ideality," the fact that they arise entirely through the projects of human beings against the background of an otherwise meaningless and indifferent world (Crowell, 2015). The existentialists mean that all human experiences of the natural and social worlds come valued as to their worth, that is being attractive or how much they need to be avoided (Turin, 2005).

According to the editors of the Encyclopedia Britannica (2015), in axiology also value theory, a distinction is commonly made between instrumental and intrinsic value theory that is, what is good as a means and what is good as an end. Philosophers have been interested in what is of intrinsic value that is taken in contrast with instrumental value. Intrinsic value is when an object is valued in itself other than what it can lead to or can result in. Pleasure in an object is considered intrinsically good when it derives from reflection and appreciation of the object's individual character and content both for itself and in relation to the structural base on which it rest (Brady, 2003). That is to say to raise the value of something as intrinsically good is to attend to its form, making and meaning for its own sake. A leather or leather product for instance intrinsic value is important when customers consider intrinsic features and properties embedded in the leather or leather product for its appreciation. Philosophers' adoption of the term "intrinsic" for this distinction reflects a common theory, according to which whatever is intrinsically good must be good in virtue of its intrinsic properties (Schroeder, 2012).

Instrumental value on the other hand is related to things which are means to achieve things which are of intrinsic value (Vikka, 1997). According to Vikka (1997) instrumental value will not be without underlying reference to intrinsic value because of the infinite regression of instrumental value when there is nothing valued or perceived as valued in itself to be related to. An abject with an instrumental value may be desired because it leads to other things which have value in itself. Money for instance is valued though it is not intrinsically valued but can lead to other things such as food, shelter and security which is a need of man (Schroeder, 2012; McLeod, 2014). Leather in the same regard may be valued not because of an intrinsic property but may rather lead to other good things that bring satisfaction to man such as religious and political needs. Traditional Africans believe that, everything natural have a mystical force behind it therefore the use of leather helps to empower every activity it performs. Among the most common articles leather is used for are the whisk used by traditional priest to invoke from the unknown for a happening in a society and amulet worn for protection against evil spirits and sickness as charms (Boahin, 2005).

CHAPTER THREE

METHODOLOGY

3.1 Overview

This chapter explicates the research methodology which served as the structure followed to meet the expectations of the study. The chapter presents the research approach adopted for the study, population for the study, sampling technique and sample as well as data collection instruments employed in obtaining data.

3.2 Research Approach

Qualitative research approach often used when a researcher seeks to describe and give meanings to intangible experiences was employed in the study. Qualitative research as explained by Wyse (2011) and University of Missouri-St. Louis (2015) is a systematic subjective approach of investigating into people's belief systems, feelings, experiences or their way of life for the purpose of gaining insight by exploring in depth, a particular phenomenon through description, analysis and interpretation. Qualitative research approach gives a complete picture of what, where, when, why and how something is done with the aim to get a better understanding through firsthand experience, truthful reporting, and quotations of actual conversations (PPA 696 Research Methods, n.d.).

Qualitative research approach was employed throughout the study. First to found out defects associated with locally produced vegetable tanned leather, secondly, identified methods employed by users of locally produced vegetable tanned leather in managing leather surface defects with regard to their strength and weakness and lastly, demonstrated the development of texturing device and established the effect of texturing device on defects found on locally produced leather surfaces. In data gathering, qualitative research approach was employed in the following manner.

3.3 Descriptive Research Design

Descriptive research design aims at describing "what exists" by answering questions such as "what is", "what was", "why" and "how" of a situation with respect to variables or conditions in the situation. According to Nebeker (nd.), it is the best method for collecting information that will demonstrate relationships and describe situation as they exist. Descriptive research collects data or information with focus on a particular variable in order to test a question concerning the current status of a situation. Information collected in descriptive study are reported spontaneously without any form of manipulation by the researcher (Shuttleworth, 2008; Opoku-Amankwa & Nicholas, 2009; Turkson, 2011). Descriptive research is often used as a precursor to experimental research to know what items to include or manipulate in an experiment (Shuttleworth, 2008).

The adoption of descriptive research made it convenient for the study to report various defects affecting surfaces of locally produced vegetable tanned leather and richly explained methods employed by vegetable tanned local leather users in managing leather surface defects. The descriptive research was employed in the study which as well paved way for a verbal description of the effect a texturing device has on defects associated with locally produced leather surfaces. Information obtained were presented as they were with no form of manipulation.

3.4 Quasi-experimental Research Design

An experiment is an artificially created situation which allows the researcher to manipulate variables and introduce control variables. The goal for conducting the experimental study is to determine the relationship between an independent variable (vegetable tanned leather with surface defects) and a dependent variable (a textured vegetable tanned leather with surface defects) (Shuttleworth, 2008).

Quasi-experimental is a type of experimental study that lacks the key component of experiment which is randomizing. Variables under study are specific and the causal impact of an intervention is directed to a target population (Trochim, 2006; Sauro, 2013).

Quasi-experimental design according to White and Sabarwal (2014) is viewed as an intervention in which treatment is tested for how well it achieves its objectives as measured by pre-specified set of indicators. Quasi-experimental design assignment is conditioned to the comparison of treatment versus no treatment. The design identifies a comparison group that is similar as possible to the treatment group in terms of pre-intervention characteristics. The comparison group considered in quasi-experimental captures characteristics without the influence of the intervention. Hence, intervention can be said to have caused any difference between the comparison and treatment group.

Employing quasi-experimental design allowed the research to access the efficacy of texturing device for leather surface defects through pre and post testing of locally produced vegetable tanned leathers with surface defects.

3.5 Population for the Study

Research population is a large collection of individuals or objects that serve as the main focus of study and to whose benefits a study is conducted. Individuals and objects in a research population usually have common traits with similar description (Explorable.com, 2009). The population for this study comprises both human and material population. Under the human population, users of locally produced vegetable tanned leather, leather experts, metal technicians and mechanical engineers were the focus of this study. Under the material population, locally produced vegetable tanned leather, the commonest leather produced in Ghana as exposed by Boahin (2005) were the study's focus.

3.6 Target Population

Target population refers to the total group of individuals and or objects to which the researcher is fascinated in generalizing the conclusion (Explorable.com, 2009). Under the material population, the study targeted locally produced vegetable tanned leathers sold in Kumasi metropolis of Ghana. Under human population, target population for users of locally produced vegetable tanned leather were final year students of leather studying institutions which included both tertiary and second cycle institutions and leather craftsmen from local craft center in Ghana specifically from the northern and southern parts of the country where leather craft centers are located. For leather experts, metal technicians and mechanical engineers, the research's target population were members form Kwame Nkrumah University of Science and Technology, Kumasi.

3.7 Accessible Population

According to Yeboah (2014) as cited in Castillo (2009), accessible population is the subset of the target population which forms the population from which primary data is gathered. Under material population, two bundles of vegetable tanned leather which is made up of 20 pieces of leather each were collected from three different leather selling markets in Kumasi specifically from Asewaase, Alaba and Kumasi Central market.

Under human population, 64 leather users, 2 leather experts and 5 mechanical engineers (technicians and product designers) were accessed.

Among the 64 leather users were 33 final year leather students of the Department of Integrated Rural Art and Industry, KNUST (tertiary school), 7 final year Visual Arts students of Prempeh College (second cycle school), 24 final year Visual Arts students of Kumasi Technical Institute (second cycle school) and 2 local craftsmen from Bolgatanga crafts village in the Upper East region of Ghana.

3.8 Sampling Technique

Sampling according to Turkson (2011, p. 46) "is a research technique that seeks to select a part of the population to represent the whole". It involves selecting a unit from a population of interest so that results gathered from the selected unit can be generalized for population from which units were chosen from (Trochim, 2006). In this study, 60 locally produced vegetable tanned leather were selected from three leather selling centers in Kumasi to represent vegetable tanned leather produced in Ghana. 64 students from four leather studying institutions and 2 local leather craftsmen were selected to represent users of locally produced vegetable tanned leather.

Non-probability sampling where subjects under study do not stand an equal chance of being selected but are based on judgment of the researcher was used (Changing works, 2002-2016; Turkson, 2011). There are several forms of non-probability sampling techniques but for the purpose of this study, the purposive, convenience and stratified sampling techniques were used.

3.8.1 Convenience Sampling

Convenience sampling is where the units that are selected for inclusion in a sample are the easiest to access (Lund Research Ltd., 2012). Convenience sampling design is non-probability sampling technique because units under study do not all stand an equal chance of being included in the study population. The selection of subjects is based on easy accessibility in terms of subject's proximity to researcher and or subject's willingness to participate in the study. This sampling technique is preferable because it is fast, inexpensive and subjects are readily available (Explorable.com, 2009).

For easy accessibility, researcher limited the study to local leather users in the Southern part of Ghana. The study focused on selecting 20 students who make use of locally produced vegetable tanned leather from the department of Integrated Rural Art and Industry in the Kwame Nkrumah University of Science and Technology (KNUST). Students from the department are required to use the locally produced vegetable tanned leather in their course work. 31 visual Arts students from second cycle institution in the Kumasi metropolis of Ghana who study leatherwork as a subject and for the content of their syllabus rely on locally produced vegetable tanned leather were selected. 2 Mechanical engineers who contributed greatly to the design and development of the texturing device were selected from the Mechanical engineering department of KNUST. Respondents in each of the population accessed were sampled based on proximity and the respondents' willingness to participate in the research study. For easy accessibility, locally produced vegetable tanned leather were collected from leather markets located in the southern part of Ghana, to be precise, Asewase, Alaba and Kumasi central markets.

3.8.2 Purposive Sampling

Purposive sampling technique according to Crossman (2016), is a non-probability sampling technique where selection of a subject is based on characteristics of a population and the objective of the study. Purposive sampling was used to select 60 sheets of locally produced vegetable tanned leathers with surface defects for defect identification. Purposive sampling also enabled the selection of 2 leather experts, 3 metal technicians and 5 mechanical engineers who contributed great knowledge to the designing and development of the texturing device. Owing to that, various tools and materials employed in the production of a texturing device were selected. Tertiary and second cycle institutions which were included in the study, apart from the schools' convenience to the researcher were also selected based on the research objective which is focused on selecting users of the locally produced vegetable tanned leather. Craftsmen were also selected based on this same objective which was to select local craftsmen who make use of locally produced vegetable tanned leather in the production of leather products. Leather craftsmen who make use of the locally produced vegetable tanned leather in the production of leather products were located at the Bolgatanga craft village in the Upper east region of Ghana.

3.8.3 Stratified Sampling

Stratified sampling is a sampling design in which the population under study is classified into subgroups called strata. This sampling design is employed when a researcher wants to examine subgroups in a population under study. With the stratified sampling, its guaranteed units under each group are involved in the final sample (Crossman, 2016).

Locally produced vegetable tanned leather which was included in the study's population were accessed in four different colours which were cream, red, coffee brown and black. Employing the stratified sampling technique, the 60 sheets of vegetable tanned leathers with surface defects collected were grouped under their respective colours with 20 samples under each of the four groups.

3.9 Data Gathering Instruments

Data gathering instruments appropriate for a qualitative research study are, personal accounts, document studies, in depth interviews and observation. These methods help in gaining in-depth understanding of subjects under study by generating rich detailed data (Baltimore County Public Schools, 2010; Thomas, Jack, & Silverman, n.d.). This study employed two of the methods which are, in-depth interview and participant observation.

3.9.1 Interview

The study adopted in-depth Interview which is a dialogue between an interviewer and an interviewee with the goal of eliciting rich, detailed information. This method is useful for collecting data that reveals perceptions, experiences and the views of the population under study. In-depth interviewing requires that the researcher asks open-ended question orally and records the respondent's answers either by written or digital documentation. Typically, in-depth interviews are conducted face-to-face though can be conducted via telephone with aid of an interview guide- a list of questions that are to be explored and help the interviewer pace the interview and make interviewing more systematic, comprehensive and directional. In-depth interview is often employed in qualitative study because they are less structured, flexible and continuous (Westat, 2002; Crossman, 2016).

In-depth interview was used to determine the experiences of locally produced leather users by finding out defects they identify on vegetable tanned leather surfaces and methods they employ in managing the defects. In-depth interviewing was also used in gathering data on texturing device specifications, appropriate tools, materials and processes required in the design and development of the texturing device from mechanical engineers, metal technicians and leather experts. With this method, the researcher was able to collect data from the different population sampled which included students, metal technicians, mechanical engineers, leather experts and craftsmen which were made up of both literates and illiterates. During data collection, the respondents did most of the talking whiles the interviewer attentively listened, guided the conversation in the right direction and documented information through notes and photographs taking. With the aid of an interview guide, specific questions were asked of the different categories of human population sampled. The order of the questions, the exact wording and the type of follow-up questions varied considerably from persons to persons. In-depth interviewing enabled the research to clarify ambiguous statements that came up during the interviewing process. Though this method was appropriate, it was time consuming.

3.9.2 Observation

Observation involves the researcher taking lengthy and descriptive notes of an ongoing actiity. The researcher may achieve this by playing the role of a participant observer or a non-participant observer. In participant observation, the researcher becomes a member of the group under study but tries not to impose assumptions about how things ought to be done but instead, observe activities and make notes on what is observed. In non-participant observation, researcher remains isolated with impact unnoticed. Researcher remains silent to critically observe and record information (Opoku-Amankwa & Nicholas, 2009; Abbott, 2009).

The participant observation was employed in this study. Researcher through participant observation identified defects associated with surfaces of locally produced vegetable tanned leather. Surfaces of locally produced vegetable tanned leather gathered were closely observed to identify surface defects appearance on the surfaces of the leather collected and also determined the efficacy of the texturing device for defects identified. With this instrument, the researcher obtained a first hand information of phenomenon under study. A less-structured observation checklist was used to assist the collection of data through direct observation of the population under study.

3.10 Validation of Data Gathering Instruments

In ensuring objectivity and high level of reliability of data, the validity of data gathering instruments were a great concern. First and foremost, locally produced vegetable tanned leather sampled for the study were classified into individual colours. Under each category, defects were carefully observed and recorded in the open where there was direct day light. A standardized camera was used to capture defects as observation went on.

Moreover, data gathered through participant observation and interviews were accompanied with observation checklists and interview guides. Observation checklists and interview guides served as indicators for identifying expected outcomes (Infant and Toddlers, 2014). Observation checklists were used as indicators for testing the texturing device's efficacy for leather surface defects. The objective checklists and interview guides were designed based on research objectives. Copies were made available to friends, colleagues, mechanical engineers, metal and leather experts for review and contribution. Constructive criticisms and suggestions were received for modification. A final vetting was conducted and endorsed by the researcher's supervisor for operation. Information on the field was gathered objectively with camera and notes writing.

3.11 Sources of Data

The two types of data used for the study were the primary and secondary data.

3.11.1 Primary Data

Primary data was obtained through the application of two research data gathering instruments: interview and observation. A direct observation of locally produced vegetable tanned leather served as an instrument for gathering primary data on defects on locally produced vegetable tanned leather as well as the efficacy of texturing device for surface defects associated with locally produced vegetable tanned leather. An in-depth interview with mechanical engineers, metal technicians and leather experts served as a primary data for the design and construction of the texturing device.

3.11.1 Secondary Data

From the various libraries visited, secondary data relating directly to the research were gathered from several documented literary materials such as: books, journals, encyclopedias and catalogues. The internet was also another source from which secondary data was sort to support primary data gathered. The secondary data served as referential base for appraisal of developed intervention with existing methods, theories and principles in the analysis of the primary data findings.

3.12 Data Gathering Procedure

Data gathering procedure is the systematic processes the research went through to collect data to satisfy the research questions.

3.12.1 Data Collection Procedure for Research Question One

What are the surface defects found on locally produced vegetable tanned leather surfaces?

The objective of this research question was to find out the surface quality level of locally produced vegetable tanned leather by inspecting surfaces of the leathers for surface defects associated with them to validate the research study.

For primary data, 60 pieces of locally produced vegetable tanned leather with surface defects were collected from three leather market centers in Kumasi specifically Alaba, Asewaase and Kumasi central market. 20 pieces of leather were collected from each market center. The leathers were categorized based on individual colours which were cream, red, coffee brown and black. Employing direct observation, each leather was spread out and observed in an open space under natural day light for defect identification. Defects identified were recorded by means of writing and captured also with a standard camera.

After defects inspection, the defects recorded were categorized into the three categories of defects proposed by Zelleke (2009), Yohannes et al. (2015) and Habib et al. (2015). These were, pre-slaughter, slaughter and post-slaughter defects. Defects recorded were further categorized based on the kind of texture defects rendered on the surfaces of leathers inspected. In these defect groupings, defects were categorized into visual defects, tactile defects and structural defects. Visual defects were the defects that influence the surface grain texture of leathers inspected and were experienced or identified by the sense of sight. Tactile defects were those which affect the surface quality of locally produced vegetable tanned leather and were identified by sense of torch and sight (Adjei, 2006). Defects which affected the entire structure of the leather and did not fall under any of the two categories described were referred to as structural defects. This type of defects affect the grain and derma of the leather. Among these defects categories, the tactile defects was considered during the design and development of the texturing device for managing leather surface defects. These defects category was considered because in the defects were energy needed for creating textures for the development of the texturing device for managing leather surface defects.

3.12.2 Data Collection Procedure for Research Question Two

How do the users of the locally produced vegetable tanned leather manage leather surface defects?

The objective of this research question was to find out existing methods used by users of locally vegetable tanned leather and their effectiveness of these methods in managing locally produced vegetable tanned leather surface defects by looking out for the strength and weakness of the methods identified. This objective also sought to bring to light the extent to which the problem of locally produced vegetable tanned surface defects have been dealt with and the gaps left to fill. Information obtained were considered in the designing and constructing of texturing device for managing leather surface defects on locally produced vegetable tanned leathers.

Information on various methods employed by users of locally produced vegetable tanned leather were obtained from local leather craftsmen and students of leather from tertiary and second cycle educational institutions in the Kumasi metropolis of Ghana.

Local craftsmen who make use of locally produced vegetable tanned leather who could not be located in the Ashanti region were located at the Bolgatanga craft village in the upper east region of Ghana. Prior to the interview, permission was sought from the institutions heads and respondents were also made aware of the research topic and objectives of the study. In order to obtain rich information to satisfy research objective two, an in-depth interview was conducted face to face with respondents with an interview guide. Responses received from respondents were recorded in a note book and in situations where there were evidence of methods used, photographs were taken.

3.12.3 Data Collection Procedure for Research Question Three

How could a leather texturing device be designed and produced to manage surface defects on locally produced vegetable tanned leather?

The objective of this research question is to employ textures as a means of managing locally produced vegetable tanned leather surface defects by means of designing and constructing a texturing device and testing the device's efficacy for locally produced vegetable tanned leather surface defects. In designing and constructing the texturing device, the research adopted and adjusted the Waterfall model usually used in software engineering to suit the study. The Waterfall model is a sequential development approach divided in separate phases, in which development flows steadily downwards each phase with no overlapping in the phases. Each phase in the development process begins as and when a previous phase is complete because the outcome of one phase acts as an input for the next phase to begin sequentially (Powell-Morse, 2016). The Waterfall model was introduced by Dr. Winston W. Royce in a paper published in 1970. This model was found appropriate for the following reasons.

- The design and construction of the texturing device was to be based on a systematic approach of first identifying defects associated with locally produced vegetable tanned leather surfaces, secondly designing textures ideal to manage defects identified and finally employing textures designed in the construction of texturing device.
- The problem to be solved by the texturing device was well defined which was to manage locally produced vegetable tanned leather surface defects.
- The texturing device's specification were clearly defined with no form of ambiguity.
- The construction method was well understood.
- The resources which required expertise were readily available to support the designing and construction of the device.
- The model made it possible for setting deadlines for each phase of the development process since the project was time bond.
- Following each step in the waterfall model was an operative way of getting the texturing device designed, developed and tested for effectiveness.

Figure 6 shows the sequential phases of Waterfall model which was adopted and adjusted to suit the designing and construction of the texturing device.

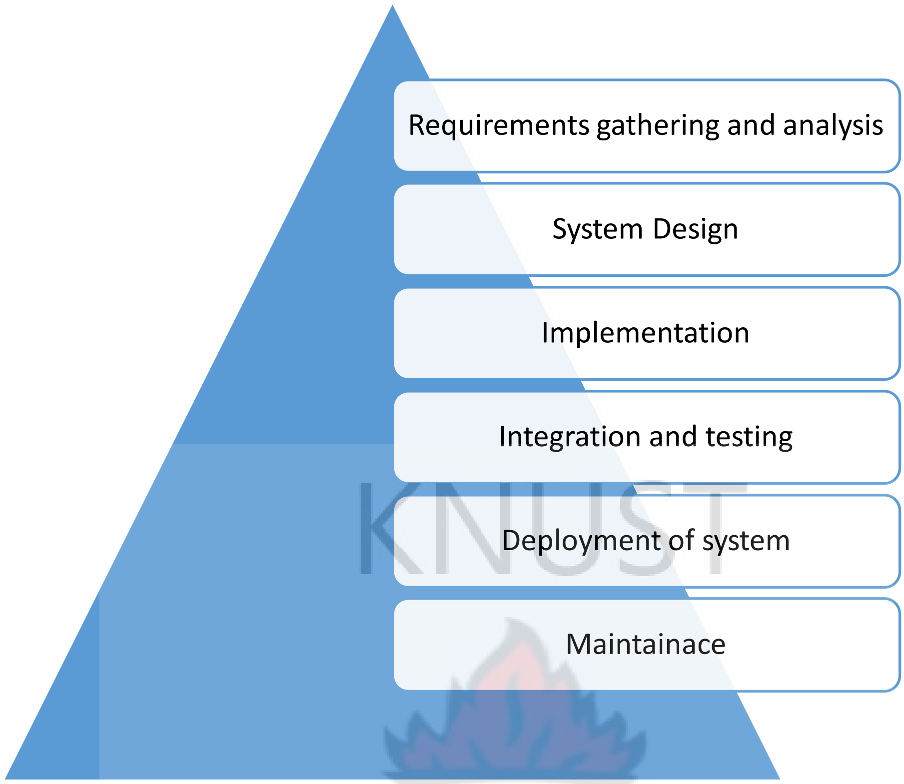


Figure 5- Sequential phases of Waterfall Model

Stage 1: Requirements Gathering and Analysis

Requirements gathering and analysis is the first stage of the development process. At this stage, all possible requirements to get the device developed was captured in this phase and documented under device specification. For the device's specification documentation, literature from books, articles, journals and the internet were reviewed for mechanical properties of vegetable tanned leather that need to be considered when working vegetable tanned leather on a machine. Leather experts who are endowed with knowledge about the properties and behavior of vegetable tanned leather were also consulted. Employing face to face interview accompanied with interview guide, two leather experts from the department of Integrated Rural Art and Industry, KNUST were interviewed to find out how the device should be designed to render it efficient and effective for positive result. In addition to the specifications, the strengths and weaknesses of various methods adopted by users of locally produced vegetable tanned leather for managing leather surface defects were considered in the design and construction of the texturing device. The specifications below were documented.

- The device must have the ability to render permanent textures on surfaces of locally produced vegetable tanned leather. To render a permanent texture, the texturing device must have the ability to exert the force needed to get textures printed permanently on leather surfaces.
- The device must work effectively on damped leather without any damage. This is due to the moulding nature of vegetable tanned leather which is the leather's ability to take shape when damp and continue to maintain the shape obtained when dried (Boahin, 2008). This specification requires that parts of the texturing device which have a direct contact with leather should be moisture friendly without any form of damage.
- The device must have the ability to render uniform textures. This specification is focused at solving problems related to the use of texturing methods adopted by locally produced vegetable tanned leather users. Texturing methods adopted by users of locally produced vegetable tanned leather in managing leather surface defects is stamping repeated motifs on leather surfaces using stamping tools and marbling dye on leather surfaces. The problem associated with stamping was the challenge of rendering uniform textures on leather surfaces.
- The surface on which leather must rest for textures to be printed on must have a resilient but repressible surface to prevent leather from exceeding the tensile limit and breaking with a limited amount of pressure. Excessive pressures on leathers resting on a hard surface make leathers lose their tensile strengths and connective tissues which make the leather over-expand and break instantly or with time.

- The device must work to cover any size of vegetable tanned leather.
- The texturing device should be able to manage defects and improve on the aesthetic appearances of vegetable tanned leathers with surface defects.
- The device must not take a long time to render textures on leather surfaces so that workers who are time bond can depend on the device.

Stage 2: System Design

In the system design stage, the required specifications documented in the first stage were studied for system designing. System designing specifies hardware and system architecture. In designing the texturing device, specifications documented in the requirement specification stage were channeled to the mechanical engineering department of KNUST which assisted in converting the abstract idea into drawings.

In addition to the texturing device design specifications, the Universal design principles were also considered to provide guidance in the designing of the texturing device. Universal design (UD), according to the Center for Universal Design (CUD) at North Carolina State University (Burgstahler, 2015, p. 2), "is the design of products and environments to be usable by all people, to the greatest extent possible, without the need for adaptation or specialized design". Universal Design principles are applied to ensure that the product meets the needs of potential users in a wide diversities of characteristics (Burgstahler, 2015). The following principles of UD proposed by the Center for Universal Design (CUD) were considered in the designing of the texturing device.

- **Flexibility in use**: The device should accommodate a wide range of individual preferences and needs. The device should allow for manual operation in the absence of electrical energy.

- **Simplicity:** The device's design should apply a simple mechanism to be easily understood regardless of users' experience.
- **Visible information:** The device should communicate the necessary information for effective use.
- **Low physical effort**: The device's design should be efficient, comfortable and with a minimum of fatigue to use.
- **Size and space:** The device's design should be accommodated in any working environment and also allow manipulation and use regardless of the user's body size.

Figures 6, 7, 8, 9 and 10 were ideas developed for the texturing device. The ideas were sketched and analyzed based on texturing device specifications gathered and the Universal Design principles proposed by Center for Universal Design (CUD).

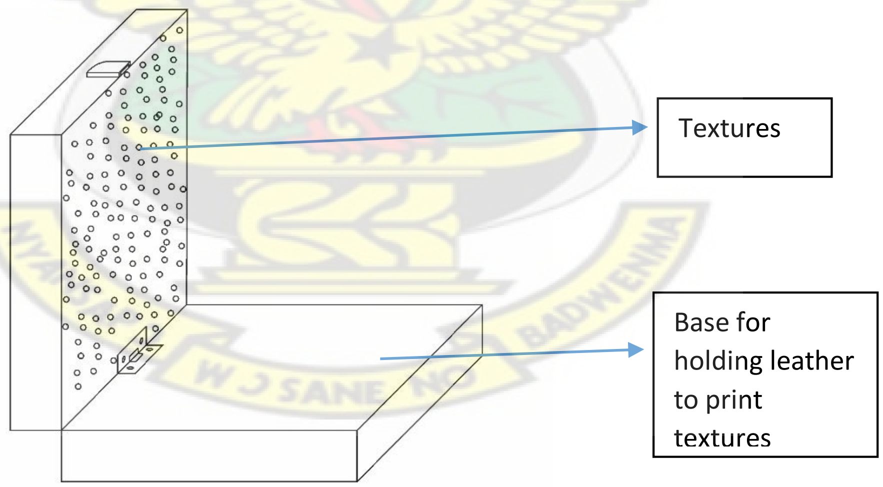


Figure 6- Design for texturing device

Source: Researcher's Design

Figure 7 is made up of two parts, a base which is to serve as a platform for leather to rest and an upper part which is to rest on the base and print the textures on leather surface when shut. The two parts are connected by a hinge which is to ensure opening and closing of the two parts. At the top center of the upper part of the figure is a knob to ensure the pressing of the upper part which has textures over the lower part to print textures on leather surfaces. Unless figure 7 is made to the average size of a cattle leather (50-55 sq. ft.), texturing a large surface area of leather which is bigger than the size of device will be difficult.

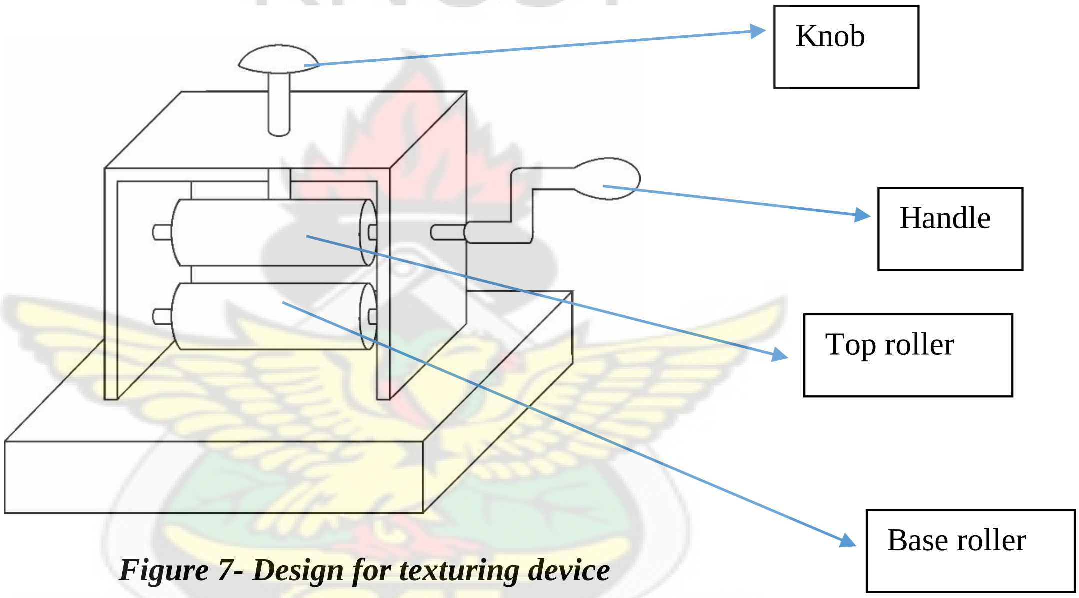


Figure 7- Design for texturing device

Source: Researcher's Design

This idea is made up of two rollers, a top roller and a base roller. The top roller has a textured surface to print textures on leather surfaces and the base roller a smooth surface to hold leather for printing. Around the rollers is a guard which holds the two rollers in place. On the upper guard is a knob which connects to the top roller to ensure up and down movement of the top roller for space and pressing respectively. At the right side is the device's handle for moving the top and base rollers to advance leather in-between the rollers and ensure a continuous printing of textures on leather surface.

Figure 8 will be effective to print any length of leather. The contact of a leather between the two rollers will ensure a continuous movement of leather through the texturing device. Figure 8 will have the limitation of printing leather with surface area wider than the length of the two rollers because of the side guards.

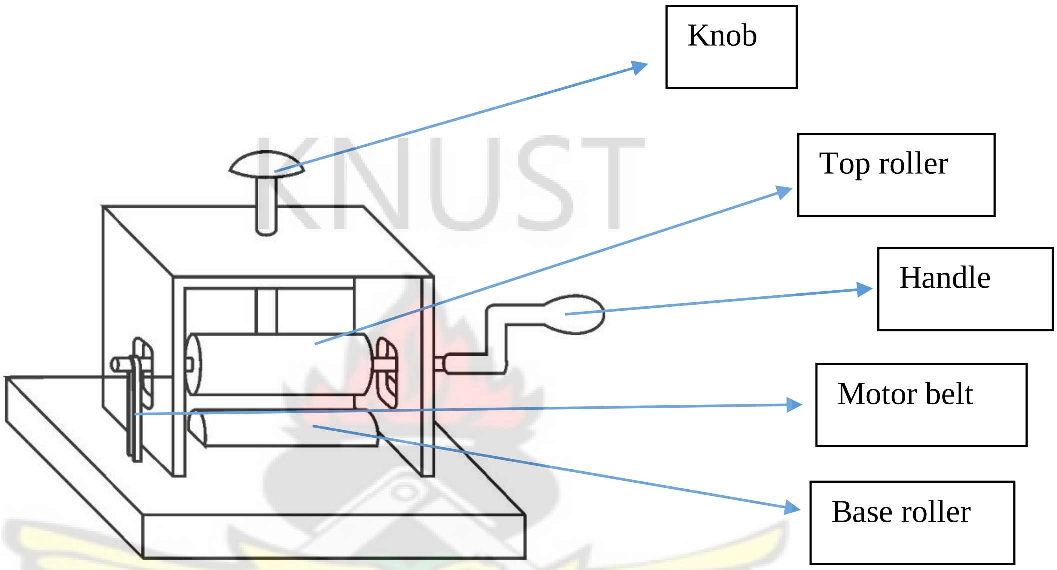


Figure 8- Design for texturing device

Source: Researcher's Design

Just like figure 8 figure 9 has two rollers, a guard, knob and a handle. The base roller of figure 9 is planted half way into the base to prevent leather from rolling around base roller when device is being operated. At the opposite side of the handle is a belt connecting the top roller shaft to motor sprocket to ensure electrical operation of the device apart from the manual operation system. Figure 9 will have a limitation of printing leather with wider surface area just as figure 8.

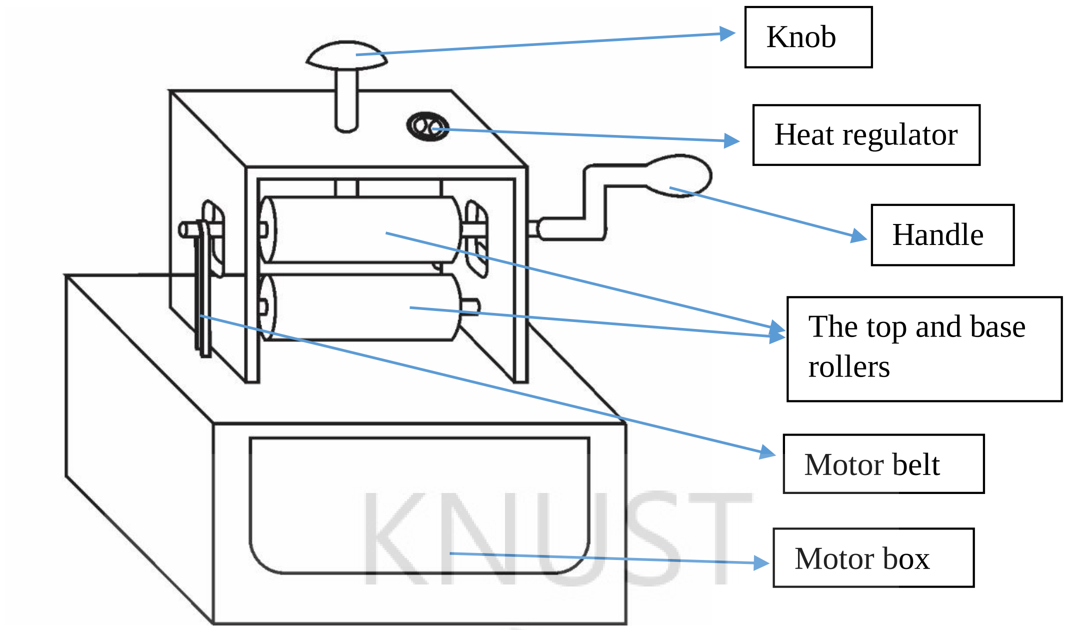


Figure 9- Design for texturing device

Source: Researcher's Design

Just like figure 8 and figure 9, figure 10 is made up of two rollers, a guard, handle and motor. Other additions are the heater and the heat regulator to ensure effective printing of textures on the dry vegetable tanned leather by scorching the textures on the leather surface. The heater is connected to the top roller to ensure heating and printing. The advantage of figure 10 over figure 8 and 9 is its ability to print textures on dry leather. Figure 10 has a motor to ensure electrical operation apart from the handle to ensure manual operation of the device.

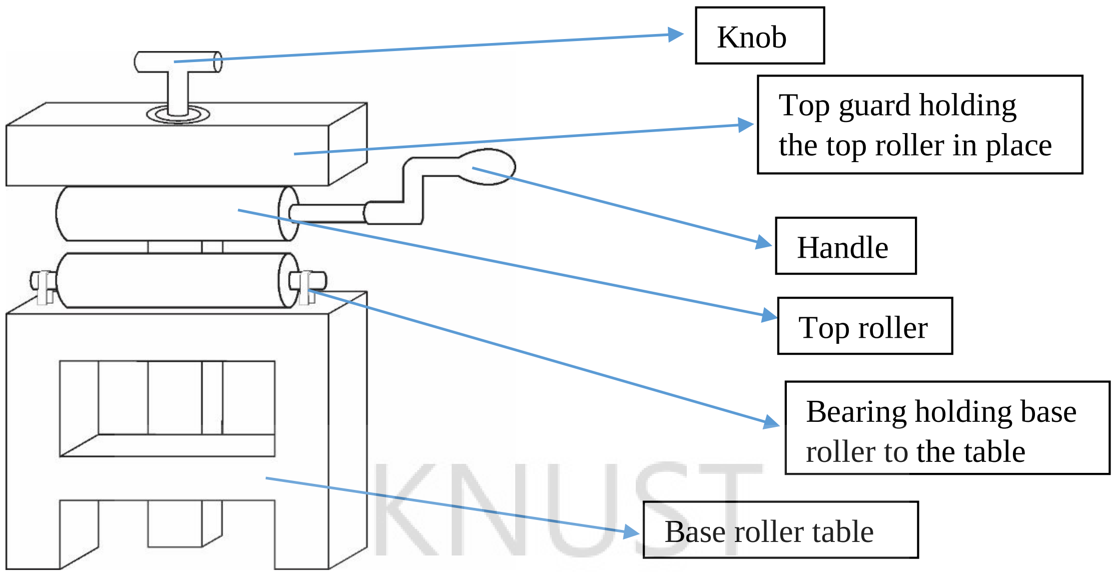


Figure 10- Design for texturing device

Source: Researcher's Design

Unlike figure 8, 9 and 10, figure 11 is made up of only a top guard with no side guards. The top guard which is set in place by a pillar holds the top roller in position. Knob which is positioned at the top side of the guard controls up and down movements of the top roller. Underneath the top guard is a table on which base roller rest. The absence of side guards around rollers will enable device to work on any width of leather.

Final sketch designed

With the help of mechanical engineers, a final design was developed by factoring the strengths of figure 8, 9, 10 and 11. Engineering options ignored in the figures were considered in the final design; the knob which controls the up and down movement mechanism of the top roller was repositioned to ensure better pressing of the top roller. Motor and switch positions were specified. Guards to ensure the safety use of the texturing device were also located in the design by covering movable areas of the device (rollers, motor chain and sprockets). The final design with all parts clearly defined was developed in 3 dimensional form using an AutoCAD (a commercial computer aided design and drafting software application).

Figure 11- Final design

Source: Researcher's Design

The Components of the device in different views with Dimensions

The drawings below are the individual components that make up the texturing device.

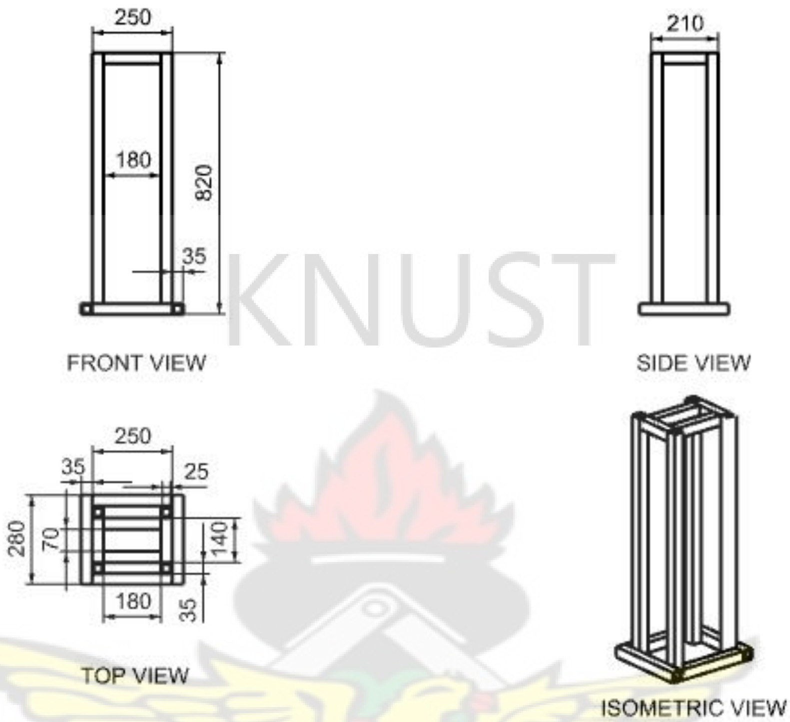


Figure 12- the base roller table in different views

Source: Researcher's Design

The based roller table holds the base roller in place to enable leather to rest on it for the top roller to print the textures on the leather's surface.

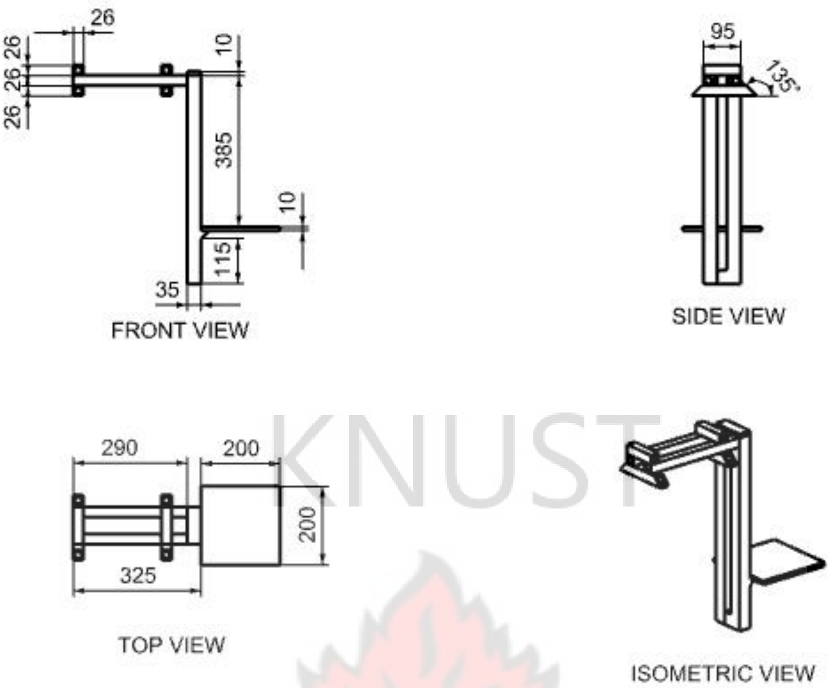


Figure 13- The top roller frame with a motor platform in different views

Source: Researcher's Design

The top roller frame with a motor platform holds the top roller over the base roller for printing textures on leather surfaces. The flat plate on the side of the frame holds the texturing device's motor to supply electrical energy. The top roller frame also houses the mechanism that controls the raising and lowering of the top roller to feed and remove leather between the two rollers.

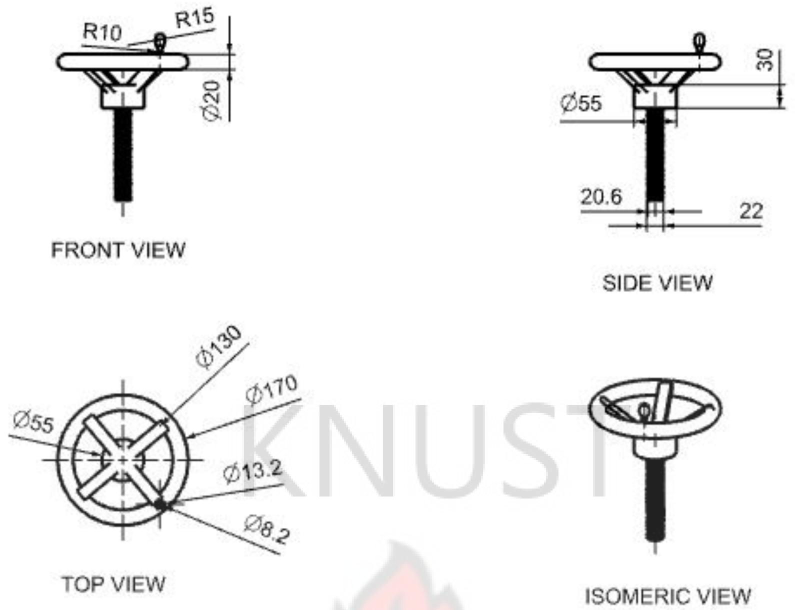
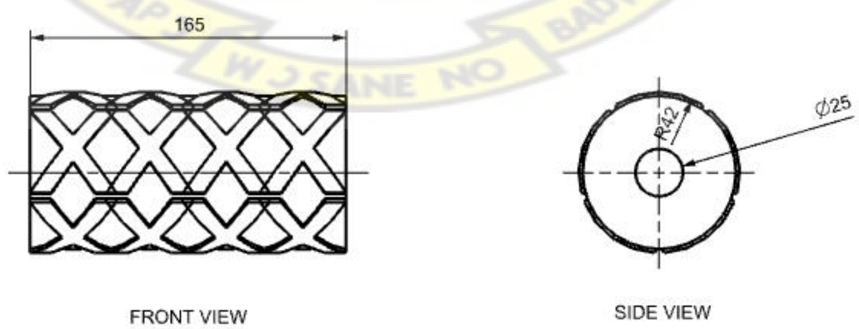


Figure 14- The wheel knob in different views

Source: Researcher's Design

The wheel knob moves the top roller up and down to open or close gap between the top and base rollers.



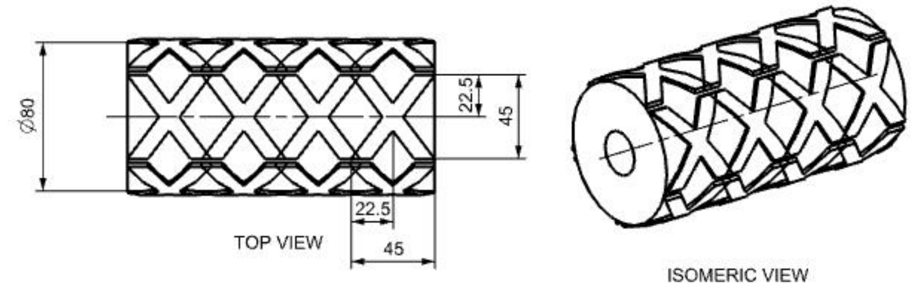


Figure 15- The top roller in different views

Source: Researcher's Design

The top roller presses on the base roller when leather is placed between the rollers to print textures onto the leather's surface.

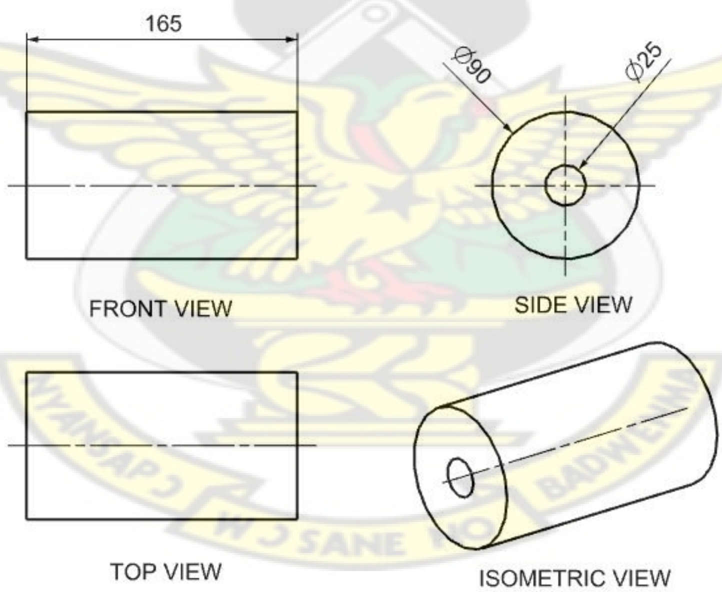


Figure 16- The base roller in different views

Source: Researcher's Design

The base roller serves as a platform for leather to rest to enable it textured.

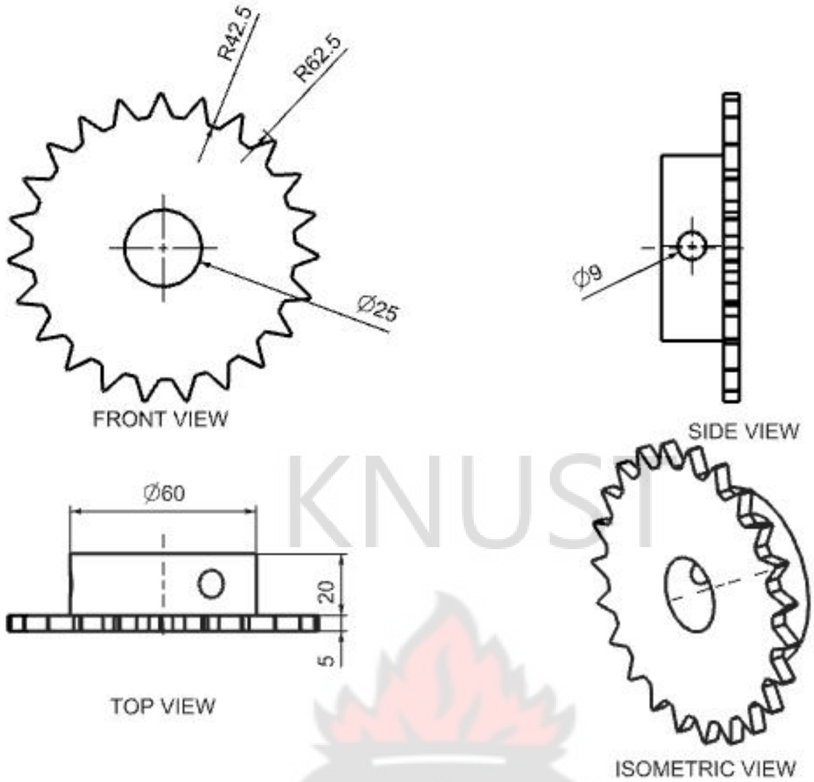


Figure 17- The sprocket in different views

Source: Researcher's Design

The sprocket holds the belt which connects the motor to the top roller shaft.

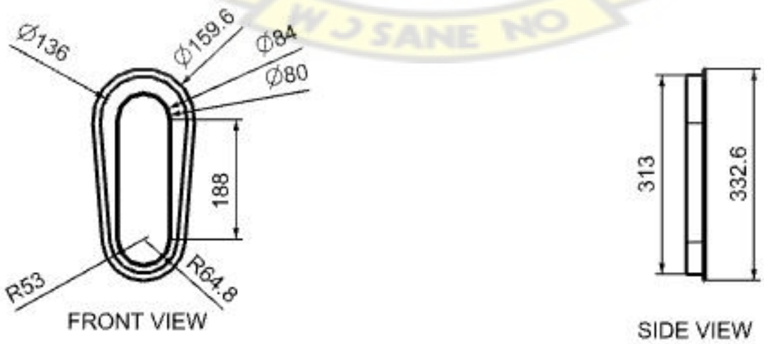


Figure 18- The sprocket lid in different views

Source: Researcher's Design

The sprocket's lid covers the sprocket and the chain to avoid the user getting injured when in motion.

Stage 3: Implementation Stage

The implementation stage is the stage where the input from the system design is developed into smaller units for integration in the next stage of the design process. With inputs from the system design, the individual components of the device were developed in the implementation stage. Each of the developed components were tried to see if it functions, this is referred to as Unit Testing at this stage of the design model. The individual components developed were later assembled into the complete device in the next phase. In developing the individual components of the device, the following machines, equipment, tools and materials were employed:

Machines/ Equipment/ Tools employed in the construction of the texturing device

Lathe machine: the lathe machine was used in drilling holes, turning and cutting the metal rollers and shafts into the desired shapes and sizes.

Vernier caliper: The Vernier caliper was used in taking internal and external dimensions of the part with circular shapes such as the shafts and rollers.

Tape measure: The tape measure was used in measuring the lengths of metals when marking out to cut.

G clamp: The G clamp was used in holding joints in place during precision positioning

Square gauge: The square gauge was used to provide accurate right-angled guide.

Stone cutting disc: The stone cutting disc was used in cutting steel metals into desired length and shapes.

Grinding disc: The grinding disc was used in smoothing welded seams

Hammer: The hammer was used for driving shafts into the rollers, for straightening and breaking metals apart.

Welding machine: The welding machine was used in joining the individual parts together when assembling the individual components of the texturing device.

Materials

Mild steel metal (low carbon steel): The mild steel metal square pipes were used in the construction of table for the base roller and the pillar connecting the table to the frame which houses the top roller of the texturing device; mild steel bars were used for constructing frame which grips the top roller in position; mild steel rods were used for constructing the base roller and shafts; mild steel sheet was used for the platform which holds the motor.

Brass: Brass metal was used for the top roller of the texturing device.

Bee Wax: Bee wax which becomes malleable below melting temperature and fluid above its melting temperature was used for constructing the top roller model when producing the top roller.

POP (Plaster of Paris): The POP was used for constructing the slab on which textures were carved and later transferred onto wax model when producing the top roller.

Ball bearings: Ball bearings are devices that allow parts to move relative to one another in a constrained fashion. The ball bearings were attached to shafts of both the top and base roller which rotate in opposite directions to ensure movement of leather when device is started.

Bolts and nuts: Bolts and nuts are fasteners for assembling parts together. Bolts and nuts were employed when assembling the individual parts of the device such as the motor to the motor platform, the base roller bearings to the base roller table and the top roller bearings to the top roller frame.

Development of the Top Roller

Textures which print on vegetable tanned leather with surface defects was designed and later developed into a metal roller. In developing textures for the top roller, the “Omdenken” theory which is the Dutch Art of Flip-Thinking by Berthold Gunster was adopted. Omdenken which means ‘yes-and-thinking’ is a theory which deals with the transformation of problems or challenges into opportunities. In Omdenken theory, a problem identified is first considered as a fact by saying yes to the problem situation and then looking for new opportunities that arise from problem’s energy after completely accepting facts and saying yes to the reality. Existing facts are transformed into new possibilities.

Omdenken has created 15 strategies that can help flip-think a problem into an opportunity. These strategies are divided into four basic attitudes: love, work, battle and play. Two out of the fifteen strategies under the four basic attitudes were adopted in the research study for texture development. Below are strategies adopted from Omdenken theory and how they were used in developing textures for managing locally produced vegetable tanned leather surface defects.

Acceptance

This is accepting reality as it truly is and looking out for what can be done with that reality. This is accomplished by saying yes to the situation and moving with it once reality has been accepted. In accepting reality as it is, defects associated with locally produced vegetable tanned leather surfaces were considered by having a close look at the defects' appearances. In terms of appearance, defects identified came in three forms which were,

Visual defects: These were defects that affected the grain surface layer of locally produced vegetable tanned leather and could only be identified through the sense of sight.

Tactile defects: These were defects that affected the grain layer and portion of the derma. These defects were identified by the sense of sight and touch.

Structural defects: Defects under this category affected the entire structure of the leather that is both the grain layer and dermis of the leather.

Flipping

In flipping, problem is reversed by turning flaw into strength, turning wrong into a right and turning a despite into because of. In flipping, images of tactile defects which were seen as problem energy were uploaded on the computer and using CorelDraw (a 2D software), defects contours were picked and organized into various textures with repeat pattern forms. With this process, various textures were developed of which figure 20 and 21 were selected and used in designing and developing of the texturing device. These two textures were selected based on their ability to blend with at least five vegetable tanned defects on CorelDraw. The textures ability to blend with more leather surface defects on Coral draw was used as an indicator for knowing the viability of the texture for vegetable tanned leather surface defects.

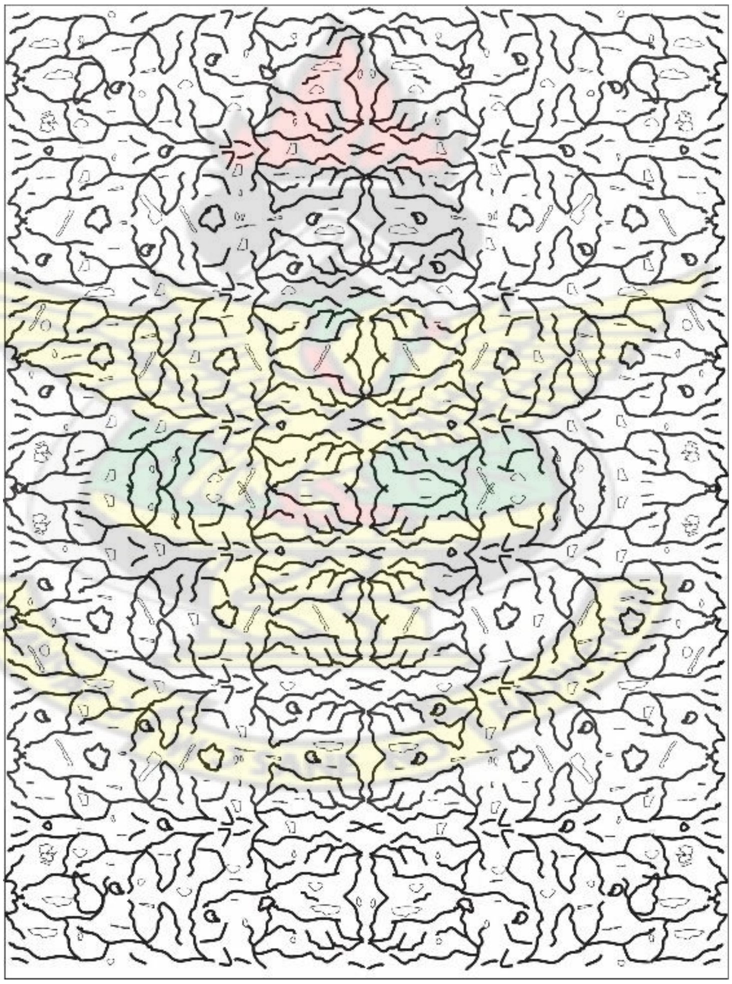


Figure 19- Texture developed from defect forms

Source: Researcher's design

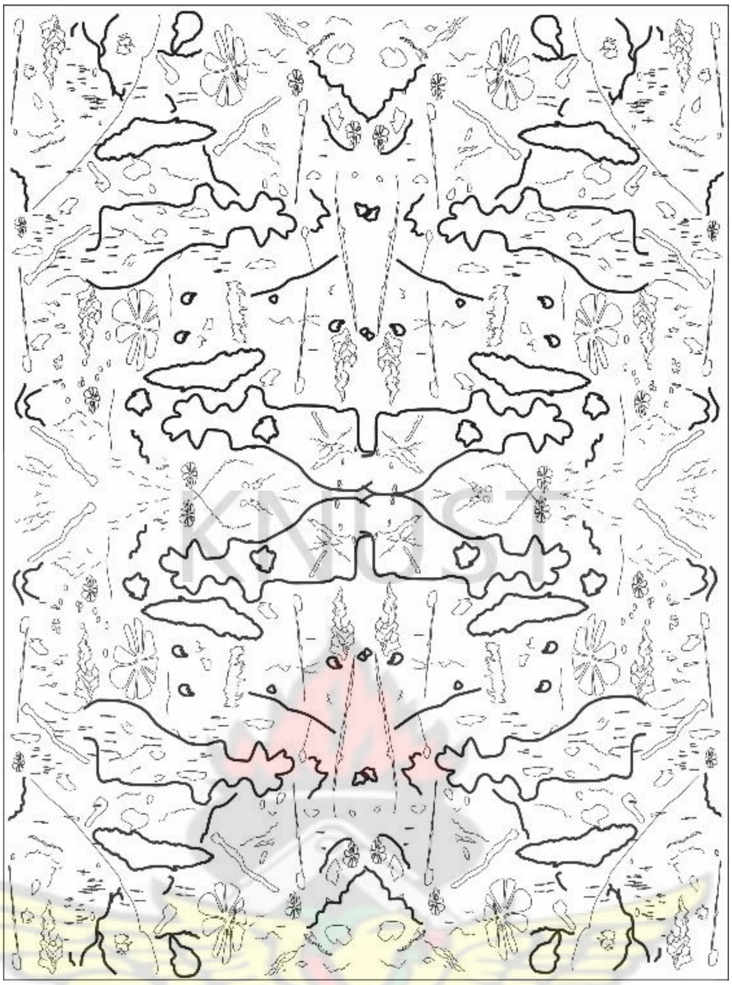


Figure 20- Texture developed from defect forms

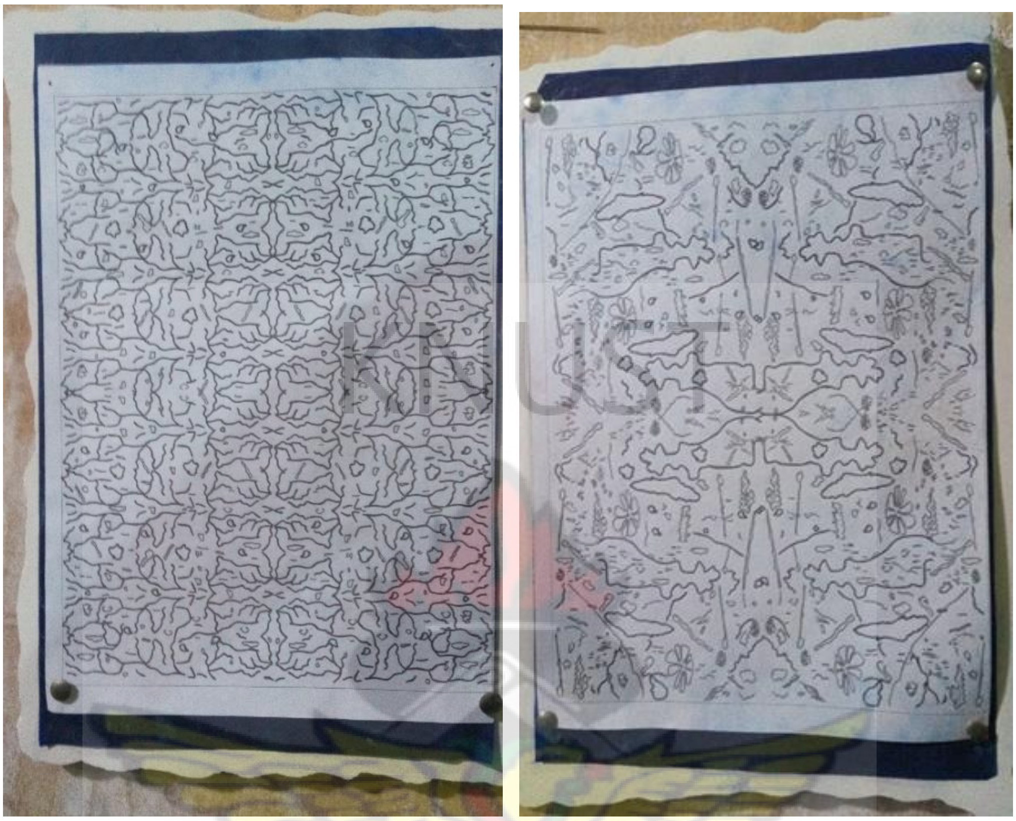
Source: Researcher's design

The Top Roller Development

Casting which is a process of pouring molten metal into a mould to solidify and take the shape of the mould was used in developing the top roller. The lost wax method of casting where wax is used to produce the model and later cast in metal was the casting method used.

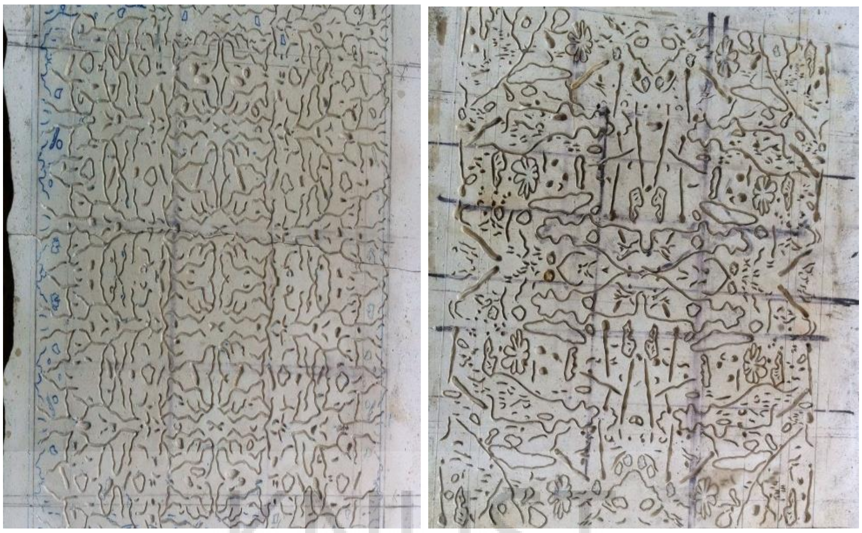
The Casting process

Two POP slabs were cast with a dimensions slightly bigger than the length and height of the top roller. Developed textures were printed out and transferred with a pencil on a carbon paper onto POP slabs. The textures transferred on the POP slab was carved out as indicated plates 3 and 4.



Plates 3- Textures A and B printed and placed on POP slabs

Source: Field photograph, February- May, 2017



Plates 4- Textures A and B carve into POP slab

Source: Field photograph, February- May, 2017

Bee wax soaked in warm water to soften into a leather hard state was placed over the POP slab and pressed down gently to pick texture from the POP slab (plates 5). The wax slab was formed into a cylindrical shape with textures showing on the outside. The two ends of the wax cylinders were capped to ensure a solid metal roller formation after casting (plates 6).

Plates 5- Textures printed on a wax slab

Source: Field photograph, February- May, 2017

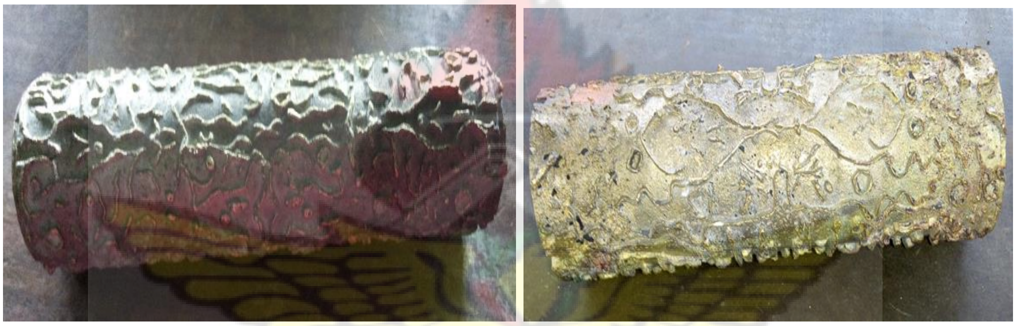

Plates 6- Wax slab with Texture formed into a cylindrical shape

Source: Field photograph, February- May, 2017

Using POP slip, a thick wall was gradually built around the wax model leaving a small entry called sprue for passage of molten metal. The POP wall built around the wax model was made to dry and harden (Plate 7). The model was placed inside an oven with sprue facing downward to melt out wax and leave the POP moulds hollow. A molten brass metal was poured into the POP mould through the sprue to the brim. The metal was allowed to cool down and solidify after which POP mould was broken from the metal. The POP mould was broken leaving a solid brass metal roller with textures on the surface (Plates 8).

Plate 7- POP mould with metal cast inside

Source: Field photograph, February- May, 2017



Plates 8- Metal rollers after casting

Source: Field photograph, February- May, 2017

With the lathe machine, holes were drilled through the center of the metal rollers to create space for the shafts as shown in plate 9.

Plate 9- Meal roller with hole drilled through the center

Source: Field photograph, February- May, 2017

The Development of the Base Roller

Using a mild steel roller with length estimated to the length of the shaft (180mm) and diameter estimated to the diameter of the base roller (80mm), the base roller together with the shaft attached were produced (Plate 10). The lathe machine was used to accomplish this task.

Plate 10- Base roller with shaft

Source: Field photograph, February- May, 2017

The Development of the Base Roller Table and the Top Roller Frame

The tape measure and marking tool were used to measure and mark out the dimensions of the individual parts of base roller table on a mild steel square pipe. Parts were cut out using a stone cutting disc. The individual parts were assembled and joined together by welding. Two metal square pipes which connects the base roller table to the top roller frame were marked out, cut and welded to the base roller table which is indicated in plate 11. The frame to hold the top roller was marked out, cut and welded to the two square pipes connecting the base roller table.

At this stage of texturing device's development, the up and down movement mechanisms which help the up and down movement of the top roller over the base roller was worked out. The knob which controls the up and down mechanism of the top roller was also connected to the top roller frame (Plate 12).

Plate 11- Base roller table

Source: Field photograph, February- May, 2017

Plate 12- The top roller frame

Source: Field photograph, February- May, 2017

A mild steel plate which served as a stand for the motor was cut and welded to the two mild steel square pipes connecting the base roller table to the top roller frame (Plate

13). The plate was placed to correspond to one end of the top roller shaft to ensure connection from motor to the top roller by the chain**.**

Plate 13- Motor platform corresponding to one end of the top roller shaft

Source: Field photograph, February- May, 2017

The developed individual parts of the texturing device (the top roller, base roller, based roller table and top roller frame) were tested for their functionality and adjustments at this stage of the device's design process.

The Assembling and Testing Stage

At this stage, all the units developed and tested in the implementation phases were assembled as indicated in plate 14 and tested for faults and failures. Bearings were connected to top and down roller shafts and screwed to their respective positions. The motor was screwed to its platform with motor sprocket in line with the top roller shaft. A second sprocket was fixed to the top roller shaft to correspond to the motor sprocket. A chain was used to connect the two sprockets.

Plate 14- Individual parts of the texturing device assembled

Source: Field photograph, February- May, 2017

The device was tested for faults and failures after assembling. Faults and failures such as uneven alignment of the top and down rollers were identified and corrected to ensure effective running of the device. A metal stainless steel plate was marked out, cut, formed and fixed around the base roller serving as a guide around the base roller. The reason for the guide is to provide space for the leather to rest before it is fed between the rollers. Movable parts of the device such as the top roller and in its frame, chain and sprockets were covered to ensure safety when machine is run (Plates 15). At this stage, all electrical connections such as the cables and the starter were done. The device was run and faults and failures corrected after the assembling of the components of the device.

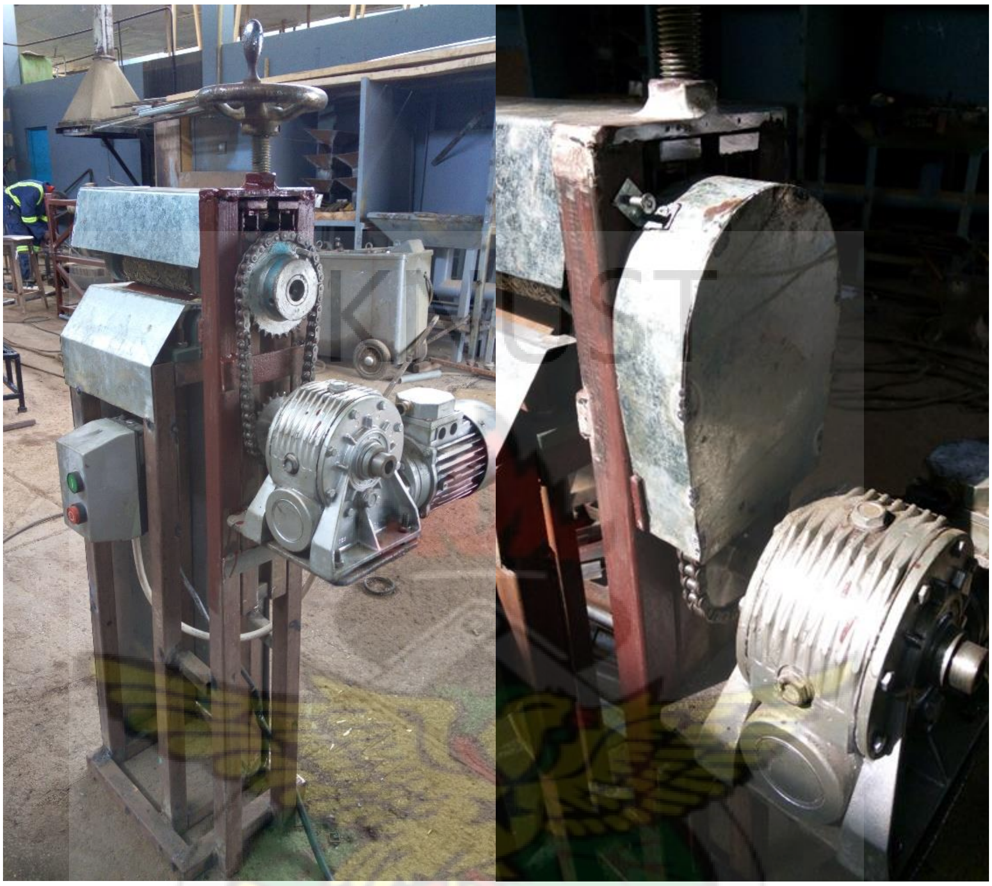


Plate 15- Moveable areas of the texturing device covered

The Deployment of the Texturing Device

At this stage, the texturing device was tested on locally produced vegetable tanned leather to test its efficacy on locally produced vegetable tanned leather. After the test, it was observed that some portions of the textures could not print on the leather surface because they were not at the same level. Again, because the base roller surface was hard and not resilient, the pressing from the top roller onto the vegetable tanned leather resting in between the two rollers resulted in the surface grain peeling from the leather (Plate 16). Surface grain peeling were predominant in areas where textures were raised.

Plate 16 was the effect obtained after running the texturing device over the surface of a vegetable tanned leather.

Plates 16- Surface grain peeling resulting from texturing device

Source: Field photograph, February- May, 2017

Maintenance of the Texturing Device after test

At this stage of the texturing device's construction, issues which came up in the deployments stage were addressed to enhance the device's functionality and effectiveness. The raised Roller textures which cut and peeled the leather surface were smoothened to blunt sharp edges. A carbon rubber with thickness 10mm was afterwards wrapped around the base roller which is indicated in plate 17. The resilient nature of the carbon rubber enabled textures reached the surface of leather at their different heights when pressed without peeling or cutting the leather surface.

This method was adopted after lathing roller 'A' to bring motifs to same level ended up wiping off most of the motifs from the roller surface. This occurred as a result of the irregularities on the surface background of the top roller motifs.

Plate 17- Based roller wrapped with carbon rubber

Source: Field photograph, February- May, 2017

3.13 Validation and Reliability of Data Collected

Having a clear understanding of the research problem, appropriate research design was selected with judicious application of data collection instruments and a regular reference to research objectives. Participant observation and one on one in-depth interview assessed with observation check list and interview guide, objective recorded data supported with field photographs justified the credibility of data collected.

3.14 Data Analysis plan

Data gathered from the defects associated with locally produced vegetable tanned leathers were photographed, documented and analyzed. Methods used by local leather users through interviews and observations were transcribed into reports.

The surface appearances of vegetable tanned leathers were optically examined for any change before and after intervention of the texturing device. Photographs taken before and after the intervention of the texturing device were recorded as evidence for the texturing device's efficacy for locally produced vegetable tanned leather surface defects. Details of these are presented in Chapter Four.

CHAPTER FOUR

PRESENTATION AND DISCUSSION OF FINDINGS

4.1 Overview

This chapter discusses and analyses findings gathered based on the research objectives**.** References made in the literature reviewed in chapter two were used as bases for argument in the discussion. Tables have as well been used to simplify most of the data collected into a reasonable organizational structure.

4.2 Presentation and Discussion of Results for Research Question One

What are the surface defects found on locally produced vegetable tanned leather surfaces?

The objective of this research question was to find out the surface quality level of locally produced vegetable tanned leather by examining surfaces of such leathers to identify surface defects associated with them. During the inspection process, it was observed that the individual leathers examined showed more than one type of defects and a number of these defects identified were common among the 60 leathers inspected. Plate 18 to plate 46 show samples of defects identified with the locally produced vegetable tanned locally leather surface. The defects are categorized under the four colours vegetable tanned leather is obtained on the local market – cream leather, red leather, coffee brown leather and black leather. Tables 4.1, 4.2, 4.3 and 4.4 are the various types of defects identified under the four categories and the number of times defects were recorded among the 60 pieces of the locally produced vegetable tanned leathers examined.

a. Defects Associated with Cream Leather surfaces

Plate 18 to plate 26 were defects identified with the cream leather surfaces examined among the 60 pieces of leather.

Plate 18- Parasitic infection

Plate 19- Stain defects

Plate 20- Scar defect

Plate 21- Scratch mark

Plate 22- Hole defect

Plate 23- Grain peeling defects

Plate 24- Cut Defect

Plates 25- Wrinkle marks defect

Plates 26- Stitched patch defect

Plates 27- Hair remains

Table 4. 1 Number of defects recorded on cream leather surfaces

Types of defect	**Number of the cream leathers with defect**
Parasitic infection	5
Stain	22
Scar	1
Scratch marks	8
Holes	6
Grain peeling	7
Cut	3
Wrinkle marks	4

Stitching Patch	1
Hair remains	2

Total number of defects recorded = 10

b. Defects Associated with Red Leather surfaces

Plate 28 to plate 37 were defects identified with the red leather surfaces examined among the 60 pieces of the locally produced vegetable tanned leather.

Plate 28- Scratch marks

Plate 29- Scar marks

Plate 30- Hole defect

Plate 31- Grain peeling defects

Plate 32- Cut defects

Plate 33- Wrinkle marks defect

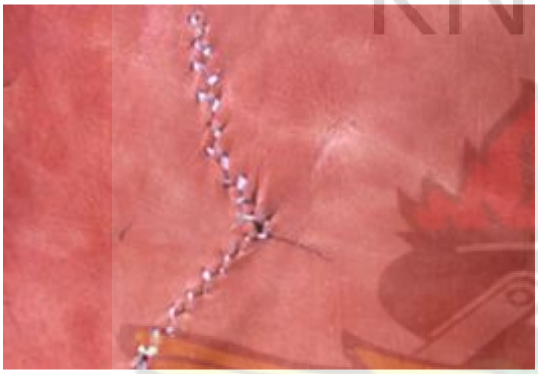


Plate 34- Stitched patch defect

Plate 35- Stain defect

Plate 36- Grain loosing defect

Plate 37- Uneven dyeing defect

Table 4. 2- Number of defects recorded on Red leather surfaces

Type of defect	Number of leathers with defect
Scratches	10
Scar	2
Holes	12
Grain peeling	8
Cut	6
Wrinkle marks	10
Stitch patch	1
Stain	10
Grain loosing	2
Patch/ Uneven dyeing	1
Total number of defects recorded = 10	

c. Defects Associated with Coffee Brown Leather surfaces

Plate 38 to plate 43 were defects identified with the coffee brown leather surfaces examined among the 60 pieces of leather.

Plate 38- Hole defect

Plate 39- Grain peeling defect

Plate 40- Wrinkle marks defect

Plate 41- Hair remains

Plate 42- Stain defect

Plate 43- Mold defect

Table 4. 3- Defects Associated with Coffee Brown Leather surfaces

Type of defect	Number of leathers with the defect
Hole defect	8
Grain peeling	10
wrinkles	6
Hair remains	2
Stains	5
Mold defect	5

Total number of defects = 6

d. Defects Associated with Black Leather surfaces

Plate 44 to plate 48 were defects identified with the black leather surfaces examined among the 60 pieces of leather.

Plate 44- Hole defect

Plate 45- Grain peeling defect

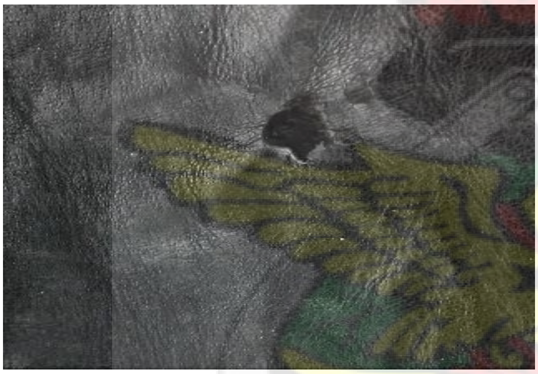


Plate 46- Cut defect

Plates 47- Grain break defect

Plates 48- Wrinkle mark defect

Table 4. 4- Defects Associated with Black Leathers

Type of defect	Number of leathers with the defect
Holes	**11**
Drag mark	**2**
Cut	**4**
Wrinkle marks	**2**
Grain break	**2**

Total number of defects = 5

Tables 4.1, 4.2, 4.3 and 4.4 indicated cream (khaki) and red leathers recorded the highest number of defects (10 defects) followed by coffee brown leather (6 defects) and finally black leather (6defects). Cream (Khaki) leather recorded a higher number of surface defects probably because of the leather's natural plain colour. The natural plain colour of cream leather may have resulted in the leather recording the highest number of stain defects (22). Black and coffee brown leather recorded the less number of defects because they are leather dyed with darker colours which are able to over shadow most leather surface defects such as stains and parasitic infections and probably may account for such leathers recording less defects. Coffee brown leather which is lighter than black leather recorded only two stain defects. Parasitic infection defects were not recorded on coffee brown and black leathers. Surface defects such as wrinkle marks, cuts, holes, drag marks, scratches and grain peelings were recorded probably because colour is not strong to overpower such defects. Red leather though dyed presented a higher number of surface defects as compared to coffee brown and black leathers. Red colour, though loud and intense, could not hide more defects because the colour lacks dark shade which coffee brown and black colours have. Defects such as parasitic infection and brown stain that were recorded under cream leather but not under red leather may probably be the defect red leather can over shadow.

Among the defects recorded, the commonest defects recorded among four colours of vegetable tanned leather studied were wrinkles, cuts and holes. Such defects were common among the four vegetable tanned leather colours inspected possibly because defects were intense in appearance and could not be subdued by any of the corrective measures adopted by leather producers.

4.2.1 Categorization of Defects Identified on Locally Produced Vegetable Tanned Leather Surfaces

Pre-slaughter, Slaughter and Post-slaughter Defects

Defects found on surfaces of locally produced vegetable tanned leather according to Zelleke(2009), Yohannes et al. (2015) and Habib et al. (2015) can be categorized into pre-slaughter, slaughter and post-slaughter defects. Table 4.7 is a tabulation of defects under pre-slaughter, slaughter and post-slaughter defects.

Table 4. 5- Pre- Slaughter, Slaughter and Post-Slaughter Defects

Pre-slaughter defects	Slaughter defects	Post-slaughter defects
Scar	Cuts	Stains
Drag mark	Hair remains	Patch dyeing
Parasitic infection	Holes	Grain loosing
	Grain peeling	Stitch patch
		Uneven dyeing
		Mold growth
		Grain break

4.2.2 Human and Natural Causative Defects

According to Asubonteng (2010) leather surface defects may occur as a result of two causative factors which are, natural occurrences and human activities. Leather surface defects influenced by natural occurrences are defects which occur when the living animal is exposed to bad weather conditions, diseases, parasites and predators (Hussain, 2015; Gerhard, 1996).

Human causative defects on the other hand are defects that result from human activities such as thrashings from Normans, poor animal housing systems, unqualified tanners and improper tannery operations like the use of inappropriate tools, equipment and weak or bad chemicals during leather production process (Asubonteng, 2010; Gerhard, 1996). Defects such as tack patches, patch or uneven dyeing and sometimes stains occur as a result of leather producers and sellers attempt to manage some leather surface defects. But because these ones often lack of technical know-how instead of correcting the defects advances the defects (Asubonteng, 2010).

Table 4.8 is the grouping of defects identified with locally produced vegetable tanned leather under their causative factors.

Table 4. 6- Human and Natural Causative Defects

Human causative factors	**Natural causative factors**
Patch defect	Parasitic infection
Drag mark	Wrinkle marks
Grain loosing	Cuts
uneven dyeing	Scar
Stains	scratches
Creases	Holes

Hair remains	
Grain peeling	
Holes	

4.3 Discussion of Results for Research Question Two

How do the users of the locally produced vegetable tanned leather manage leather surface defects?

The objective of research question two was to find out existing methods implemented by users of locally produced vegetable tanned leather and the effectiveness of the methods by identifying their strengths and weakness. Information obtained from research question two have been interpreted qualitatively by exploring in depth, methods employed by users of the locally produced vegetable tanned leather. With Qualitative research approach, a complete picture of firsthand information through truthful reporting and quotations of actual conversations with regard to methods employed by users of the locally produced vegetable tanned leather was reported.

Users of the locally produced vegetable tanned leather are students from the second and tertiary education institutions in the Kumasi metropolis of Ghana and leather craftsmen from the Bolgatanga crafts village. Most of the population studied were students of leather and not leather craftsmen. This was so because leather crafts men who use leather in the production of leather goods such as footwear, bags, upholstery, garments and containers in various leather centers in the Ashanti region, Greater Accra region and the Northern region of Ghana have refrained from using locally produced vegetable tanned leather and import leathers and leatherettes. Imported leathers and leatherettes sold at high cost though lack important properties of vegetable tanned leather such as resilience, breathability, perspiration and durability as buttressed by Boahin (2005). The rejection of the locally produced vegetable tanned leathers results from their poor surface appearance.

With reference to the Curriculum Research and Development Division (2008), the ultimate goal of the Ministry of Education, Science and Sports (MESS) is to equip visual arts students in the junior and senior high schools studying leatherwork as a programme, with knowledge and skills in handling and producing various leather artefacts. The syllabus is designed to help the students to achieve skills and techniques such as, cutting, tooling, stamping, peeling or incision, burnishing, lacing, piercing, skiving and dyeing through the process of self-expression. In order to go through these techniques, the student is left with no option than to depend on the locally produced vegetable tanned leather which share qualities needed to undertake such techniques. In view of this, students of leather in leather studying institutions are forced to go in for the locally produced vegetable tanned leather despite the leathers' liabilities to surface defects which impede the surface qualities students' desire for their works.

In order for students to produce quality works to attract good grades, students are forced to manage leather surface defects by adopting corrective measures. In situations where leather surface defects correction may take much of the students' time especially when students are time bound or where leather is prone to excessive defects, a leather may simply be discarded for another and that makes students incur high cost of production.

4.3.1 Methods Employed by Leather Users in Managing Locally Produced Vegetable Tanned Leather Surface Defects

In order to produce works of good standards leather users adopt various methods to improve on the leather with surface defects. The methods below are employed by leather users in managing leather surface defects.

a. Tack Patching

Tack patching is a leather defect management method used by some local leather craftsmen to repair defects like open cuts and larger holes on surfaces of locally produced vegetable tanned leathers. In tack patching, a strip of leather or plastic yarn is used to join an open cut or hole in a leather by means of hand stitching. Though tack patching ensures closure of open cuts and holes, stitch lines which are formed on the leather surface after patching the open cuts and holes remain as defects for leather users as indicated in plate 18. Leather users trim Patched areas during leather artefact production because the presence of stitch lines on leather surfaces interrupt the leather's surface grain structure and reduce the aesthetic appearance and value of leather artefacts produced from such leathers.

Plates 49- Patched leathers

Source: Field photograph, February- May, 2017

b. Dyeing

Dyeing is method of changing the original colour of a leather into another colour with a colouring substance called dye to manage leather surface defects. Defects such as stain, surface grain peeling and parasitic infections are managed by dyeing. Users of leather adopt two ways of dyeing leather which are, immersing and marbling. Dyeing by immersion involves submerging the whole leather into a dye solution called dye bath. Dye bath is prepared by mixing a vat dye with warm water, sodium hydroxide (caustic soda) and sodium hydrosulphite (hydros) in the ratio, 3:1:3. The function of caustic soda and hydros in dye bath is to ensure colour fastness and brightness. With this method, the brightness of the colour after dyeing is dependent on the concentration of the dye in the solution. Leather is wet gently and immersed into dye bath and allowed to stay in the bath for about 10 to 15munites right after the dye preparation to prevent any form of contamination. Wetting of leather ensures effective absorption of dye into leather fibers. Before the leather is immersed in the dye bath, it is sometimes tied or folded to create designs on its surface. The leather is removed after 10 to 15munites and spread out in a shade to allow oxidation to take place before washing it in clean water and is finally dried in the sun shine. In dyeing, the colour of the dye is dependent on the appearance of the defect in relation to the colour of the defect.

Marbling is another type of dyeing method employed by leather users to manage leather surface defects. Just like immersion, marbling involves the use of a dye bath composed of water, vat dye, caustic soda and hydros. In marbling, leather is soaked in water and beaten in mortar with pestle to soften the leather by opening the fibers to ensure effective penetration of dye into the fibers. After pounding the leather is spread out on a clean large table and gently gathered by pulling it with the fingers bit by bit towards the center. With a table-spoon, the dye is fetched and spread evenly onto the leather. The leather is left under a shade for about 10 to 15minutes to oxidize and change colour. The leather at this stage is washed in clean water and dried in the sun shine.

According to leather users, the marbling technique is a more effective method in managing leather surface defects such as stains, grain peelings, parasitic infections, wrinkle marks, hair remains and shallow cuts than dyeing by immersion. This is because the different shapes, lines and shades of colour produced on the leather surface after dyeing (plates 19) mingles and subdue defects making them less visible. With regard to marbling more than one colour can be dyed on a single leather making it more effective than dyeing by immersion.

Despite the effectiveness of dyeing as a method of managing locally produced vegetable tanned leather surface defects such as stains, grain peelings and parasitic infections, the following weaknesses were shared by locally produced vegetable tanned leather users who adopt this method of managing leather surface defects.

The method is time consuming and becomes impossible to adopt when the user is time bound. According to leather users, it takes at least a day to dye and get leather dried for usage under a normal sunny day. In a situation where the atmosphere is clammy, leather can take more than a day to dry. The length of time leather takes to dry when the atmosphere is clammy depends on the thickness of the leather. In view of this, it becomes a great challenge for the leather user to adopt this method of managing leather surface defects when leather artefacts need to be produced in a day or two.

Dyeing denies the leather user of the natural aesthetic appearance of locally produced vegetable tanned leather such as colour and grain pattern. Locally produced vegetable tanned leather comes in a natural khaki or cream colour which is desired by some leather users and consumers. When leather is affected by surface defects, the change in colour through dyeing done to manage defects denies the leather user and consumer the natural grain colour. The surface grain structure of various animal skins and hides gives leather an outstanding surface quality which makes the material unique and aesthetically, pleasing to the eye. Since getting leather free from surface defects is an ultimate requisite of the leather market and most leather factories, the aesthetic appearance of locally produced vegetable tanned leather is often overlooked though desired.

Mold growth caused by fungi is very common with dyed leathers when dye leathers come in contact with moisture and heat for a period of time. The influence of mold on leather surfaces leave dyed leather surfaces patchy and less pleasing for leather artefact production.

Most leather users lack the expertise required to produce better dyeing. Users of locally produced vegetable tanned leather are often experts in the making of various leather products other than leather manufacturing processes such as dyeing which is a finishing process in leather production. Instead of obtaining a regular dyed surface, the leather users rather obtain an uneven dyed surface as indicated in plate 20 which affect the surface appearance of leather artefacts from such leathers. Another challenge producers' face (as a result of lack of required expertise in dyeing) is colour bleeding when the leather comes into contact with moisture. Vegetable tanned leather bleeds and stain when it comes into contact with moisture.

Plates 50- Marbled leathers

Source: *Kumasi Technical Institute Visual Arts Department*

Plates 51- Leather dyed by immersion

Source: *Department of Integrated Rural Art and Industry leather studio, KNUST*

c. Painting

In painting, colour is applied on leather surfaces with brushes to manage surface defects such as stains, scratch marks, parasitic infections and sometimes minor cuts by users of the locally produced vegetable tanned leather. By painting, users of the locally produced vegetable tanned leather are able to express various ideas on surfaces of vegetable tanned leather which do not only manage surface defects, but also contribute to the value of the leather by improving the aesthetic appearance of the leather and products produced from them. Because vegetable tanned leather is highly absorbent, colours which are applied on their surfaces are able to fix well. According to users, though painting is an effective way of managing leather surface there are some challenges which relate to painting.

In order to produce good painting a special skill is required. Good painting contributes to beauty and quality work. When painting is poor, the entire work become less attractive and instead of the painting improving the surface appearance of the leather, it makes leather artefacts less attractive. In order to produce leather works with outstanding surface appearance, leather users who lack good painting skills but desire to produce good paintings employ professionals who render the services to them at a fee which adds to their cost of production.

Painting becomes time consuming when leather surfaces are large or when scenes, motifs and images to paint are comprehensive.

It is difficult to rectify mistakes when painting leather surfaces. Once a vegetable tanned leather receives paint, cleaning the paint when a mistake occurs becomes impossible because of the high moisture absorbency rate of the vegetable tanned leather.

Painting is not the right surface defect managing method for locally produced vegetable tanned leather when a single colour or the usual cream, red, coffee brown and black colour is desired by the consumer.

d. Screen Printing

Just like painting, screen printing is the application of colour onto a leather surface but with a different application method. With screen printing, print paste is forced through a mesh with a design to be printed from a mesh but in a reversed form so that when printed the colour can be obtained in the positive side of the leather surface. The negative areas of the design to be printed from mesh onto leather surfaces are blocked by making blocked areas impermeable to colour. Using a squeegee (a flat pallet knife for forcing paint through holes of mesh), colour is forced through the open areas of the mesh whiles it rest on the leather surface to be printed. Screen printing, just like painting, is able to manage stains and subdue defects like minor cuts, parasitic infections and sometimes hair remains. Screen printing unlike painting is less time consuming especially when the same design is required for a mass production. Screen printing becomes much expensive and time consuming when variations are required in mass production. Screen printing unlike painting gives room for less mistakes because prints are defined by the mesh. Challenges associated with screen printing as a leather surface defect managing method is the management of different leathers with defects messily spread on their surfaces with the same design frame. While some defects may be covered by colour spread through the mesh, other defects may also hide under blocked areas of the mesh making them visible after the screen printing. Just like painting, screen printing cannot be the right leather surface defects management method when the usual colour of the locally produced vegetable tanned leather is desired by the consumer. Plate 21 shows screen prints made on vegetable tanned leathers to manage leather surface defects.

Plates 52- Screen printing on leathers with surface defects

***Source**: Department of integrated rural art and industry leather studio, KNUST*

e. Wax Polishing

Wax polishing is the application of neutral shoe wax polish on the surface of the leather using a sable brush or foam. Neutral wax polish seals shallow scratches and make leather surfaces smooth and glossy. Minor scratches which are sealed with neutral wax polish remain conspicuous though smooth when felt. Conspicuousness of the defects under wax polish is the result of the transparent nature of the neutral wax polish.

f. Liquid Polishing

In liquid polishing, leather users apply a black or brown polish on the surface of black or coffee brown leather respectively to either blend an uneven dyed surface colour or reduce the intensity of minor scratches and parasitic infections such as tick bites on leather surfaces. Liquid polish is applied as a surface finish for leather products with such types of leather surface defects. According to users of the method, applying liquid polish to patchy dyed surface has proven more effective than any other surface defect.

g. Scorching

Scorching is the use of hot metal rod or soldering iron to burn designs on vegetable tanned leather surfaces with the purpose of managing defects. Scorching creates varying shades and tones on vegetable tanned leather surfaces by either passing hot iron rod or soldering iron along outlines of designs created on leather surfaces. Varying the types of heated iron rod or soldering iron tips used, temperature and the way the iron is applied to the material allow the local leather user to create different burning effects (tones and shades). Scorching sometimes is employed on vegetable tanned leather surfaces to create textures which blend and minimize the intensity of some defects. Textures created by means of scorching have been used by leather users to manage defects like parasitic infections, stains, scratches, hair remains and scars.

According to leather users, the ability to create pleasing scorched works on leather surface is dependent on the one handling the scorching tool, the control of temperature and the ability to choose the right soldering iron tips. Lack of these skills contributes additional damage to the locally produced vegetable tanned leather with surface defects instead of managing them.

Scorching becomes more effective on cream and red vegetable tanned leathers than on black and coffee brown leathers. The dark appearance of black and coffee brown leather is unable to bring out shades and tones burned on such leather surfaces.

Again, just like dyeing, painting and screen printing, scorching will not be ideal when the usual cream and red colour of vegetable tanned leather is desired by a consumer.

h. Stamping

Stamping is the use of pressing tools in the form of metal rod with motif at one end of the rod to produce a repetitive pattern on leather surfaces. In stamping, leather is placed on a punching board or any hard resilient surface and with a mallet, a stamping tool is struck to print pattern on leather surfaces. According to users, stamping reduces the surface glossiness of leather and leaves the leather surfaces rough and matt. When stamping, as the number of patterns increases or repeated, they fuse together and reduce the visual clarity of the leather surface as well as defects by obscuring the defects.

Defects like creases, wrinkles and minor scratches according to users of this method are best concealed when stamping patterns are small, numerous and closely parked on the surface (DePaul University [n.d.] and Allman [2012]).

Although according to leather users, stamping is an effective method for reducing the intensity of leather surface defects like creases, wrinkle marks and scratches, the method is labour intensive and time consuming, more especially when the stamping surface area is large. Again, producing patterns with same depth is less assured since the method is manual and for that matter the striking force may differ (plate 22 is a leather belt with a varying stamped depth). The users of this method also reported that, there is always the danger of injuring themselves when striking the stamping tools with mallet.

Plate 53- Stamped leather belt with varying depth

Source: Integrated Rural Art and Industry leather works exhibition

i. Appliqué

Appliqué is a method employed in controlling leather surface defects by fixing a second leather or a different material over a defected leather's surface area to mask defects and also create design on the leather surface. A leather or a different material with a colour different from the working leather is often fixed to the working leather's surface to mask defects as indicated in plate 23. Leather may be attached to a defect leather surface by either gluing or stitching it manually or with machine. This method is effective because defects are completely masked.

Appliqué becomes an expensive and tedious method to manage leather surface defects when the defect spreads on a large surface area of the leather. This is because leather users require a lot of time combined with effort and skill to mask all defects. In addition, when the entire surface area of the leather is defected, this method cannot be adopted because masking the entire surface area of the leather will result in bonded leather instead of an appliqué work. Again the beauty of an appliqué work is much dependent on the leather user's skill in producing appliqué forms which conform perfectly to the work.

Plates 54- Appliqué leatherwork for masking defects

Source: Prempeh College leather studio

j. Inlaying

Inlaying involves cutting out leather areas with surface defects and inserting a similar leather which sits perfectly in the space created after cutting out the defected areas. When inlaying, the leather introduced to the working leather must be of the same colour, grain pattern and thickness as the working leather to perfectly blend inlayed work with the working leather surface. Again, to ensure that the leather sits perfectly in the space created, edges around areas to be joined are skived at same angle.

Though inlaying is an effective way of getting vegetable tanned leather free from leather surface defects, it requires technical know-how to produce a good inlayed work. Furthermore, in situations where the leather user needs to cut away an area of leather with surface defects and replaced with another leather by inlaying, the problem often faced is the challenge of getting leather of the same grain patterns and thickness. This problem is the result of the variations in thickness among different types of leather and also, the variation in different sections of the same leather. Obtaining leather with same intensity is another problem faced when managing leather surface defects by this method. According to leather users, Indigenous vegetable tanned leathers vary in colour intensity. Even when leather for inlaying is obtained from portions of the working leather, colour is likely to vary due to different colour variations in different vegetable tanned leathers which are influenced by the variations in various leather structures or poor dyeing done by unskilled local leather producers.

k. Incision

Incision is the use of a sharp knife to remove layers of leather from the grain side of the leather. Incision is best achieved on thicker leathers but in situation of a thin leather, incision slightly penetrates the surface of the leather. Leather users adopt this method in managing defects like cuts, scratches, grain loosening and grain peelings. The method is started by first drawing designs on the leather surface and slightly or deeply cutting into the designed area of the leather surface with a sharp knife without damaging it. The grain layer portions within the cut areas are gently peeled off to reveal the flesh side underneath the grain layer.

Incision is a less effective method when defects eat deeply into the leather layers. An example is the situation of a deep cut defect. When a defect is deeply eaten into a leather, a larger thickness of the leather needs to be removed before the depth of the defect is reached leaving the incised area weak. Again when a leather has a large defect area, incision is likely to become irregular when peeling layers. There is the likelihood of some parts becoming thicker than others. For an incision to be done well, the skill of the user in incision is paramount.

l. Weaving and Thonging

Weaving which is a process of cutting leather into strips and interlacing them to either decorate or form a product is one of the techniques adopted by leather users to manage leather surface defects. In managing leather surface defects, strips are interlaced in such a way that leather strips with surface defects underlie strips without surface defects. Thonging which is joining and also a decorative technique also hides defects when thongs are laced over defect. Weaving and thonging hide leather surface defects by leaving no suspicion about the leather having defects on its surface when a leather product is finished as indicated in plate 24.

The limitation of weaving as a method for hiding leather surface defects is that it is time consuming especially when weaving an entire leather product. Again, when a strip for interlacing is completely covered with defects, it cannot be used because the defects will be revealed during interlacing. The limitation of thonging is that, the technique only manages defects around the thonging areas of the work.

Plates 55- leather file weaved and thonged to hide defects

Source: Prempeh College leather studio

m. Leather Fillers

Leather fillers are paste-like chemicals which are used to fill openings resulting from defects. Leather fillers become pliable when dry and can absorb colour or dye to obtain the colour of the leather it is applied on. Leather fillers are effective in managing defects like cuts, scratches, pin holes and grain peelings. Leather fillers are very expensive and hard to come by on the Ghanaian market making it uncommon among indigenous leather users.

4.4 Discussion of Results for Research Question Three

How will texturing device be designed, constructed and its efficacy for indigenous vegetable tanned leather surface defects be tested?

Waterfall model which is a sequential model with separate phases with the outcome of one phase acting as an input for the next phase sequentially was adopted and incorporated with the Design Principles and "Omdenken" Theory for designing and constructing the texturing device. All six stages of the Waterfall Model which include, Requirement Gathering and analysis, System Design, implementation, Deployment of System and Maintenance were followed sequentially to design and construct the texturing device. At the Requirement Gathering and analysis stage, all possible requirements of the texturing device were sort for and documented. Requirements for the designing the texturing device were sort for from leather experts. The weaknesses of methods used by users of the locally produced vegetable tanned leather were also considered in the requirements gathering and analysis stage.

System design is the second stage in the Waterfall model. At this stage of the design process, texturing device specifications gathered in the first stage of the design process were transformed into a sketch. The sketch developed went through series of idea development process until the one which deemed fit and more appropriate with respect to the device specification was arrived at.

Universal Design principles which are principles applied by designers to ensure that a product meets the needs of potential users in a wide diversity of characteristics without any adaptation or specialized design (Burgstahler, 2015) were considered at this stage of the design process. Flexibility, simplicity, low physical effort and minimum space accommodation were the principles considered at this stage of the design process.

At the implementation stage which the third stage in the design process, tools, machines, equipment and materials needed to get the texturing device produced were employed in the development of the individual components of the texturing device. The individual components are the top roller, base roller, top roller frame, base roller table and protective coverings. Each of the components developed were tested for their functionality.

At this stage of the design process, the “Omdenken” theory which is the Dutch Art of Flip-Thinking by Berthold Gunster was adopted in development of textures for the top roller. “Omdenken” theory deals with the transformation of problems or challenges into opportunities by looking for new opportunities that arises from problem’s energy. Tactile defects which appeared in different shapes, lines and dots which were seen as problem energy were organized into various textures after which two of the textures were selected and employed in the development of rollers for the top roller part of the texturing device.

Texturing device individual components were produced from rejected machine parts in the form of metal rods, sheets, plate and pipes as well as metal scraps. These materials were used because they were readily available and cheap. Complex and simple machines, equipment and tools such as the lathe machine, welding machine, grinding machine, cutting disc, tape measure and G clamp were employed in the construction of the individual components of the texturing device.

At the integration and testing stage, individual components developed at the implementation stage were integrated and tested for faults and failures. Faults and failures identified were rectified.

The texturing device was finally tested on a vegetable tanned leather at the Deployment stage to test for the functionality of the texturing device. After the test, it was observed that, some portions of the textures could not print on the leather surface placed between the two rollers because patterns were not at the same level. This problem identified was rectified at the maintenance stage which marks the final stage of the Waterfall model. Carbon rubber commonly used in the footwear industry for making soles of footwear was wrapped around the base roller rendering it a resilient surface. The resilient surface of the base roller enabled the textures to reach the leather surface at different heights.

4.4.1 Properties of the Texturing Device

Texturing device has being designed and constructed with the following properties;

The Top Roller

The top roller was built in brass metal with outside dimeter measuring 80mm and inner dimeter measuring 25mm with length measuring 165mm. Though these dimensions do not correspond to the average side of a leather hide or skin which are 50-55 sq. ft. and 6-9 sq. ft. respectively as cited by Moore & Giles (n.d.), the top roller has being designed to revolve and advance leather between the top and base rollers thereby printing any length of leather. Contact of the top roller with the base roller enable the advancement of the leather between the rollers.

The top roller has textures built on its surface which stamps leather surfaces as they advance between the top and base rollers. Space left around the two ends of the rollers enable the texturing device to imprint on any width of leather.

The Top Roller Frame

The top roller frame houses the top roller and the wheel knob. The top frame is connected by two square pipes to the foot of the device. The top roller frame and the two square pipes connecting to the foot of the device houses and manages the up and down movement mechanism of the top roller.

Base Roller

The base roller is constructed from a steel metal rod with an outer dimeter measuring 90mm and inner dimeter measuring 25mm. The movement of the top and base rollers when in contact enable the advancement of leather fed in-between them.

Base Roller Table

The base roller table is constructed with a steel metal square pipes with dimension, 820mm (height) by 250mm (breath) by 140mm (width). The height of the table enable the user to stand or sit whiles operating on the device. The base roller table holds the base roller in place for the leather to rest. The table is designed with free space around it to enable the device work on any width.

Wheel Knob

Wheel adjustment enable the up and down movement of the top roller. The wheel knob adjustment also determines the amount of pressure the top roller exerts on the leather fed the top and base rollers.

Electric Motor

The electric motor is a rotating machine that converts electric energy to mechanical energy. The electric motor controls the movement of the top roller by producing a rotary force. The speed at which the top roller moves is determined by the speed at which electric motor runs. Attached to the motor a motor reducer which reduces the speed of the motor to ensure effective control of the leather when advancing between the rollers. Table 4.9 shows the motor designer's specifications.

Table 4.9- Designer's specification for the motor

Motor RPM	1125
Motor Hertz	50HZ
Motor Voltage	220v
Motor phase	3-phase

The Sprockets

Sprockets are wheels upon which radial projections engage a chain passing over it to transmit rotary motion between the motor shaft and the top roller shaft. The sprockets together with the chain conduct electric power in the form of rotary motion from the motor to the top roller shaft.

The Chain

The chain connects the motor sprocket to the top roller sprocket to transmit rotary motion from the motor shaft to the top roller shaft to enable the texturing device run when there is the flow of electricity.

The Motor Starter

The motor starter is used to start, run and stop the motor based on command.

The Handle

The handle controls the manual operation of the texturing device when chain is disconnected from the top roller sprocket. Manual operation of the texturing device becomes possible only when the chain is disconnected from the texturing device sprockets.

4.5 The Texturing Device Operating Mechanisms

The texturing device has being designed and constructed to operate on the following mechanisms;

The Up and Down Movement Mechanism

The up and down movement mechanism enables the top roller to be raised and lowered when leather of any thickness is feed in the device. The top roller frame and the wheel knob are the two parts of the device that control the up and down movement mechanism of the texturing device. The top roller frame is composed of an outer frame and an inner frame which are connected together by the wheel knob. Attached to the wheel knob is a screw nut which lies on top of the outer part of the top roller frame to ensure effective turning of the wheel knob without trailing inside holes in which the wheel knob passes to connect the two frames. The base of the wheel knob is locked at the underside of the inner frame to ensure up and down movement of the top roller when the wheel knob is adjusted. The knob is adjusted to create a 10mm space between the top and base roller to take any thickness of leather which ranges between 0.4mm and 4.8mm as cited by Zelikovitzleathers (2009).

The Rolling Mechanism

The rolling mechanism of the texturing device enables the device to work on a leather of any length. The texturing device has two rollers, one (top roller) which rotates when the device is turned on and enables the other (base roller) to rotate in an opposite direction when they come into contact with each other. Rollers rotating in different directions when in contact with each other enable the device to pick and advance leather feed between rollers.

The Printing mechanism

The texturing device uses the relief patterns from the metal surface (top roller) to print the textures on the leather positioned on the second metal surface (base roller) with a resilient material wrapped over its surface. Resilient material wrapped over the base roller surface has a thickness equal to the height of the highest relief pattern on the top roller. This resiliency property enables the texture patterns to have a direct contact with the leather to print the textures when the two rollers comes into contact with the leather placed between them.

The Running Mechanism of the Device

A ‘normally open pushbutton’ (coloured green) and a ‘normally closed pushbutton’ (coloured red) which accompanies the starter enables the machine to run or stop when pressed or pushed. Disconnection of the chain from roller sprocket enables the device to run manually when handle is connected.

4.6 Test for the effectiveness of the texturing device for a full sheet of indigenous vegetable tanned leather

This test was conducted to establish the effectiveness of the texturing device for a full sheet of leather. The leather was inspected before (plate 25) and after (plate 26) the intervention of the texturing device to note any change.

Before intervention

Plates** 56- **Full sheet of leather before the influence of the texturing device

After intervention

Plates** 57- **Full sheet of leather after the influence of the texturing device

The warbling edges of the leather resulted in creases formation on the leather surface when leather was passed through the texturing device. The small gap left between roller bearings also made it difficult for the printed side of the leather to freely move between roller bearings whiles areas of the leather to be printed advanced in between the rollers. The gap between the roller bearings which is very small to cater for the thickness of the leather reduced the speed at which the leather moved in-between the roller bearings as compared to the speed at which the two rollers moved with the leather. The difference in speed between the two areas forced the leather to fold and crumple at portions which came in-between the rollers and the bearings. This resulted in the several creases formation on the leather surface. Portions of the leather which were crumpled and folded also resisted the printing of the textures as indicated in plate 26.

4.7 Test for the effectiveness of the texturing device on varying sections of locally produced vegetable tanned leather

Variations that exist in various sections (shoulder, bend, belly,) of a full sheet of leather as cited by Boahin (2005) and Vidler (2015) as well as the challenge of printing texture on a full sheet of leather made it necessary to divide the leather into varied sections and tested to find the effect of the texturing device on the varied sections of a full sheet of leather. Plates 28, 30, 32 and 34 are the test results for the effect of texturing device on varied sections of a full sheet locally produced vegetable tanned leather.

Plate 58- Shoulder section before intervention of the texturing device

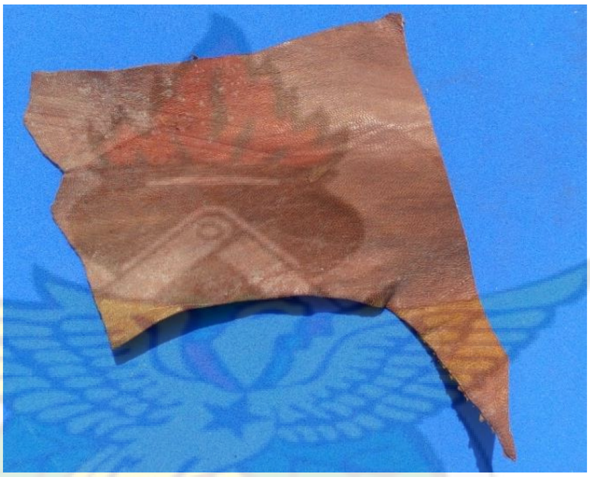
Plate 59- Shoulder section after intervention of the Texturing device

Plate 60- Bend section before intervention of the texturing device

Plate 61- Bend section before intervention of the texturing device

Plate 62- Belly area before intervention of the texturing device

Plate 63- Belly section after intervention of the texturing device



Plates 64- Leg section before intervention of the texturing device

Plates 65- Leg section after intervention of the Texturing device

From the test conducted, the shoulder, leg and belly sides of the leather which have warbling edges obtained folds when those sections of leather were passed through the texturing device. The bend section of the leather which had no warble edges with all sides lying flat did not obtain any creases when the section of the leather was passed through the device.

4.8 Test for the effectiveness of the texturing device for indigenous vegetable tanned leather surface defects.

Defected areas of a vegetable tanned leather were trimmed from different sections of leathers and passed through the texturing device to examine the efficacy of the texturing device for defects. Leathers were dampened before passing them through the texturing device because of their ability to take shape when wet and maintain shape when dried as asserted by Boahin (2005). The test was done for the four colours of which local vegetable tanned leathers are obtained on the market (Cream, red, coffee brown and black leather). The plates below are defected leathers before and after the intervention of the texturing device.

4.8.1 Cream Leathers before and after Intervention of the Texturing Device

BEFORE **AFTER**

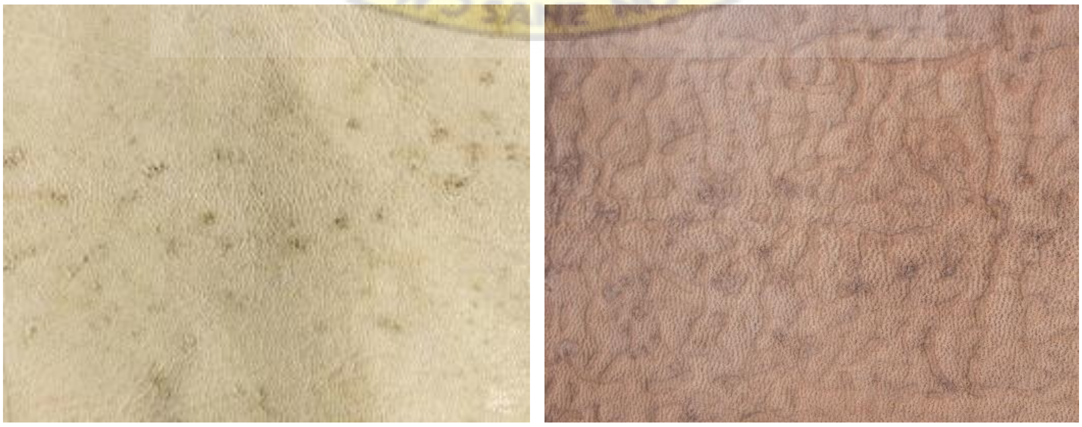


Plate 66- A parasitic infection at the bend side of the leather.

BEFORE **AFTER**

Plate 67- A scratch mark at the bend side of the leather.

BEFORE **AFTER**

Plate 68- A grain peeling at the belly side of the leather.

BEFORE **AFTER**


Plate 69- A cut at the belly side of the leather.

BEFORE **AFTER**


Plate 70- A scar at the bend side of the leather.

BEFORE AFTER

Plate 71- Hair remains at bend side of the leather.

BEFORE AFTER

Plate 72- A hole defect at bend side of the leather.

BEFORE	AFTER


Plate 73- A wrinkle defect at the belly side of the leather.

BEFORE	AFTER


Plate 74- A knot defect at bend side of the leather.

Visual examination with a plain sight before and after intervention of the texturing device perceived wrinkle marks defects as the only defect which completely fused with textures imprinted on the cream leather. Though a wrinkle defect was completely nullified, that portion of the leather surface got folded. This fold occurred as a result of the warbled edge of the belly section from where the leather defect was cut. A knot defect was slightly nullified with traces of the defect visible when viewed with a plain sight. Scratch marks, parasitic infection, stains, cut, grain peeling, scar and hair remains remained visible with defect intensity reduced by slightly fusing with the textures.

Visual examination of cream leathers after the intervention of the texturing device revealed that, the cream leathers tested had colours dimmed affecting the visual clarity of both the texture prints and the surface defects. This effect was more obvious when the printed leathers were viewed from a far distance. The dimming of the cream leather colours may be attributed to the roughness of leather surfaces rendered by the texturing device. According to Girard (2016) light reflection from a rough surfaces gives matte and gloomy surface appearance compared to smooth and shiny surfaces. The dullness of the leather surfaces is likely to have as well resulted in the reduction of some defects intensity on the cream leather surfaces. Allman (2012-2016), Deines (2014) and Anon (n.d.) asserts that, texture corrects surface imperfections by fusing together individual defects and reducing the visual clarity of the surface with flaws.

4.8.2 Red Leathers Before and After the Intervention of the Texturing Device

BEFORE **AFTER**

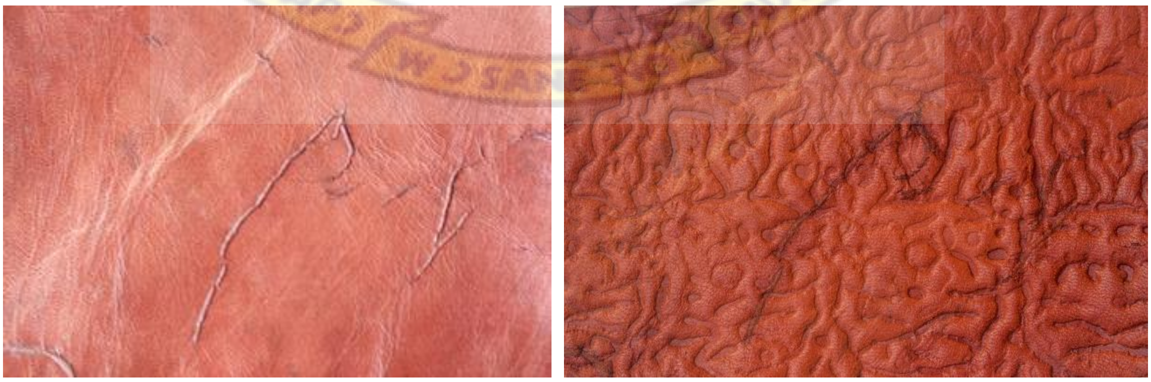


Plate 75- A cut at bend side of the leather.

BEFORE AFTER

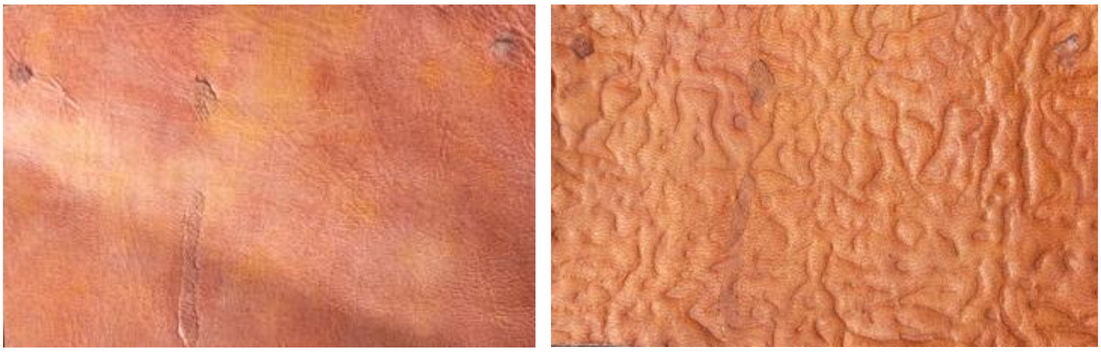


Plate 76- A grain peelings at the bend side of the leather.

BEFORE AFTER

Plate 77- A patch or an uneven dyeing at the bend side of the leather.

BEFORE AFTER

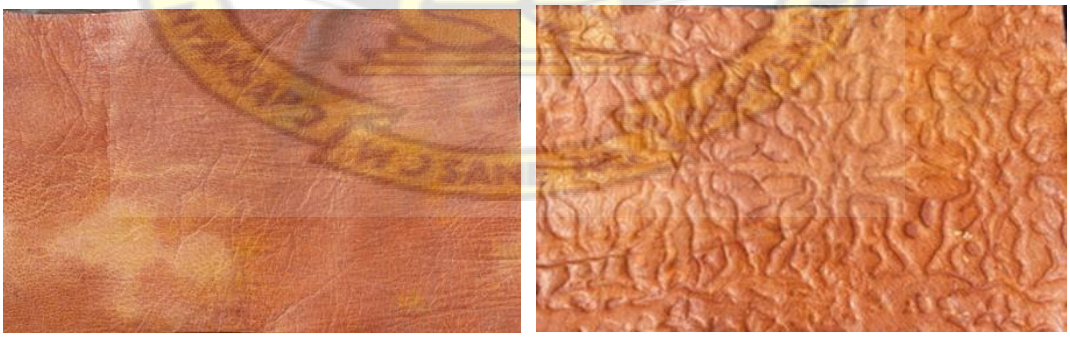


Plate 78- A mold defect at shoulder side of the leather.

BEFORE AFTER

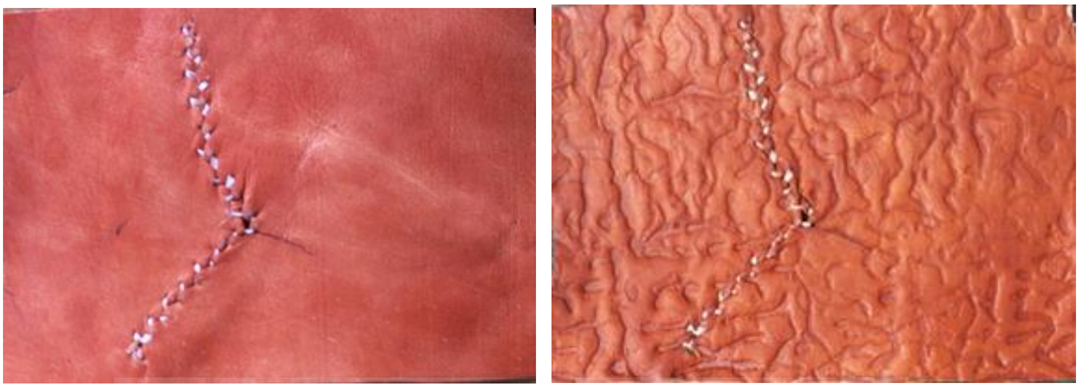


Plate 79- A stitch patch defect at bend side of the leather.

BEFORE AFTER

Plates 80- Hair remains at the shoulder side.

BEFORE AFTER

Plate 81- Scars at bend side of the leather.

BEFORE **AFTER**

Plate 82- Wrinkle marks at belly side of the leather.

BEFORE **AFTER**

Plate 83- Scratch marks at bend side of the leather.

BEFORE **AFTER**

Plate 84- A grain loosing at the bend side of the leather.

BEFORE **AFTER**

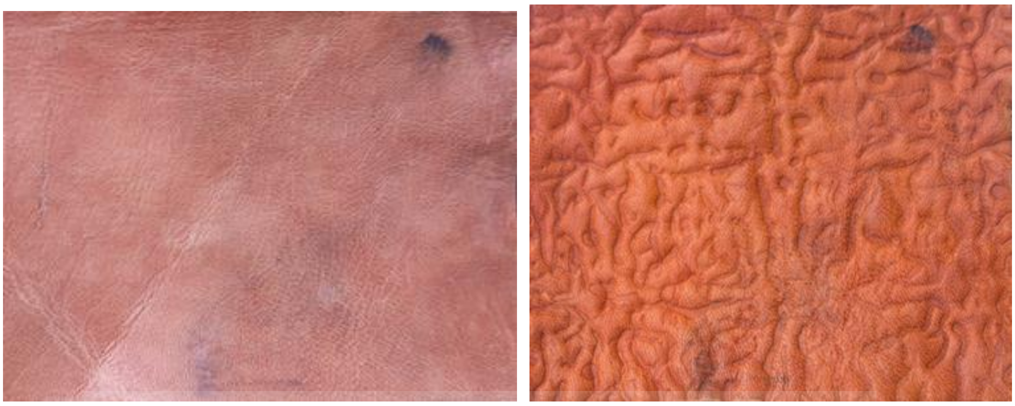


Plate 85- Stains at the belly side of the leather.

BEFORE **AFTER**

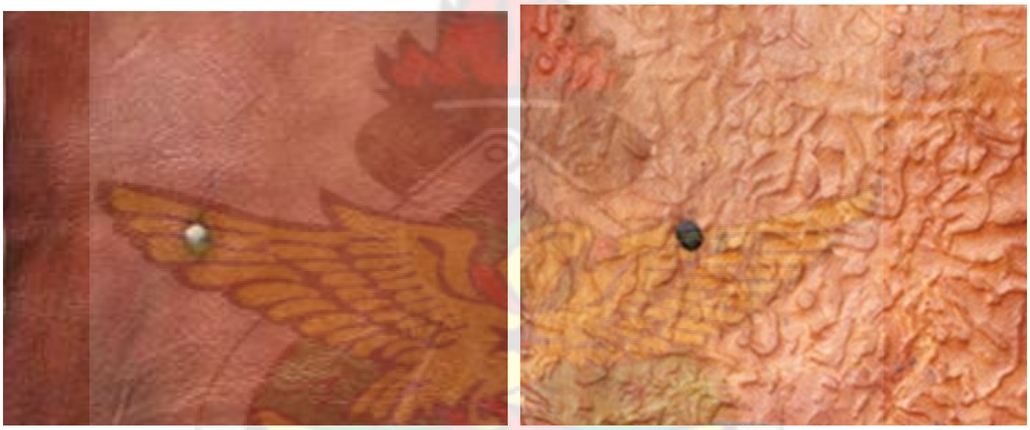


Plate 86- A hole defect at belly side of the leather.

Grain loosening and wrinkled defects were completely nullified by becoming invisible when viewed with a plain sight after passing defects through the texturing device. A mold and uneven dyeing defect became slightly visible at pale areas and completely invisible at areas with dark shades of the colour. Scratch and cut defects had defect intensity well reduced and slightly fused with the leather background. These defects at a quick glance are close to invisible when viewed with a plain sight. Defects like holes, black stains and patches remained visible after the influence of the texturing device.

4.8.3 A Coffee brown Leather Before and After the Intervention of the Texturing Device

BEFORE **AFTER**

Plate 87- A hole defect at the belly side of the leather.

BEFORE **AFTER**

Plate 88- Wrinkle defects at the belly side of the leather.

BEFORE AFTER

Plate 89- Hair remains at the bend side of the leather.

BEFORE AFTER

Plate 90- A grain peeling defect at bend side of the leather.

BEFORE AFTER

Plate 91- A scratch mark at shoulder side of the leather.

BEFORE **AFTER**

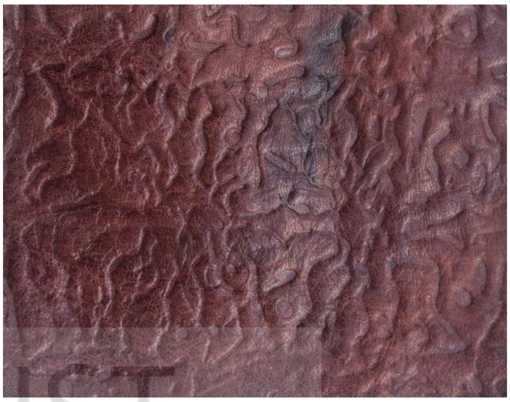


Plate 92- A black stain at bend side of the leather.

BEFORE **AFTER**

Plate 93- Mold defects at belly side of the leather.

Most of the coffee brown leathers identified had mold growth and uneven dyeing defects associated with other defects. The influence of mold defect made the leather surface appear dull especially after damping the leather prior to texturing. The mold and uneven dyeing appearance in the midst of leather defects collected before the texturing slightly reduced the intensity of defects such as scratches, grain peeling and cut especially when viewed at a sharp glance.

Texture imprints in the midst of an uneven dyeing obscured the appearance of grain peeling defects whereas cut and scratch defects became less visible when viewed with a plain sight. In the case of wrinkle defects, they were visible in the midst of mold defects but after the influence of the texturing device, the wrinkled defects were completely obscured with fiber loosening at the side giving an impression of a defect despite the defect's invisibility. The intensity of hair remains slightly reduced in the midst of texture imprints (plate 58). Hole defects remained visible with no change in defect's appearance (plate 56). Black stain which did not have mold defect interference had the stain slightly mingling with the texture prints (plate 61). Mold and uneven dyeing defects remained visible and slightly fused with the textures.

4.8.4 Black Leather Before and After the Intervention of the Texturing Device

BEFORE **AFTER**

Plate 94- Wrinkle defects at belly side of the leather.

BEFORE **AFTER**

Plate 95- A cut defect at bend side of the leather.

BEFORE **AFTER**

Plate 96- A hole defect at belly side of the leather.

BEFORE **AFTER**

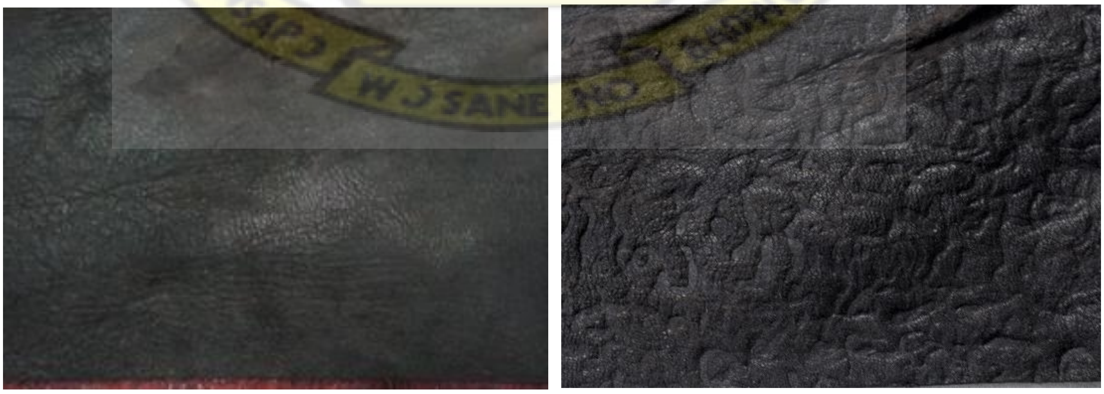


Plate 97- A drag mark at belly side of the leather.

BEFORE **AFTER**

Plate 98- A grain break at bend side of the leather.

Black leather slightly resisted the impact of the texturing device at the belly side of the leather making the texture imprints not visibly printed on the leather surfaces. The resistance of the texture prints on black leather may be the influence of the chemical employed in changing the colour of the leather from cream to the black. Despite the leather's resistance on the texture prints from the texturing device, the wrinkle defects were completely nullified by the texturing from the texturing device with a fold occurring on the leather surface. The fold occurred as a result of the warbled edge of the belly side of the leather where the defect was cut. Cut and drag mark defects remained visible after texturing with slight reduction in their intensity.

4.9 Analysis of the Influence of the Texturing Device Imprints on Vegetable tanned Leather Surface Defects

The inability of the texturing from the texturing device to manage hole and patch leather defects on vegetable tanned leathers may have resulted from the effect of defects on the grain and derma structure of the leather. The texturing device imprints only affect the surface grain of the leather unlike hole and patch leather defects. The device's ability to manage wrinkles defect and reduce the intensity of cut, grain peeling, scar, stains, scratch marks, hair remains and parasitic infection defects may also be attributed to the fact that both the texture imprints and the defects influence are on the grain side and portions of the derma of the leather. This similarity between the defects and the texture imprints may have resulted in the fusion of defects and the texture imprints than in the case of Hole and patch leather defects.

After the influence of texturing device on leather, the textured areas with high relief (raised) backgrounds brightened and areas with low relief (recessed) darkened which added to the aesthetic appearance of leathers tested. It is evident that the high relief area of the texture prints reflects light rays falling on the leather surface whereas the low relief areas have reflected light rays casting shadow on them thereby reducing visual clarity of the leathers surface appearance. Reflection from rough surfaces minimizes reflection by increasing the chances of reflected light bouncing back onto the surface, rather than out to the surrounding air thereby casting shadows in some regions impeding the clarity of a surface quality (The Optical Society, 2016). The reduction in the leathers' surface visual clarity on textured leather surfaces is obvious to have resulted in the reduction of the intensities of vegetable tanned leather surface defects after passing them through the texturing device.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Overview

The chapter outlines the summary, conclusions and recommendations of the study.

5.2 Summary

The research aimed at designing a surface texturing device for managing vegetable tanned leather defects. The objectives of the research study were;

1. To inspect and identify defects associated with locally produced vegetable tanned leather surfaces.
2. To examine the methods employed by locally produced leather users in managing leather surface defects.
3. To design and construct a texturing device and test device's efficacy for managing locally produced vegetable tanned leather surface defects.

The research established findings on the Texturing device for managing surface defects on locally produced vegetable tanned leather. The major findings were:

1. With respect to research objective one which sought to identify various defects associated with locally produced vegetable tanned leather surfaces, the research adopted the observational data collection instrument to identify defects associated with locally produced vegetable tanned leather surfaces. A plain sight under natural bright day light was employed in identifying the defects. Wrinkle marks, Cuts, Holes, Scratches, Grain peeling, Mold defect, Stain, Parasitic infection, Uneven dyeing and patch leather defects were the defects identified with locally produced vegetable tanned leather. Defects identified were grouped into three categories which included, the time of the defects

occurrence (per-slaughter, slaughter and post slaughter defects), defect causative factors (Natural and Human causative factors) and defects appearance in relation to texture (tactile, visual and structural defects).

2. Objective two sought to examine various methods employed by locally produced vegetable tanned leather users in managing leather surface defects. In-depth interview accompanied with observation were employed as a data collection instrument to identify methods used by users of locally produced vegetable tanned leather in managing leather defects. Leather users adopt dyeing, screen printing, patching of holes and open cuts, painting, polishing, scorching, stamping, appliqué, inlaying, incision, leather fillers, weaving and thonging for managing various leather defects.

   The research revealed that these methods which are employed by leather users in managing leather defects have their own strengths and weaknesses. In the case of painting, dyeing and screen printing, though the methods hide stains, minor scratches and grain peeling defects but in situations where the actual colour of the leather is required of a work, these methods become less feasible. Though according to leather users, stamping is an effective method for reducing the intensity of leather surface defects like creases, wrinkle marks and scratches, the method is labour intensive and time consuming, more especially when the stamping surface area is large. Again, producing pattern with same striking force is less assured since the method is manual and for that matter, the striking force may vary. In the case of appliqué, inlaying, scorching, incision and painting, special expertise is required of the vegetable tanned leather user to be able to effectively employ the methods. Users who lack the skills employ professionals who render the service to them at a fee which add to their cost of production.

3. In contributing to the development of the weaknesses associated with the methods used by users of the locally produced vegetable tanned leather in managing leather surface defects, research objective three sought to design and construct a texturing for managing locally produced vegetable tanned leather surface defects. The physical orientation of defects forms were picked from leather surfaces and organized into different textures after which two of them were selected and used in the designing of texture for texturing device. The texturing device's test on locally produced vegetable tanned leather surface defects revealed that, tactile defects that is, defects affecting the surface texture of leather and can be experienced by sense of touch and sight are best managed by the texturing device. Under the tactile defects, grain loosening and wrinkle defects which do not break into the grain structure of the leather were completely nullified with no traces of the defects seen when. Scratch marks, cuts, knot, grain peeling, hair remains, and scars defects which most of these defects break through the grain structure of the leather though not completely nullified by the texturing device had defects intensity reduced. Hole and patch defects which eat into the entire structure of the leather remained visible with no change in defects' appearances. Stain and mold defects which were defects grouped under the visual defect category were slightly nullified with traces of defects remaining obvious after the influence of the texturing device.
4. The texturing device designed and constructed does not print well on full sheet of leather due to the smaller space between the top and base roller bearings. The

texturing device effectively prints on leather of any length and size equal to or less than the width of thers rollers.

5. The texturing device imprints on thight leather structures such at the bend and the shoulder sections of the leather was much visible than on areas with loose fibre structure such as the bely sections of the leather.
6. Vegetable tanned leather sections with warble edges such as the shoulder, belly and leg sections obtained folds at the edges when the sections were passed through the texturing device.

5.3 Conclusions

Research findings obtained in the research study informed the following conclusions made.

1. Locally produced vegetable tanned leathers are associated with various leather surface defects which reduce the aesthetic appearance of leather and its products. The drain in vegetable tanned leather and its products' aesthetic appearance by leather surface defects have resulted in the down grading and rejection of the leather by most leather users apart from those who are forced to use the leather because of its inherent properties.
2. Despite the rejection and down grading of the locally produced vegetable tanned leather due to surface defects, students of leather from second and tertiary education institutions and few leather craftsmen continue to use such leathers in leather artefact production because of the leather's peculiar properties as described by Boahin (2005) and (Harader, 2008). In order for users of the leather to produce leather artefacts with an outstanding aesthetic appearance, various techniques such as dyeing, painting, screen printing, polishing, patching of

holes and open cuts, scorching, stamping, appliqué, inlaying, incision, leather fillers, weaving and thonging are adopted in managing defects associated with the locally produced vegetable tanned leathers. In other cases, defects are merged into the design of leather products when possible.

Techniques employed by leather users in managing leather defects are associated with various weaknesses despite their strengths calling for an alternate method. These weaknesses called for the design and construction of a texturing device for managing leather surface defects. The texturing device designed and constructed efficacy for managing leather surface defects was based on Allman (2012-2016), Deines (2014) and Anon (n.d.) assertion that, texture correct surface imperfections by fusing together individual defects and reducing the visual clarity of the defects.

3. Texturing device was good at managing tactile defects and some visual defects than structural defects. Tactile defects which do not break into the grain structure of the leather (grain loosing and wrinkle defects) were completely fused with texturing device imprints with no traces of the defects remaining visible. Tactile defects which break into the grain structure of the leather (cuts, scratches and scars) had the defects intensities reduced by the texturing device imprints. Visual defects such as uneven dyeing were managed by the texturing device whereas mold defects had defects intensities slightly reduced, with stain defects, the texturing device imprints had no influence on them. The texturing device did not also have any influnce on structural defects such as holes and stitched patch defects.

5.4 Recommendation

Considering the importance of good surface appearance to leather users, the researcher recommends the following.

1. Farmers and local leather producers are encourage to adopt proper mechanisms that will reduce defects on vegetable tanned leather surfaces during leather production.
2. Leather users who downgrade and reject locally produced vegetable tanned leather due to their surface defects should instead adopt leather defect managing methods discussed in the study to contribute to the development of the local leather industry.
3. The limitations of the texturing device designed such as the creation of folds on full leather sheets and warble areas of vegetable tanned leathers should be worked on by other researchers for better results.
4. The designing of different top rollers with different textures to test the effect of varying textures for managing locally produced vegetable tanned leather defects by other researchers.
5. A research study to be conducted by other researchers on vegetable tanned leather properties before and after the influence of texturing device to address any change in leather's properties such as tensile strength, resistance to tearing, puncher and flexing.
6. The testing of the texturing device on chrome tanned leather surfaces (varying finishing treatments) to test device's efficacy for other types of leather surfaces apart from the vegetable tanned leather.

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APPENDICE

Appendix A

Interview Guide for Indigenous Leather Users on the Title: Construction of a Texturing Device for Managing Leather Surface Defects

1. Do you make use of vegetable tanned leather?
2. Are they associated with surface defects?
3. What are some of the defects you often come across?
4. Do you dispose such leathers or manage them?
5. How do you manage them?
6. What are the strength of the managing process?
7. What are the weaknesses of the managing process?

Appendix B

Observation checklist for addressing the efficacy of texturing device for vegetable tanned leather and their surface defects.

1. Can texturing device be operated manually and electrically?
2. Do texturing device print textures on leather surfaces?
3. What is the effect of texturing device for an entire leather surface area?
4. What is the effect of Texturing device on the different surface area of vegetable tanned leather such as the shoulder, belly, bends and neck sides which varies in fiber structure?
5. What is the effect of texturing device on the four colours of the locally produced vegetable tanned leather (cream, Red, coffee brown and black leather)?

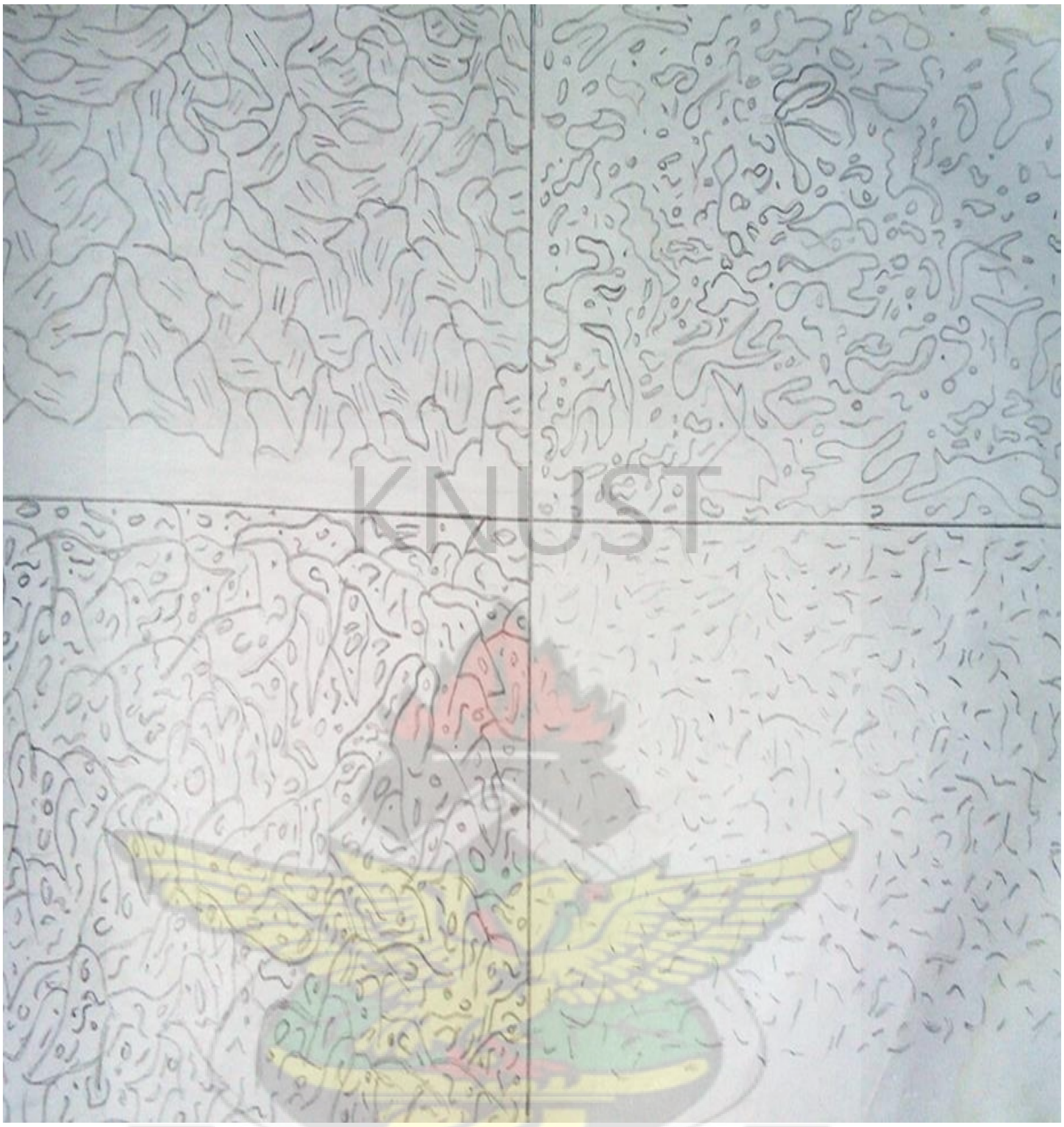
6. Do texturing device have any effect on locally produced vegetable tanned leather surface defects?

Appendix C

Defects outline forms obtained by drawing contour lines around defects using CorelDraw Software. Defects outline elements were employed in the designing of textures for constructing leather surface texturing device.

Appendix D

Textures developed from defects outline elements but were not considered for designing textures for the leather surface texturing device.



Appendix E

BUDGET FOR THE PROJECT

RESOURCE	QUANTITY	DESCRIPTION	UNIT COST (GH¢)	TOTAL COST (GH¢)
Metal steel bars	**2**	**12.7cm by 150cm**	**180.00**	**360.00**
Metal steel plate	**1**	**4ft by 8ft**	**160.00**	**160.00**
Iron scrapes	**3**	**5.08cm by 100cm**	**300.00**	**300.00**
Brass metal	**2**	**7g**	**400.00**	**400.00**
Carbon rubber	**1**	**44cm by 25cm**	**10.00**	**10.00**
Motor	**1**	**3 phase**	**420.00**	**420.00**
Grinding stone	**2**	**12cm by 3cm thickness**	**60.00**	**120.00**
Stone cutter	**6**	**8cm by 0.2cm thickness**	**55.00**	**330.00**
photocopying, printing, binding and data				**500.00**
workshop charges				**400.00**
Transportation				**200.00**

TOTAL COST = GH¢2,910