UNIVERSITY OF EDUCATION, WINNEBA

RECYCLING SOLID WASTE FROM LOCAL LEATHER FOOTWEAR PRODUCTION IN GHANA THROUGH ART

ALBERT KWAME ARTHUR

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RECYCLING SOLID WASTE FROM LOCAL LEATHER FOOTWEAR PRODUCTION IN GHANA THROUGH ART

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DECLARATION

Student's Declaration

I, Albert Kwame Arthur, declare that this thesis, with the exception of quotations and references contained in published works which have all been identified and duly acknowledged, is entirely my own original work, and it has not been submitted, either in part or whole, for another degree elsewhere.

Signature:...

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Supervisors' Declaration

We hereby declare that the preparation and presentation of this work was supervised in accordance with the guidelines for supervision of thesis as laid down by the University of Education, Winneba.

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ABBREVIATIONS

EVA: Ethylene-Vinyl Acetate

FBD: Footwear Buffing Dust

FBO: Footwear Buffing Operator

FP: Footwear Production

HW: Hazardous Waste

LFP: Local Footwear Producer

LO: Leather Offcut

MSW: Municipal Solid Waste

PU: Polyurethane

PVC: Polyvinyl Chloride

RDT: Resource Dependency Theory

RT: Rubbish Theory

ST: Systems Theory

WM: Waste Management

ABSTRACT

Globally, footwear manufacturing is considered a highly polluting industry due to its generation of hazardous solid waste. Nevertheless, there is limited work conducted on footwear related waste in Ghana. The objectives of this study were to investigate the factors that influence the generation of solid waste, the characteristics and the utilisation of solid waste generated by local footwear producers in selected metropolises in Ghana. The study also experimented with recycled art approaches using the solid wastes identified. Qualitative research and practice-led approaches were used for different objectives of the study. Case study and art experimentation designs were employed for the qualitative and practice-led aspect of the work respectively. Data was collected using semi-structured interviews and reflective journaling. Data was analysed through data reduction, data display and conclusion drawing. Findings revealed that footwear patterns influenced leather offcut generation the most. Footwear buffing dust generation was also influenced by sole type and work setting. Leather offcuts in Kumasi had less defects and offered more variety in terms of colour, size, shape, and texture than leather offcuts in Tamale. Reuse of leather offcuts and footwear buffing dust was low among respondents with disposal at landfill preferred. Leather offcuts created varied texture effects in 2D artwork. While footwear buffing dust possessed all the material characteristics necessary for casting, the material worked for modelling with limitations. It is concluded that the generation of leather offcuts and footwear buffing dust depend on footwear related factors; and these materials have characteristic features that offer opportunities for recycled art. Nevertheless, their usage is limited among local footwear producers and footwear buffing operators. Therefore, recycled artists should collaborate with art educational institutions to research into new design for waste approaches.

CHAPTER ONE

INTRODUCTION

1.1 Overview

This chapter presents the background to the study to establish the relevance of the topic. It outlines the problem that the study seeks to address and clarifies the assumptions that frame the analysis of the problem using theoretical frameworks. It also explains the rationale, objectives, research questions, significance, delimitations, and assumptions of the study. Key concepts are defined in this chapter for easy reference moving forward.

1.2 Background to the Study

Generation of waste is inevitable in any human community. According to Pizarro (2017), human activities in prehistoric times involved using materials for domestic activities which led to the generation of waste. Wastes were usually small in quantity (Barles, 2014) and very little effort was put into creating a management system to ensure their safe disposal. Domestic activities led to the generation of different waste types that were biodegradable. Therefore, the approach of allowing nature to absorb back waste generated worked well. Over time, increasing populations led to high quantities of waste that nature could not absorb (Weinberg et al., 2000; Melosi, 2004).

Constant innovation was good for society because it enhanced the way of life of individuals and allowed manufacturing firms to grow, create jobs, and contribute to economic development and poverty alleviation. Nevertheless, the activities of innovators produced even more waste, some of which were toxic, hazardous, and non-biodegradable. Increasing quantities of solid wastes were problematic because they were bulky, could fill large spaces, and had the tendency to pollute air and water bodies if not managed properly. Therefore, governments, industry players, and academics engaged in projects aimed at managing solid waste in different sectors.

On one hand, footwear related waste can be considered hazardous. On the other hand, the footwear production (FP) sector has continued to sustain humans from ancient times to modern civilisation through the provision of important basic needs. Footwear production is a subset of the leather products industry which has catalysed industrial transformations in many countries, especially in the developed world (Asubonteng, 2010). Within the leather products industry, the footwear sector plays an active role (Asubonteng, 2010, Asubonteng, Boahin & Azuah, 2016) by using the most leather and generating the highest revenue globally. Therefore, contributions from the leather products industry to economic development (e.g., the provision of employment) since precolonial times (Morton, 2017) are in part due to the activities of the footwear industry.

In Ghana, footwear producers dominate the leatherwork trade that has existed for centuries (Boahin, 2005, 2008; Atiase, 2016). Although it started in northern Ghana, the vocation has permeated other parts of the country specifically the Ashanti and Greater Accra Regions (Asubonteng, 2010) where leatherwork has served as a source of livelihood for many families. The activities of leatherworkers in Ghana centre on the production of leather using indigenous methods of tanning as well as the production of leather articles such as footwear for aesthetic and functional purposes (Boahin, 2008). Local footwear producers (LFPs) operate as micro enterprises and specialise in the production of shoes, sandals, and slippers using locally tanned and imported leather. From the above, it is important not to underestimate the impact that footwear producers can have on individuals and the economy, especially in developing economies like Ghana. This position suggests that there is a need to balance the negative and positive impacts associated with footwear production to obtain a positive net output.

Waste management has evolved over the years from being an unintentional to an intentional activity due to the increasing generation of hazardous and non-biodegradable waste. The incorporation of waste into art is one of the strategies that has been used for waste management for many years (Akpang, 2013). Aykanat (2014) suggests that waste can serve as raw material for art. Umoru-Oke & Adekanmbi (2018) also argue that visual artists prefer solid wastes such as plastic bags, car tyres, used recharge cards, bottle corks, discarded beverage cans, and electronic waste among others. In a study by Akpang (2013), wastes were also referred to as found objects which were used by African artists. This interaction between waste and art is varied, with art playing a major role in providing a platform on which items once considered valueless can be made useful. It is against this backdrop that investigating the issue of utilisation of solid wastes in the local footwear industry in Ghana, through art, is deemed important and necessary.

1.3 Theoretical Framework

The importance of a theoretical framework in any research process cannot be overemphasised (Grant & Osanloo, 2014). It serves as the foundation that supports all aspects of the study and provides justification for the problem statement, objectives, research questions, and research significance (Grant & Osanloo, 2014). Thus, the researcher's understanding of the topic and how he conducted the study was guided by assumptions made within the selected theories that underpinned the study. This study was underpinned by three theories namely, Systems Theory, Resource Dependence Theory, and Rubbish Theory.

Systems theory framed the entire direction of the study like the elevation drawing of an architect that shows the exterior of a house (Grant & Osanloo, 2014). Propounded by Von Bertalannffy in 1940, system theory assumes the existence of distinct elements, in a "boundary-maintaining entity or process" (Laszlo & Krippner, 1998), that interact with each other in a complex interdependent relationship to form a whole (Lai & Lin, 2017). Bortolete (2015) and Pizarro (2017) argue that waste management is systemic and has several connected elements that need to be considered for positive outcomes.

Waste management in this study was conceptualised as a system comprising functional elements of waste generation, utilisation, and final disposal. Bertalannffy (1972) argued that real systems do not only look within themselves for interconnectedness to understand the whole; rather they assume an open position that allows them to interact with their environment and evolve (Heylighen & Cliff Joslyn, 1992). This assertion mirrors arguments by Pizarro (2017) that the waste management system encompasses people who interact with each other to perform functions like generation, handling, separation, collection and transportation, processing, and disposal of waste. In this study, the researcher expected interactions between waste management systems and elements in the external environment such as infrastructure, know-how, and technology. The waste management system depends on an external environment that makes it easy to access and manage waste as well as absorb outputs from the waste management process (Chikere & Nwoka, 2015).

Suppositions underpinning the Resource Dependency Theory served as a guide to understanding stakeholder engagements as an external element in the waste management system. Resource Dependency Theory can be traced to the work of Pfeffer and Salancik (1978) on the external control of organisations, a resource dependence perspective. The main argument of the Resource Dependency Theory is that organisations need multidimensional resources that are usually not in their possession but rather embedded in the hands of others. This dependence on others serves as a basis for power for those who own the resources needed. Therefore, organisations must position themselves and strategies properly to have continuous access to the needed resources to win in competitive markets; and this task can be achieved through access to information (Pfeffer & Salancik, 1978). This research hypothesised that access to information on organisations that generate footwear-related waste and an understanding of the value of the waste offered could help recycled artists manage their dependence levels.

The Rubbish Theory enabled the researcher to conceptualise how external environmental elements such as know-how on methods and techniques could influence the waste management system. Propounded by Thompson (1979), Rubbish Theory sheds light on how the value of objects are created and destroyed from a cultural and social perspective. According to the theory, objects in society fall within a continuum of differing values and life span. While some objects are considered transient because they possess a value that decreases over time to zero, others increase in value to infinity and are deemed durable. These two categories are not exhaustive. They lead to a third category (called rubbish) where objects linger timelessly, in a state of zero and unchanging value, after they reach the end of their usefulness. The classification of an object as rubbish means that it adopts a covert category that is invisible to the social system. This creates a "region of flexibility" (Thompson, 1979, P: 9) where creative individuals can discover the object and transition it from the rubbish to the durable category. Using the assumptions of Rubbish Theory as a blueprint, this study assumed that until recycled artists get access, solid wastes will continue to be in the covert category of rubbish.

1.4 Topic and Research Problem

Footwear production is one of the highly polluting industries in society due to its generation of solid wastes containing hazardous chemicals to humans and the environment (Kolomaznik et al., 2008; Jiang et al., 2016; Balamurugan et al., 2014). Ferreira (2012) classifies industrial waste from leather goods such as footwear as a class one solid waste type due to its high toxicity. Statistics from the International Trade Centre (2018) shows that Ghana produces about 2,260,600 skins out of which 22,600 are converted into leather per annum. According to Senthil (2014), about 20% to 30% of leather for footwear production become waste. UNIDO (2003) also reports that the largest quantity of this waste is generated at the cutting stages of the footwear production process. Therefore, it is possible that between 4,520 and 7,910 vegetable-tanned leather becomes waste in Ghana yearly. This does not include waste generated from imported natural and synthetic leather.

The arguments above suggest that waste generation is inevitable in any economy where footwear manufacturing takes place. These wastes usually end up on land sites, on roadsides and in water bodies. Therefore, James (2020) in a footwear innovation summit called for experts to investigate strategies for waste minimisation in the footwear production sector arguing that time is running out for stakeholders. Despite calls for proper management of footwear-related waste globally, there is limited work conducted on the topic in the Ghanaian context. Studies on waste management that have been undertaken in Ghana focus on the generation and characterisation of household and municipal solid waste in non-footwear related sectors (Miezah et al., 2014; Oteng Ababio, 2014; Seshie, 2015; Addo & Wahabu, 2019). In some of these studies, reports were made on the generation of footwear that had reached its end-of-life cycle and other household leather items. Additionally, there is limited understanding of current waste management approaches for footwear related waste.

There are a few studies in the literature that look at waste recycling through art using other materials. For example, Yeboah, Asante & Opoku-Asare (2016) experimented with plastic waste in making teaching and learning instructional materials for art education. Opoku-Asare & Yeboah (2013) also showed through practice that pulp fabric waste could be used in making handmade paper for artwork when combined with mulberry fibre. According to the Rubbish Theory, the conversion of waste to non-waste would require creativity and innovation that could be obtained via experimentation with waste. Hence the motivation for this study.

1.5 Rationale and Purpose of the Study

The purpose of this study was to explore how solid waste in the local footwear production industry in Ghana can be recycling through art. The following objectives were pursued:

1. To investigate the factors that influence the generation of solid waste by local footwear producers and footwear buffing operators in selected metropolises in Ghana.

2. To analyse the visual characteristic features of solid waste generated by local footwear producers and footwear buffing operators in selected metropolises in Ghana.
3. To examine the strategies employed in the use and disposal of solid waste generated by local footwear producers and footwear buffing operators in selected metropolises in Ghana.
4. To explore the utilization of leather offcut for two dimensional art techniques.
5. To experiment with footwear buffing dust as an alternative material for sculpting.

1.6 Research Questions

To address the objectives, the research was guided by four main research questions. These were:

1. What are the factors that influence the generation of solid waste by local footwear producers and footwear buffing operators in selected metropolises in Ghana?
2. What are the characteristic features of solid waste generated by local footwear producers and footwear buffing operators in selected metropolises in Ghana?
3. What are the strategies employed in the use and disposal of solid waste generated by local footwear producers and footwear buffing operators in selected metropolises in Ghana?
4. How can leather offcuts be utilised for two dimensional art techniques?
5. How suitable is footwear buffing dust as an alternative material for sculpting?

1.7 Significance of the Study

The researcher believes that based on having used appropriate methodologies, the study will contribute to both academia and practice. Key contributions worth noting include the following:

1. Firstly, the literature review section of the study contributes to knowledge because it serves as one of the few reviews that have pulled together literature on solid waste management in footwear production globally and in Ghana.
2. Secondly, the study validates findings from the literature through empirical work. Findings from the study can serve as reference material for students and researchers on the topic in Ghana.
3. Thirdly, the study is one of the few works that explore how waste in footwear production can be used in recycled art. This brings to the fore insights on opportunities for using the solid waste generated from local Footwear Producers and footwear buffing operators to generate income; an activity that is currently minimal and would be beneficial to art practitioners.
4. Further, art practitioners' ability to put solid waste generated to good use using the insights generated from the study will reduce the negative effects of the waste on the environment and human health.

1.8 Delimitations and assumptions

Considering time constraints for the study, the researcher limited the study to specific boundaries. Firstly, the researcher chose to investigate the topic of solid waste management among local footwear producers and footwear buffing operators because he was curious about the topic and wanted to improve waste management standards while creating employment opportunities for others. The footwear industry uses the most leather and generates the highest revenue; hence it serves as a good study context to achieve the desired goals.

Secondly, although solid waste in footwear production comprised a lot of materials, the researcher chose to focus on leather offcuts and footwear buffing dust. This was because leather featured strongly in the literature as an expensive versatile material that needed to be used efficiently. On the other hand, footwear buffing dust posed greater health risks, in comparison to other waste types in footwear production due to the ease of inhalation.

The researcher assumed that by explaining the anonymity and confidentiality processes of the study to respondents, they would give honest responses that will validate the study. Additionally, the reconnaissance visit conducted at the beginning of the study enabled the appropriate framing of interview questions to be able to get to the heart of the problem investigated. Research objective four focused on experimenting with 2D artwork because of the knowledge gap in the usage of leather for two-dimensional artwork. Using footwear buffing dust as an alternative material for sculpting for objective five was a perfect fit considering the unique properties of this newly discovered material.

1.9 Definition of Terms

Andamento: the laying styles used in constructing a mosaic artwork

Art experimentation: a process of playing with methods, and techniques using leather offcuts or footwear buffing dust to better understand the creative process.

Footwear buffing dust: dust particles obtained from grinding activities carried out on footwear soles.

Footwear buffing dust casting: a process of shaping footwear buffing dust by solidifying a resin-footwear buffing dust mixture in a mould.

Footwear buffing dust modelling: shaping bonded glue-footwear buffing dust composite by pushing, pulling, and pinching.

Footwear buffing dust sculpting: The process of shaping something to create an artwork

Footwear buffing operators: craftsmen involved in the provision of footwear sole grinding services to local footwear producers.

Found Object: a natural or man-made item that an artist keeps due to an inherent interest.

Grout lines: special gaps between leather tesserae that create a network of lines in a leather mosaic work.

Leather: durable, flexible, and non-putrescible material created by the tanning of animal skin or hide.

Leather goods: handbags, luggages and travel goods, attaché cases, and small items such as purses and belts made from leather.

Leather marquetry: a two-dimensional art technique that involves the cutting and pasting of leather offcuts on a support to create a jigsaw puzzle effect.

Leather mosaic: a two-dimensional art technique that involves the cutting and pasting of leather offcuts on a support to form a larger image.

Leather products: artefacts made from natural leather.

Leather tesserae: Small pieces of leather offcuts used in building a composition in a leather mosaic artwork

Leatherette products: artefacts made from synthetic leather.

Leather offcuts: leather pieces that are left behind after cutting patterns for the manufacture of a leather footwear.

Local footwear producers: craftsmen who make footwear using limited automation in their activities.

Recycled art: a creative work that is made from leather offcuts or footwear buffing dust.

Solid waste: materials and substances related to the production process that are considered valueless to its owner.

1.10 Organisation of the Rest of the Study

The rest of the thesis is organised as follows:

Chapter 2: Review of Related Literature – This chapter reviews the relevant literature about the topic. Key issues regarding each of the objectives are addressed.

Chapter 3: Methodology – This chapter outlines the processes used by the researcher to conduct the study. Research designs, sampling, data collection, and data analysis issues are discussed.

Chapter 4: Results / Findings – This chapter presents the outcomes of the research conducted. Tables and figures are used to communicate insights generated. The chapter also conducts a cross-case analysis of findings as well as an analysis of results in comparison to findings from the literature.

Chapter 5: Summary of Findings, Conclusions, and Recommendations – This chapter reports key themes from the study concerning the research objectives. Conclusions are inferred from the key findings and used as a basis to make recommendations for policy making and future research. This chapter also reflects on the implication of the findings for theory.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

2.1 Overview

This chapter reviews related literature on the topic. It describes the footwear production industry and the meaning and types of solid waste in the footwear sector. The chapter also examines the literature on the generation, characterisation, usage, and disposal of solid waste produced in the footwear production industry globally, and in Ghana. The chapter also reviews literature on the techniques for two-dimensional artwork and sculpting.

2.2 History of the Footwear Production Industry Globally

Footwear production has a long history. Swann (2014) suggests that footwear production dates to ancient Egypt in 1450BC. This historical account is slightly different from the account of Uma (2015), who argues that the origins of footwear production can be traced to activities by individuals in the ice age (Uma, 2015). In those days, footwear was made from dried grass and used as wrapping around the leg to protect the foot from harsh weather conditions (Uma, 2015). Over time, footwear evolved into a better sewed together product (what is now the sandal) made from new materials like leather (Uma, 2015). Not until the mid-19 century (1800), both legs of the footwear were designed in the same way. Footwear for the left and right foot were straight and could be worn on any leg until an invention that created distinctions was introduced by a bootmaker from Philadelphia (Veres, 2005).

Swann (2014) suggests that the army in the early days of the history of footwear production served as an important customer group with high demand. Festive occasions increased demand for footwear as British monarchs bought large quantities of footwear for donation to the poor. This led to a situation where demand far exceeded supply and necessitated additional hands to support production. In some cases, soldiers had to join the labour force for footwear production. The limited supply of footwear in those days justified the history of leather and leather products manufacturing in South Africa. Historical wars such as the Boer war, the firs world war and the Second World War facilitated the emergence of footwear production in South Africa as the country supplied vital leather products such as saddler, harness, and boots to the Dutch and the British.

By 1303, international trade for shoes had started as sailors exchanged their footwear for food and water. As far back as 1426, Britain was buying over 2.5 tons of over-shoes from Italy, whiles America witnessed the export of shoes for European settlers in 1503. Spain is also reported to have joined the world trade for shoes in 1508 when they sent 400 pairs of sheepskin shoes to America. Between 1555 and 1594, trading in second-hand shoes emerged with about 4,800,000 used shoes exported, by William Tresover, organ master to the British Queen, to an unknown location (Swann, 2014). By the 17th century, varieties of footwear including boots, shoes, slippers, and over-shoe had surfaced on the footwear market and these from 1699 onwards were sold on a wholesale and retail basis with large shoe retail companies selling a variety of shoes from different makers (Swann, 2014).

The first shoe machine for uppers was introduced in 1855, and by 1858 the first sewing machine for sewing soles was patented. Further, it is reported by Swann (2014) that

America, shortly after its independence in 1780, played a key role in revolutionizing the footwear industry through the introduction of pegged soles and machines that made footwear production easier. Today, the production of footwear has shifted from those who played a key role in its origination with an emphasis on mass production in developing countries. This is due to the decision by pioneers to pursue wholesaling and importing rather than manufacturing (Swann, 2014).

Within the footwear production sector, Asia has been a significant player since the 1980s. (Swann, 2014). China accounts for about 60% of the rubber and plastic footwear produced globally; with their contribution to waterproof and textile footwear reported to represent 46% and 37.5% (Velasquez & Donaldson, 2018). India is also reported to supply a substantial portion of global footwear outputs per year with an annual production of 2.2 billion pairs in 2017 (Velasquez & Donaldson, 2018). O'Connell (2020) also provides statistics that suggest that the top players in the footwear industries globally include China, India, Vietnam, and Indonesia, which produced 13,478, 2,579, 1,300, and 1,271 billion pairs of footwear respectively for the world market in 2018. Outside Asia, Brazil features as a strong participant in the footwear industry, recording production levels of 909 million pairs of footwear in 2017 (Velasquez & Donaldson, 2018) and 944 million pairs in 2018 (O'Connell, 2020). In Europe, Italy dominates the footwear trade, producing about 190 million pairs of footwear in 2017 (Velasquez & Donaldson, 2018) and 184 million pairs in 2018 (O'Connell, 2020).

Regarding leather footwear, China again leads the charts and accounted for 16.3% of total leather shoe exports in 2018; followed by Italy and Vietnam who contribute 14.5% and 12% of total leather shoe exports respectively (Workman, 2020). These statistics suggest that African contribution to the footwear production industry is limited with statistics as far back as 2010, showing that the continent produced only 170 million pairs of footwear per annum (UNIDO, 2010). In contrast, the continent is reported to import large quantities (about 350 million pairs) of cheap and second-hand footwear from China and Europe (UNIDO, 2010). In 2010, Egypt was judged the largest footwear manufacturer in Africa, with a production of 57 million pairs of footwear in 2500 leather factories which were generally small enterprises that engaged artisans (UNIDO, 2010).

Kenya also featured as another top producer, in terms of export volumes, in 2010 recording a production level of 44 million pairs of footwear. In addition, countries like Morocco, Tunisia, and South Africa were considered important in the leather and footwear industry. Unfortunately, there is limited data on current footwear production levels in Africa to enable the researcher to ascertain the extent to which the above-mentioned statistics have changed. Nevertheless, Velasquez and Donaldson (2018) argue that Ethiopia is becoming an important player from Africa in the footwear production industry with a production level of 40 million pairs of footwear in 2017.

2.3 History of the Footwear Production Industry in Ghana

The literature on footwear production in Ghana, and Africa, is limited. Yoruba (2014) opines that the history of footwear in Ghana dates to pre-colonial times when references were made to the shoe in Ashanti chieftaincy ceremonies. Agya Sei (2014, cited in Frimpong, 2015) shows that the 'ahenema', a traditional slipper made from leather uppers and a wooden or leather sole, existed among the Akans as early as the 19th Century. Obuobisa also (1998, cited in Frimpong, 2015) explains that footwear was introduced into Ghana by the Moshie and Fulani tribes through trade with North African countries such as

Sudan who according to Yoruba (2014), had developed sandals as far back as the 19th century.

Agya Sei (2014, cited in Frimpong, 2015) also acknowledges that footwear types in pre-colonial Ghana were limited to the sandal. In the colonial period, Ghana had footwear production factories that contributed to creating the economic viability that made independence possible (British Information Service, 1957). These structures may have catalysed the establishment of the Ghana Industrial Holding Corporation (GIHOC) shortly after independence by Ghana's first president Dr. Kwame Nkrumah in 1960. GIHOC manufactured boots for government security personnel and the public (Myjoyonline, 2014). The organisation produced what became known as the 'Achimota' sandal adopted by secondary schools in Ghana (Gyebi-Agyapong, 2015).

In those days, vegetable-tanned leather, produced locally, was perceived to be of poor quality. Therefore, the 'Achimota' sandal was constructed using imported leather from other countries which made the product expensive (Gyebi-Agyapong, 2015). Nevertheless, demand existed for the product; but this demand could not be met as GIHOC struggled to survive in the 1970s with many failed attempts in the following years to revamp it. In the 1980s, the number of employees at GIHOC declined from 1500 to 140, leading to a complete shutdown in 2002 (Myjoyonline, 2014). The year 2013 saw the resuscitation of GIHOC through a collaboration between the government of Ghana and an organisation from the Czech Republic. In this new partnership, the name of the revived company was changed to the Defence Industry Holding Company (DIHOC); charged primarily to produce footwear for the Ghanaian armed forces and the public.

It is possible that following the collapse of GIHOC, employees who had been trained in the art of shoemaking pursued entrepreneurship in the footwear industry. These entrepreneurs may have benefited from enterprise development initiatives such as the Economic Recovery Program which aimed to encourage small-scale enterprises in sectors like the footwear industry (Sowa, Baah-Nuakoh, Tutu & Osei, 1992). Therefore, the footwear production practices that existed before colonialism continued side by side with western designs as these entrepreneurs practiced their trade. Asubonteng et al. (2016), for example, experimented with innovative designs that sought to make the 'ahenema' lighter. Through their study, they managed to create new models of the 'ahenema' that had high heels, came in a variety of colours, and possessed scratch-free properties that appealed to the youth (Asubonteng et al, 2016). Today, various footwear types including shoes, sandals, and slippers for adults and children can be found on the Ghanaian market.

Local footwear producers in Ghana use leather primarily, but they also combine it with other materials such as textiles and rubber. While footwear manufacturers in Tamale use more vegetable tanned leather, manufacturers in Kumasi work with imported chrome tanned and leatherette. Although Local Footwear Producers are scattered all over the country, numerous footwear clusters exist in Kumasi. Thus, news reports by BFT Online (2017) indicate that the Ashanti region has become the hub of shoemaking in Ghana. The operations of local footwear producers in the country vary across regions. In Kumasi, local footwear producers operate as micro enterprises and specialise in specific footwear types (e.g., slippers, sandals, shoes) for specific target groups (i.e., male, female, unisex, and children). According to Gyempeh (2016), the footwear sector in Kumasi can be grouped into clusters with a population of about 412 micro-entrepreneurs whose products are targeted primarily to households and clients within the commercial sectors.

Reconnaissance visits to local footwear markets in Kumasi and Tamale indicated that very few manufacturers specialize in the production of ladies' shoes, with slippers and sandal production dominating. Further, it was observed during this visit that the use of machinery in the activities of local footwear producers was limited. Nevertheless, service providers that offered access to buffing machinery for a fee were beginning to emerge, so some footwear producers outsourced part of their activities. Footwear producers in Tamale were also found to work at home with only a few located at the marketplace. It was easy to spot father, son, brothers, and cousins sitting on one compound producing footwear.

2.4 Footwear Concepts

The section reviews literature on footwear concepts that help the researcher understand the context within which the study was conducted. The types and parts of, as well as the materials and processes for footwear production are discussed.

2.4.1 *Types of footwear*

Footwear can be classified based on the following; design, target, characteristic features, materials, and purpose (Table 1 on page 21). Footwear is classified by design based on parts of the foot covered by the footwear (e.g., boots, shoes, etc. (Italian Trade Commission, 2010; Khan, 2015; Frimpong, 2015). While boots cover the whole foot and extend to the lower leg, shoes cover the foot below the ankle (Frimpong, 2015). Over the years, the purpose of the shoe has shifted from protection to aesthetics and functionality;

and this has led to the proliferation of new shoe types based not only on parts of the foot covered but also on how the footwear is constructed (Di Roma, 2017).

Shoe types include sandal, peep-toe, mule, slingback, slippers, oxford, and derby, among others. For example, sandals are usually open-toed (Figure 2 and Figure 3 on page 22) while the slippers are designed such that they can be taken off and worn easily (Choklat, 2012).

Table 1: Classification of Footwear

Design	Target	Features	Materials	Purpose
Boots	Men's footwear	Flats	Clog	Sports footwear
Shoes	Women's footwear	Low heel footwear	Leather footwear	Leisure footwear
- Sandal	Unisex footwear	High heel footwear	Rubber footwear	Casual footwear
- Peep-toe	Children's footwear		Fabric footwear	Indoor footwear
- Mule	Infant footwear			Safety footwear
- Sling back				Ballet footwear
- Slippers				Dress footwear
- Oxford				Cold weather footwear
- Derby				Diabetic patient footwear
- Monk				
- Moccasin				

Source: Italian Trade Commission, 2010; Khan, 2015; Frimpong, 2015; Choklat, 2012; UNIDO, 2000; Tagang, 2014; Di Roma, 2017

Figure 1: Footwear types for women

Source: PopOptiq.com, cited in Jericho (2019)

Figure 2: Footwear types for men

Source: Quora.com, cited in Jericho (2019)

Classification of footwear based on target includes men's, women's, children's, infants', and unisex footwear. The broad types of footwear above can further be categorised in terms of characteristic features such as flats, low, or high heels (Frimpong, 2015). Frimpong (2015) suggests that shoe types can be classified based on materials used by giving the example of wooden soles as a footwear type called clogs. The categorisation of footwear based on purpose is found in the literature (UNIDO, 2000; Khan, 2015) to comprise an endless list of footwear types including sports, leisure, casual, indoor, safety, protective, ballet, dress, specialist cold weather, and diabetic patient footwear, among others. These categorisations are considered important due to the implications they have for construction. It is the footwear producer's responsibility to ensure that the right design and materials are used to make the footwear fit for purpose. Therefore, there is the need, for example, for the footwear manufacturer to ensure that cold-weather footwear is designed to cover a large part of the leg using material that is thick enough to keep the foot warm and protect the wearer from harsh weather conditions. In contrast, footwear designed for those suffering from diabetes foot problems would require the use of materials that are thin and soft to reduce pressure on the foot (Tagang, 2014).

2.4.2 *Parts of the footwear*

Footwear construction involves the assemblage of different parts (Onyancha, Magut & Mesa, 2019). According to Asubonteng et al. (2010) and Tagang (2014), footwear parts can be grouped into two parts: the uppers and the sole. Rossi (2000) suggests that the uppers and sole can be divided further into toe cap, vamp, quarter, insole, and outsole, among others (Figure 4 on page 24).

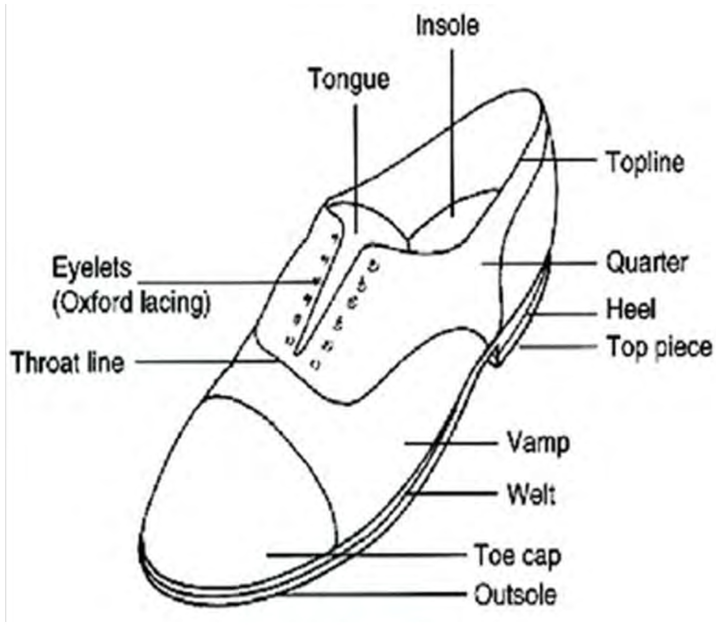


Figure 3: Parts of standard footwear
Source: Rossi, 2000

Maksudova, Ilkhamova, Mirzayev and Pazilova (2017) suggest that footwear comprises an upper layer and an inner lining. Choklat (2012) argues that the most important components that make up the basic structure of the shoe are the upper, lining, toe box, heel counter, sock lining, shank, insole, outsole, and heel. The upper represents the portion of the footwear that covers the foot (Onyancha, et al., 2019). It falls above the sole and comprises patterns that are sewn together (Choklat, 2012). The lining supports the inner part of the upper covers, the rough seams of the footwear, and offers comfort by providing a covering for any reinforcements used (Tagang, 2014). The toe box represents the front part of the footwear that holds the toes while the heel counter shapes the heel cap area to keep the foot in place (Choklat, 2012).

The insole supports the upper and keeps the bottom of the footwear firm. This part is usually covered with a sock lining that gives additional support to the foot bed for the wearer's comfort (Choklat, 2012). The insole also serves as a good finishing surface for labelling (Choklat, 2012). The shank connects the heel to the ball of the foot, and the outsole represents the part of the footwear below the upper that touches the ground. The sole is the first part of the footwear that comes underneath the foot in a shoe after lining (Tagang, 2014). It needs to be strong to withstand pressure from stitching or adhesive tacks that are used in the process of lasting, so it is usually supported with a hard material under the foot called the heel (Choklat, 2012). Promjuna, Nopadon and Sahachaisaeree (2012) explain that the shoe can also have another part called the midsole which provides impact, strength, and posture balance to the wearer while the outsole ensures a good grip between the footwear and the ground.

Considering the footwear types described above, it can be argued that parts of the standard footwear can change. For example, for a sandal that has an open toe, the toe box would not exist. Thus, Asubonteng et al. (2016) propose slightly different parts for the 'ahenema', namely an upper made of a strip of leather and a nose (that is the decorative piece that supports the joint of the stitched together upper). Depending on the type of shoe, the upper could be divided into smaller parts such as vamp, quarter, facing, and counter uppers with corresponding linings (Choklat, 2012). Therefore, while the upper for oxford and derby shoes are likely to comprise vamp and counter uppers that are stitched together, the moccasin design makes room only for the vamp upper.

2.4.3 *Materials for footwear production*

Different parts of the footwear are made of different materials (Onyancha et al., 2019). Throughout history, several materials have been tried to produce footwear to understand their suitability (i.e., the ability to exhibit wear properties). Availability is also considered an important factor in choosing materials for footwear manufacture. According to Almomani et al. (2016), using the right material for different parts of the footwear is important to reduce foot problems for the wearer. To this end, natural and synthetic materials including textiles, rubber, glass, wood, brass, leather, iron, and synthetic polymers have been tested to understand their suitability for constructing footwear (Frimpong, 2015; Tagang, 2014; Maksudova, Ilkhamova, Mirzayev & Pazilova, 2017). Results indicate that leather, textiles, and rubber are suitable materials.

Jericho (2019) highlights materials such as wool, canvas, polyester, nylon, and linen as possible fabrics for footwear uppers construction. Yu, Wang and Ru (2015) also explain that rubber is usually used as a material to produce uppers for rain boots that come in different designs and colours on the market. Nevertheless, they argue that there are limitations to using rubber for uppers construction due to its characteristic of poor air permeability (Yu et al., 2015) They suggest that continuous use of rubber in footwear upper production will require creativity and innovation that addresses the problem of poor breathability (Yu et al., 2015). Therefore, Larcombe (1975, cited in Tagang, 2014) confirms that materials such as leather and fabric (woven, non-woven, and knitted) possess the needed properties for shoe uppers production. However, Jericho (2019) cautions that rubber shoes may be useful for those who want greater flexibility.

Leather is considered a more suitable material to produce footwear (Tagang, 2014) due to its characteristic features of elasticity and plasticity (Tyrell & Carter, 2009). Nonetheless, leather is expensive; hence the use of synthetic polymers that mimic the properties of natural leather (Covington & Wise, 2019). Using the right material and design is especially important for diabetic patients who need comforts to aid their healing (Tagang, 2014). Therefore, for diabetics, leather is also considered the most suitable material, since it can give the needed protection from injury and is easy to work with (Vass, 2006 cited in Tagang, 2014). For athletes, materials such as mesh, natural and synthetic leather in making are deemed suitable for the construction of the footwear uppers (Promjuna et al, 2012).

Although plastic did not feature as a preferred material for uppers production, a review of the literature mentions its dominance as a material for footwear lining, insole, and outsole. Maksudova et al. (2017) also argue that fabric and leather are equally good materials that can provide the needed support. According to Khan (2015), leather has recently become one of the most useful materials for lining shoes with vegetable-tanned leathers that are light, a popular choice. Leber and Evanski (1986) also identify materials such as felt, leather, foam, and synthetic polymers such as polyethylene, neoprene, and nylon as suitable materials for insoles. Their assertions are supported by more recent studies (Tagang, 2014; Almomani & Qudah, 2016; Güner, Alsancak, Altinkaynak, Guven, Ozgun & Aytekin, 2018) that emphasise the suitability of natural and synthetic rubber for insoles.

Lo, Wong, Yick, Ng and Yip (2016) suggest that fabric serves as a good option for insole construction with advantages like availability, versatility, and cost-effectiveness. In all the above studies, emphasis is placed on the need to use materials that reduce plantar pressure. Therefore, Lo et al. (2016) suggest that when the fabric is used for insoles, it should be combined with a soft cushioning material to improve comfort. Tagang (2014) also explains that the design of the insole is important in ensuring the desired effect of the footwear on the wearer's plantar; suggesting that curved insoles provide more support than flat insoles.

According to Shimazaki and Aisak (2018), materials used for making the outsole of shoes must be selected properly since they can impact the amount of heat generated which affects the wearer's comfort. In literature (Promjuna et al., 2012; Lin & Jiang, 2018; Onyancha et al., 2019), appropriate materials include leather and polymer which includes natural rubber and synthetic materials such as polyurethane (PU), ethylene-vinyl acetate (EVA), polymerizing vinyl chloride (PVC), Phylon, and Duralon. Promjuna et al. (2012) explain that for midsoles, PU, Phylon, and EVA are preferred while natural rubber (carbon or solid) and Duralon are favoured for outsoles due to their properties. Lin and Jiang (2018) also emphasise that soft rubber soles are good for sports shoes because they improve stretch capacity and prevent injuries from movement. Similarly, Etefa (2019) in a study that focused on artisans in a rural community in Ethiopia, showed that footwear soles can be made from tires that comprise natural rubber or synthetic polymers. From the above discussion, leather, and polymers (both natural and synthetic) constitute the materials used for major parts of leather footwear.

2.4.3.1 Leather as material for footwear production

The definition of leather depends on the source of raw material and the manufacturing method (Sharphouse, 1995). The raw material for leather is pelt which is obtained from animals (Asubonteng, 2010). Pelt is a generic name for kip, skin, and hide which represent the outer covering or different animals. While kip refers to the outer covering of very small animals such as reptiles, the skin comes from small animals like goats and sheep, and hide is derived from large animals such as cows and buffalos. Pelt can be described as an inexhaustible renewable natural resource that has served and will continue to serve, mankind in diverse ways (Lawson 1990). Nevertheless, because it is organic, pelt has the potential to decay over time; hence the need to apply chemicals that can help to preserve it (Asubonteng, 2010).

Covington and Wise (2019) explain that leather is the outer covering of animals that goes through a chemical process to make them non-putrescible and able to withstand contamination. Similarly, Mann and McMillan (2017) suggest that leather is a pelt that has undergone some treatment through a process of tanning to retain key characteristics such as malleability and durability. Tanning involves the application of scientific processes to pelt to convert them into materials with stabilized proteins (Asubonteng, 2010). This process was discovered in the pre-historic era where individuals realized that by soaking pelt in water infused with tree barks, they could make it less susceptible to decomposition, extend its lifespan, and keep it soft over a long time (Mann & McMillan 2017). In those days, tree bark served as a natural material for permanently modifying the protein structures of the pelt. Therefore, Adom (2015) explains that the term tanning came from an old Latin and German word for oak or fir trees, which provided an acidic chemical compound called Tannum and Tannenbaum, respectively.

Today, research has led to alternatives. The World Bank Group (2007) highlight that tanneries can now choose tanning agents obtained from different sources namely chromium, aluminium, zirconium, iron, titanium, vegetable, aldehyde, and synthetic resins. These tanning agents are like those mentioned by Maina, Ollengo and Nthiga (2019) who also add oil as another substance for tanning specific leathers. Further, Adom (2015) adds that tanning can be done using two or more combinations of the above-mentioned tanning agents. Broadly, tanning agents can be grouped under organic or mineral with vegetable and aldehyde and synthetic resins tanning considered organic (World Bank Group, 2007).

Before tanning, the pelt goes through a preparatory phase, where it is subjected to processes of unhairing, liming, deliming, bating, and pickling (Mann & McMillan, 2017). Adom (2015) and Maina et al. (2019) suggest that preparation for tanning starts at the point of slaughtering (where the animal is killed, and the pelt peeled off). Kabutey (2013) also clarifies that the process of removing pelt from the body of the animal is technically referred to as flaying. Further, Asubonteng (2010) adds curing as an important stage in the pre-tanning process. This involves salting and drying to dehydrate the pelt and prevent it from decay and fungi attack. Following, practices such as soaking, liming, unhairing, fleshing, bating, and pickling are carried out (Adom, 2015; Asubonteng, 2010; Kabutey, 2013; Maina et al., 2019). Soaking and liming involve immersing pelt in water infused with chemical wetting agents or lime and enzyme materials, respectively.

While the soaking is to help restore the moisture content lost during curing, liming helps to loosen the hair fats and further disinfect the pelt to prevent insect and fungi attacks. Unhairing involves removing hair from the grain surface of the pelt to make the surface smooth. Fleshing also has to do with the removal of excess fat, flesh, and muscles on the flesh side of the pelt while bating removes all residues and chemical substances applied to the pelt. In addition, pickling involves immersing the pelt in a solution of sulphuric acid and salt to improve absorption of the chemical used during tanning. After tanning, leather further goes through finishing processes such as crusting, coating, fat liquoring, neutralization, and dyeing among others that help to protect the grain surface, make it wear-resistant, uniformly levelled, and give it an attractive look (Adom, 2015; Asubonteng, 2010; Kabutey, 2013; Maina et al., 2019). This post tanning process leads to finished leather that the leatherworker can use to produce leather products such as footwear.

Generally, it can be argued that leather is the material of choice for footwear production (Kráľ, Schmėl & Buljan, 2014). Bitlisli, Kucukaki and Zengin (2013) argue that it functions well when used for footwear uppers, linings, and in-soles. It creates a condition of porosity in a way that allows for easy absorption, the transmission of moisture, and good ventilation (Vass, 2006, cited in Tagang, 2014). Covington and Wise (2019) suggest that leather is the most suitable material for footwear due to its potential to provide comfort at any time and offer a wide range of options in terms of finishing colour and texture. Further, leather, in comparison to other materials, offers more comfort for the human foot due to its characteristics of flexibility, breathability, elasticity, durability, and insulation ability.

Despite these features that generally make leather a material of choice for footwear production, only specific leather types are more suitable for footwear production. According to Asubonteng (2010), the characteristic features of leather can vary based on the raw material used, its quality, and the tanning process applied; and this influences its suitability for specific uses. Therefore, Covington and Wise (2019) argue that different types of leather should be used for different types of footwear. For example, chrome tanned leather is usually better for shoe uppers while vegetable-tanned leather serves well as the insole (O'Flaherty, 1978). Likewise, calfskin tanned using vegetable-tanned methods is an ideal material for lining footwear due to its soft and elastic nature (Vass, 2006 cited in Tagang, 2014). These features allow for the natural breathing of the foot making it possible for air and moisture to penetrate to the foot easily.

2.4.3.2 Polymers as material for footwear production

Polymer refers to a substance of high molecular mass resulting from the amalgamation of many small molecules called monomers in a regular manner. It derives from the Greek words 'poly' meaning many and 'mers' denoting parts or units (Gowariker, Viswanathan & Shreedhar, 2005). There are three types of polymers: natural, semi-synthetic, and synthetic. Natural polymer (e.g., rubber) comes from natural resources like plants; they can be chemically modified to create semi-synthetic polymers such as hydrogenated natural rubber (National Research Council, 1994; Chanda, 2006). A synthetic polymer is produced chemically in scientific laboratories (National Research Council, 1994; Chanda, 2006). The classification above is based on the origin; and Chanda (2006) suggests other categorisations based on the thermal response, mode of formation, line structure, application and physical properties, tacticity, crystallinity, polarity, and chain.

The thermoplastic polymer is softened when exposed to heat without changing its properties while thermosetting polymers undergo chemical changes when heat is applied (Groover, 2002). Further, polymers can be formed either by the quick and successive addition of monomer molecules in a chain fashion or through a reaction of monomer molecules that belong to different functional groups to form a chemical bond (Groover, 2002). The polymer can be linear, branched, or cross-linked; and can possess different physical properties that make it useful for different things (Groover, 2002). To this end, Kumar (2015) suggests that polymers that belong to the rubber (elastomer) category have a lower tensile strength in comparison to plastic; and fibre has an even higher tensile strength when compared to plastics.

In addition, Groover (2002) and Kumar (2015) explain that plastic can be moulded with or without heat. Royal and Pillai (2017) argues that polymers used in footwear production include ethylene-vinyl acetate, polybutadiene, and natural rubber, all of which fall within the thermoplastic and elastomer categories. These polymers are generally used in making the insole and outsole of specific footwear types such as flip flops and Hawaii chappals (Pillai, 2017). According to Royal and Pillai (2017), ethylene-vinyl acetate serves as a good and common material for sports shoes production due to its cushioning ability. Nevertheless, its ability to withstand tear and wear is limited.

Polybutadiene rubber is described to have high elasticity which makes it able to withstand stress and product durability; hence it is a good material for footwear construction (Royal & Pillai, 2017). Galloway also mentions that polyurethane is a good material for sports shoes because it has features like abrasion and slips resistance. Similarly, Gnanasundaram et al. (2015) explain that PU composite is a suitable material for footwear soling due to its strong tensile property, robustness, and versatility. Roh, Oh and Kim (2013) suggest that polyurethane is used to produce not only footwear sole but also synthetic leather as polyurethane resins are used to coat woven fabrics of synthetic fibres. Synthetic leathers are thinner than soling materials and can be used in the production of uppers for various footwear types.

Ponsubbiah and Gupta (2019) combined waste from polymers such as nitryl rubber, styrene, butadiene rubber, and isoprene rubber with waste from chrome-tanned leather to create soling material for footwear. They concluded that the polymers work together in creating a material that was flexible but strong (Ponsubbiah & Gupta, 2019). Hanhi, Poikelispaa and Tirila (2007) highlight the use of several elastomers and rubber types with varying characteristics could be useful in footwear construction. Nevertheless, in another study, Hanhi et al. (2007) highlight that although rubber, polyurethane, and polyvinyl chloride compound dominate in modern shoe soles construction, thermoplastic rubber seemed better than polyurethane and polyvinyl chloride polymers which had poor durability. To this end, Pervaia, Andreyeva and Maistrenko (2019) argued that when compared with synthetic polymers, natural polymers offer better quality and ergonomically friendly products.

2.4.4 *The footwear Production (FP) process*

Footwear manufacturing can fall under three categories. The first category is the traditional manufacturing process which involves the production of footwear parts by hand using basic tools (Dedeoglu, n.d.) like scissors, a lasting pincer, shoe hammer, and lacing thread cutter. On the other hand, semi-mechanized manufacturing combines handheld tools and machinery, while fully mechanised manufacturing employs machines at every stage of the production process.

The traditional footwear manufacturing process starts with preparing the footwear design and using this to create a stamp that guides the next stage activity of cutting (Dedeoglu, n.d.). Instead of stamping, the design could also be traced on the leather to guide cutting. At the cutting stage, footwear parts (e.g., upper, insole, and lining) are cut in line with the prepared model and assembled. The assembled upper is stretched on a mould (also called the last) and fitted with nails. The sole and the upper are then assembled and branding details are indicated inside the footwear. Trimming of rough edges then takes place; followed by the straightening, cleaning, and polishing of heels, soles, and sides. According to Zerobnick and Woodward (2002), finishing includes a sanding process that smoothens the surface of the footwear sole. Further, the footwear is checked for defects during the quality control stage and passed on to retailers for sale.

Bangayan et al. (2016) opine that although there are differences in footwear design, the process of footwear production remains the same with activities such as upper making, sewing, lasting, sole attaching, and finishing common. Nevertheless, it appears that the sequence in which production activities occur can vary based on the footwear model. In addition, there are differences in the extent to which the various footwear manufacturing activities dominate, depending on footwear type. To this end, Herva et al. (2011, cited in Tagang, 2014) categorize footwear production processes into three broad stages. The first stage involves the design, cutting, and sewing. The second stage which is referred to as the mechanical stage is made up of moulding, trimming, gluing, and thermal treatment, while the third stage comprises activities like fixing of accessories, cleaning and polishing, visual control, and packing.

Pattern making and prototyping is crucial in the footwear construction process. Pattern making involves the process of converting three-dimensional design into a template that can be used to guide cutting. This definition suggests that patterns are developed after the final design idea has been selected; and require creativity and a clear methodology (UNIDO, 1985). In addition, pattern making calls for well-developed drawing and cutting skills that enable the footwear manufacturer to create net patterns (without allowance), cutting patterns (that make room for sewing and folding allowance), and tracing or working patterns (UNIDO, 1985). The inexperience of the footwear manufacturer in drawing and cutting could lead to excesses in sewing and folding allowances. In addition, inaccuracies in pattern sizes could make the pattern too small and subsequently contribute to waste.

These guidelines in pattern making apply not only to the uppers of the footwear but also to the insole, lining, and outsole (UNIDO, 1985).

2.5 Defining Solid Wastes in Local Footwear Production

UNIDO (2000: 5) defines waste in the leather products industry as "any substance or object that the holder discards, intends to discard or is required to discard". It includes leather products that are out of date, products for which the holder has no use, and residues from industrial processes (UNIDO, 2000). This definition is like the definition of waste adopted by the UK in the 1990s, which emphasised one's intention to discard or the actual discarding of items and substances (Department for Environment, Food and Rural Affairs, 2012). Barles (2014) also argues that while some definitions emphasise usefulness in their quest to understand waste, others focus on its nature (where waste is sometimes seen as something with negative characteristics such as horrible and dirty) or on its constituents. Despite these definitions, there have been concerns about the need to clarify what is or is not waste following legal battles in the UK (Department for Environment, Food and Rural Affairs, 2012). In 2006, amendments to the definition of waste in the UK led to the introduction of new directives that suggest that waste can cease to be waste and become a secondary raw material (Department for Environment, Food and Rural Affairs, 2012). Here, importance is placed not only on the "discard test" but also on the "potential for recovery test" with the introduction of concepts like the end-of-waste criteria which is well established in the ferrous metal and glass industries.

Within the waste framework directive suggested by the UK government, things that are disposed of, things that come from production residue, things that are considered to have low economic value, and things that contain hazardous substances constitute waste

(Department for Environment, Food and Rural Affairs, 2012). In contrast, things that are by-products and are still suitable for use so can be passed on to others as second-hand have the likelihood of becoming non-waste (Department for Environment, Food and Rural Affairs, 2012). For this study, the researcher defines waste as materials and substances, related to the production process that is considered valueless to its owner.

2.6 Types of Solid Wastes in Footwear Production

Solid waste can be categorised under Municipal solid waste (MSW), and Hazardous waste (HW), among others (Lohchab, 2018). Municipal solid waste comprises waste (e.g., kitchen waste, paper, cardboard, metal cans and tins, clothing, and plastics) generated from daily routines among households, commercial establishments, and institutions in communities (Lohchab, 2018). Hazardous waste refers to waste that is toxic, infectious, can explode, can react when exposed to water, air, and heat, and can destroy living organisms (Lohchab, 2018). According to Sida (2017), hazardous wastes are generated by manufacturing companies such as tanneries, textile, and paper mill firms as well as organisations in the extractive industry that use pollutants and heavy metals. Other researchers (UNIDO, 2000; Senthil et al., 2014; Kiliç, Puig & Fullana, 2017; Teklay et al., 2018b) also show that the footwear sector is a major contributor to hazardous waste globally. However, footwear manufacturers play an important role in society.

Classification of solid waste types in footwear manufacturing depends on the source of the waste generated. Waste types mentioned in the literature (UNIDO, 2000; Department for Environment, Food and Rural Affairs, 2012) relate to the stage of the production process from which the waste is generated. Waste types include offcuts, dust and sludge particles, discarded products, and discarded footwear accessories. Offcuts are generated during the cutting stage of the footwear production process. They are the excess pieces of materials obtained after cutting patterns that come in varied sizes. Pringle et al. (2016) show that offcuts can be very tiny in which case they are referred to as trimmings. Dust and sludge particles emerge from the buffing or sanding stage of the footwear production process. Senthil et al. (2014) explain that buffing dust is usually associated with soles that require smoothening as part of the leather products manufacturing process.

Discarded products comprise footwear that has reached its end of life (Department for Environment, Food and Rural Affairs, 2012) or prototype samples that are not needed (Pringle, Barwood & Rahimifard, 2016). Discarded footwear accessories also include laces, eyelets, D-rings, threads, fasteners, shanks, and fillers as well as waste from machine maintenance (e.g., metallic spare parts) (UNIDO, 2000). All these waste types can be made of different materials such as leather, textiles, and rubber. Therefore, footwear-related waste can be further classified based on material type as leather offcuts, fabric trimmings, leather dust, polymer offcuts, and polymer buffing dust, among others. This study focuses on leather offcuts and footwear buffing dust generated in the footwear manufacturing process. This is because, leather is an expensive material that should be maximized in terms of usage (Asubonteng, 2010), and footwear buffing dust poses high health risks due to the ease of inhalation (WHO, 2012).

2.7 Generation of Leather Offcuts and Footwear Buffing Dust

Literature on the volume of waste generated in footwear production is limited. Studies (e.g., UNIDO, 2000; Senthil et al., 2014) on the topic have focused on waste generated per sheet of leather used in the production process rather than an estimation of waste volumes nationally or globally. UNIDO (2000) reports that leather, when used in footwear production, generates more waste in comparison to other materials such as textiles with waste generated constituting 25% to 35% of leather used. Similarly, Senthil et al. (2014) stated that footwear and leather goods production in India yielded waste that fell between 20% – 30% of leather used. These reports suggest that solid leather waste in footwear constitutes 20% to 35% of leather used in each economy with the largest quantity of waste generated at the cutting stage of the manufacturing process (UNIDO, 2000).

UNIDO (2000) explains that the volume of waste generated in footwear production can vary depending on several factors such as the cutting and assembling technology employed, type of footwear (UNIDO, 2000), quality, type and size of material used, size of the footwear and skill of the manufacturer (Teklay et al., 2018b). Automation of manufacturing processes such as cutting is reported to reduce waste generated by 2 to 3 points (UNIDO, 2000). Similarly, UNIDO (2000) finds that stitching generates less waste in comparison to other methods such as injection moulding. Waste generation in footwear manufacturing is also reported to be higher for safety shoes followed by women's, men's, and children's shoes (UNIDO, 2000). While waste generated for a million pairs of safety shoes totalled 520 tons, waste from men, women and children's shoes stood at 233, 242, and 152 tons respectively (UNIDO, 2000). These wastes comprised mostly leather uppers and lining material. Figures recorded by UNIDO (2000) indicated higher quantities of waste from men's shoes (totalling 96.2 tons) in comparison to waste from women's shoes (totaling 70.6 tons).

Regarding footwear buffing dust, literature on the topic is limited. A study by Sekaran et al. (1998) was the only relevant research found in academic and grey literature on footwear buffing dust generation. Even so, their study focused on buffing dust from leather tanning rather than leather production reporting a total of 2kg to 6kg of buffing dust generated for each ton of hide and skin processed (Sekaran et al., 1998). Teklay et al. (2018b) argues that solid wastes are usually higher during tanning in comparison to the leather products manufacturing stage. Therefore, it could be argued that the buffing dust quantities in footwear manufacturing may be lower than the above-mentioned estimates.

2.8 Characterisation of Leather Offcuts and Footwear Buffing Dust

Some studies (Gawaikar & Deshpande, 2006; Ozgunay, Colak, Mutlu & Akyuz, 2007) have tried to characterise leather offcuts and footwear buffing dust by focusing on their chemical and mechanical properties. Although this is good, it ignores other basic characteristics (e.g., quality, size, shape, colour, and type) that are relevant for recycled art (Ashton, 2018). In addition to the above characteristics, thickness is also another important characteristic that determines the suitability of leather for various items (Tagang, 2014) Characterising leather offcuts and footwear buffing dust in this way helps to understand their value for reuse in art.

2.8.1 *Characterising leather offcuts by quality*

The quality of leather cannot be over-emphasised in the manufacturing of leather products and this statement is true for leather offcuts if we are to make them useful. According to Adu-Asabre, (2011), it is difficult to create a universal standard for determining leather quality; nevertheless, the quality of leather should be based on physical properties and visual appearance. Therefore, researchers (Asubonteng, 2010; Adu-Asabre, 2011) have indicated that the quality of leather depends on the number of defects that come about ante mortem and post-mortem. Defects are due to poor practices in livestock management, slaughtering, flaying, preserving, and processing of skins and hides (Asubonteng, 2010, Adu Asabre, 2011).

Oyda and Mandado (2019) argues that parasitic, viral, bacterial, fungal diseases, and mechanical damages lead to defects such as scratches, wrinkles, flay cuts, rub marks, and growth marks that affect the aesthetic appearance of leather. Similarly, the International Organization for Standardization (ISO 2828) highlight that brand marks, pox marks, cutthroat, badly bled skin, discoloration, the existence of holes, and sun blisters constitute defects that decrease the value of leather. Adu-Asabre (2011) explains that quality leather should use adequate tannin and have a surface appearance that is free of fungi attack, bright, smooth, spotless, thick, and big. It is inferred that the characteristic features mentioned above that help to assess the quality of leather would apply also to leather offcuts.

2.8.2 *Characterising leather offcuts by shape*

In footwear production, patterns play a key role in designing the uppers and other parts of the footwear such as the lining, insole, heel, and sole (Choklat, 2012). Patterns are important because they serve as a guide to getting the actual size and shapes needed for producing the footwear (Choklat, 2012). Footwear uppers consist of different patterns that are sewed together in different ways depending on the type of footwear produced. Sample drawings presented by Choklat (2012) show that patterns are predominantly irregular-shaped polygons with a few semi-circular and rectangular-shaped designs. This mirrors arguments by Promjuna et al. (2012) who suggested that curved and semi-curved shapes are used predominantly for cushion trainers.

3D images of designed uppers in a study by Di Roma (2017) showed that leather offcuts from footwear could come in shapes of circles, ellipses, triangles, and irregularly shaped polygons. Besides, their study showed that shapes like rectangles and squares were not common (Di Roma, 2017). Despite this, it seems that the shape of leather offcuts generated will depend on the shape of the patterns used. Hence leather offcuts derived from footwear production may include more irregular shaped polygons, curved, and semi-curved edges.

2.8.3 *Characterising leather offcuts by size*

Vincent, Bruijn, Wijskamp, Rasheed, van Drongelen and Akkerman (2019) categorised offcuts from thermoplastic composites in footwear manufacturing into small, medium, and large. They explained that while small offcuts had widths and lengths less than or equal to 60mm and 150mm respectively, medium-sized offcuts had widths of between 60mm and 160mm and lengths of between 150mm and 420mm. Further, large offcuts in their sample had widths of between 160mm and 260mm with lengths of between 420mm and 760mm. In contrast, Di Roma (2017) showed that leather offcuts can be very small, sometimes centimeter-sized pieces. These dimensions indicate the possibility of variation in leather offcuts in terms of size. However, it appears that footwear manufacturers may only consider waste, leather offcuts that are very small in size.

Choklat (2012) explains that footwear parts, such as the uppers, are either cut from sheets of leather or bought in an already made form that requires only stitching and no cutting. When cutting from sheets, there is a need for the sheets to be large enough to accommodate the size of the pattern. Thus, there is the tendency that if offcuts are large enough for manufacturers to cut out footwear patterns, they may not consider them valueless. To this end, it could be inferred that leather offcuts are likely to be small. Nonetheless, Choklat (2012) argues that pattern cutting is a skill that requires years of experience to master. Therefore, medium-sized offcuts may be considered by inexperienced producers as too small and be discarded.

Perhaps, size should not be an issue of concern as Vincent et al. (2019) argue that size reduction is an important step in recycling. This is due to its role in facilitating the processing of offcuts for remanufacturing (Vincent, et al., 2019). Most recyclers try to shred offcuts into centimeter-sized flakes as part of the recycling process (Vincent, et al., 2019). Hanhi et al. (2007) suggest that in some cases, size reduction of offcuts is done through processes of grinding that lead to a finer and smoother texture.

2.8.4 *Characterising leather offcuts by type*

Adom (2015) argues that leather types influence their use; therefore, knowledge of types of leather offcuts available provides clarity on reuse possibilities. Types of leather offcuts depend on the type of leather used in producing footwear. A review of the literature suggests different classifications of leather types. Broadly speaking, leather and associated offcuts could either be natural or synthetic. While natural leather is derived from nature i.e., animals, synthetic leather is derived from polymers. Natural leather can further be classified based on tanning method, animal type, and finishing. Based on the tanning method, leather types are either vegetable-tanned or mineral-tanned. Mineral tanned leather is made from mineral tannins and water-soluble salts such as chromium, aldehyde, iron, titanium, aluminium, and zirconium as a tanning agent. However, chromium is the most popular.

Regarding categorisation by animal type, studies (Adom, 2015; Kabutey, 2013) emphasise leathers that come from cattle, calf, goat, sheep, buffalo, deer, pig, frog, alligator, ostrich, and lizard. Zengin, Oglakcioglu, and Bitlisli (2017) also mention aniline, pigmented, and patent leather using finishing as the criteria for their classification. While aniline leather is leather that is dyed without any coating to maintain its natural look, pigmented leather is coated with a pigmented protective topcoat that gives it an opaque look. Further, patent leather is characterized by a glossy finish that makes the leather look shiny. These finishing techniques are also used to classify synthetic leather employed in footwear production which comes in types such as natural rubber, polyurethane, polyvinyl chloride, and ethylene-vinyl acetate explained in section 2.4.3.1 (Zengin et al., 2017).

2.8.5 *Characterising leather offcuts by colour*

Isoaho (2016) emphasises the important role of colour in creativity, arguing that colour can affect the appeal of a product to a potential consumer. Colour, to some extent, can influence the perception of artists on the usefulness of materials for creative endeavours; and those who choose to use offcuts need to understand the colour offerings available. Aside from making objects aesthetically appealing, colours have meanings that help individuals communicate specific messages (Isoaho, 2016; Soni, 2014); thus, the suitability of finished leather offcuts for specific projects would depend on client requirement and the message intended to be communicated with the item.

Ackay (2012) argues that colour significantly influences the purchasing decisions of teenagers with differences in their choices based on gender. In their study, they found that black and white were popular colours for footwear among male and female teenagers, with red being a preferred colour for male teenagers only (Ackay, 2012). Regarding footwear for formal occasions such as work, Soni (2014) also discovered that preferred colours included black, brown, burgundy, and dark tan, depending on the colour of clothing and fashion accessories used. Nevertheless, black and brown were usually popular as these colours were perceived to match almost any other colour. Focusing on shoe manufacturing companies, Goguen (2012) also found that best-selling colours for shoes made by manufacturers like Nike and Puma included black, brown, red, blue, black, silver, grey, and white.

Deng, Hui and Hutchinson (2010) also found that some footwear manufacturers combined different colours in footwear design, with respondents in their study choosing different shades of the same colour that is visually coherent rather than contrasting colours to highlight specific aspects of the footwear. These colour preferences can change over time based on fashion trends (Soni, 2014) with some target groups. For example, Sakar (2010) discovered that children demand more colour variety when it comes to footwear. It could be argued that leather offcuts are likely to come in a wide variety of colours as local footwear manufacturers may have worked on multiple contracts with different specifications in terms of colour. This is good for reuse as it makes room for combinations that can increase visibility (Isoaho, 2016), improve harmony between the different colours used, and improve aesthetic appearance (Deng et al., 2010).

2.9 Waste Management Strategies and Techniques

Pizarro (2017) asserts that waste management approaches date back to ancient civilisations in Rome, Babylon, Greece, and Mesopotamia. In those days, emphasis was placed on reuse (Strasser, 2000; Weinberg et al., 2000), with waste generated after reuse expected to be absorbed by the environment (Baker, Bournay, Harayama & Rekacewicz

(2004). This practice led to unhygienic conditions that manifested themselves in epidemic outbreaks in urban centres (Weinberg et al., 2000; Melosi, 2004). Over time, society witnessed a change in approach where waste was collected and deposited at a place far from the inhabitants of a community (Pizarro 2017). With this approach, treatment of waste was minimal, therefore waste collected at landfills gradually became pollutants leading to the rise of an environmental movement in the 1960s and 1970s that preached containment and concentration of pollution (Pizarro, 2017). Today, waste management is driven by the need to preserve depleting resources; hence the use of strategies that position waste as a valuable resource (Pizarro, 2017).

Waste management is an issue of concern globally. Over the years, countries have made efforts to establish clear guidelines and sometimes legislation on how waste should be managed (Pizarro, 2017). Pizarro (2017) asserts that waste management approaches date back to ancient civilisations in Rome, Babylon, Greece, and Mesopotamia. In those days, emphasis was placed on reuse (Strasser, 2000; Weinberg et al., 2000), with waste generated after reuse expected to be absorbed by the environment (Baker, Bournay, Harayama & Rekacewicz (2004). This practice led to unhygienic conditions that manifested themselves in epidemic outbreaks in urban centres (Weinberg et al., 2000; Melosi, 2004). Over time, society witnessed a change in approach where waste was collected and deposited at a place far from the inhabitants of a community (Pizarro 2017). With this approach, treatment of waste was minimal, therefore waste collected at landfills gradually became pollutants leading to the rise of an environmental movement in the 1960s and 1970s that preached containment and concentration of pollution (Pizarro, 2017).

Today, waste is driven by the need to preserve depleting resources; hence the use of strategies that position waste as a valuable resource (Pizarro, 2017). The European Union advocates the use of a waste hierarchy framework that emphasizes waste prevention as the most preferred approach, followed by minimization, reuse, recycling, energy recovery, and disposal in order of priority (Abdul-Rahman, 2014; Vats, 2016; Halkos and Petrou, 2018).

2.9.1 *Waste prevention, minimisation, and reuse*

Waste prevention focuses on addressing the waste management problem from a cause perspective. Waste prevention is sometimes used synonymously with waste minimisation (Cheremisinoff, & Bendavid-Val, 2001; Tam & Tam, 2007, European Commission, 2008). However, an OECD report in the year 2000 clarified that the two concepts are different (Bortoleto and Hanaki, 2017). Waste prevention is defined in the European Commission's waste framework directive as "the measures taken before a substance, material, or product has become waste, that reduces 1) the quantity of waste, 2) the adverse impacts of waste generated on environmental and human health, or 3) the content of harmful substances in waste" (Zorpas & Lasaridi, 2013, p. 1048). It involves the avoidance of waste by minimising materials used for production to enhance product efficiency. This argument implies putting restrictions on consumption and introducing products that generate minimal waste. Therefore, the waste prevention strategy precedes the usage of products by consumers (Bartoleto & Hanaki, 2017), and places the ultimate responsibility of waste prevention on manufacturers (Bartl, 2014). The above explanations suggest strict avoidance of waste in waste prevention (European Commission, 2008; Zorpas & Lusaridi, 2013). However, this may not happen in reality; thus Bortoleto &

Hanaki (2017) explain that waste prevention focuses on waste reduction at source i.e., at the manufacturer level and before products become waste.

Bortoleto and Hanaki (2017) suggest that waste minimisation is a broader concept than waste prevention. According to the European Environment Agency (cited in European Commission, 2008), minimisation emphasises waste reduction efforts by players in the domestic, commercial, and industrial space. This assertion suggests that, unlike waste prevention, waste minimisation concerns not only waste and hazardous chemical reduction at source, but also the efforts of consumers and retailers in the waste production process. The European Commission (2008) explains that waste minimisation includes any process or activity that avoids, reduces, or eliminates waste at its source or results in re-use or recycling. At the point of reuse, consumers would have been exposed to the product and by the recycling stage, the product would have become waste. Despite these slight differences, both strategies emphasize proactivity in waste management efforts. Therefore, the European Commission (2008) argues that there is only a thin line between waste prevention and minimisation with both concepts applicable to various stages of the product life cycle. To this end, waste prevention activities include using designs that enhance product lifespan, minimising production offcuts, adopting waste efficient business practices, and using business models that support extended producer responsibility such as take-back schemes (Department for Environment, Food and Rural Affairs, 2013).

Reuse as another strategy in the literature is closely related to waste prevention and minimisation. It is defined as the process of repeating usage of a product, after its first use for the same purpose for which it was produced, or for a different purpose that does not require reprocessing (Waste Framework Directive, cited in European Commission, 2008;

Vats, 2016). Like waste prevention and minimisation, it occurs at a time when products have not been declared waste. Therefore, the European Commission (2008) purports that reuse is a variant of waste prevention as it temporarily delays the time that products become waste, reduces the quantity of waste generated, and decreases the need for a new product that could become waste in the future. Reuse activities can be carried out by the original owner of the product or by third parties who borrow, rent, share, buy, or receive as a gift the product from the original owner (Environmental Protection Agency, 1996). Further, reuse presupposes that the product is in good working condition to enable continuous usage; thus, suggesting the need for proper maintenance (Environmental Protection Agency, 1996). Bartl (2014) emphasises that in situations where products are not in good working condition, products may require repair, reconditioning, or remanufacturing to become reusable. While repair refers to correcting faults in the product, reconditioning involves rebuilding major parts, and remanufacturing entails rebuilding by the manufacturer (Bartl, 2014).

In general, economies continue to prioritise waste prevention, minimisation, and reuse as important waste management policies (Bortoleto, 2015). Nevertheless, their ability to meet set targets, especially for waste prevention, has been limited due to challenges faced in engaging individuals (Bortoleto, 2015). Therefore, studies by the Department for Environment, Food and Rural Affairs (2013), Abdul-Rahman (2014), and the European Commission (2008) indicate that success in adopting a waste prevention approach will depend on the active participation of stakeholders in the supply chain and an attitudinal and behavioural change among actors. Gritten (2007) also suggests that an integrated approach to waste prevention and minimisation with a clear incentive structure based on reward or punishment could yield good results.

2.9.2 *Recycling*

According to Velis et al. (2009), recycling dates to nineteenth-century London. Nevertheless, its first use in literature can be traced to the work of Bibra on recycling in the oil industry in 1924 (Bartl, 2014). It came from a combination of the word "re meaning back to the original place again, and cycle" (Bartl, 2014, p. 4); thus, recycling can be considered a dynamic process involving the restoration of a product's lifecycle. Vats (2016) purports that recycling aims to extend the life of products, decrease the consumption of materials, and minimise disposal costs. Over the years, its definition has broadened with the currently accepted definition being 'any recovery operation by which waste materials are reprocessed into products, materials, or substances whether for the original purpose or other uses (Bartl, 2014, p. 4). Unlike waste prevention, minimisation and reuse, recycling is applied to products that have already become waste, hence the term recovery. Bartl (2014) explains that the recovery effort in recycling may or may not require a change in the physical and chemical properties of the material. To this end, he highlights three types of recycling namely product recycling, material recycling, and feedstock recycling (Bartl, 2014).

Product recycling seems like reuse in the sense that it involves using the product for something other than its original purpose keeping its physical and chemical constituents intact (Bartl, 2014). In contrast, material recycling alters only the physical characteristics of the material without changing its chemical properties in the recovery process while feedstock recycling alters both physical and chemical characteristics of the product during the recovery process (Bartl, 2014). These categorisations are like classifications mentioned by Grigore (2017) with slight differences in terminologies. She argues that reuse is a form of primary recycling that has limitations on the number of times materials can be reused (Grigore, 2017). In addition, secondary recycling involves changing the mechanical properties of products through processes of cutting, shredding, grinding, granulation, drying, compounding, and melting (Grigore, 2017).

According to Ignateyve, Vanderbeke & Thielemans (2014), size reduction and thermal treatment are needed to ensure easy blending of recyclable material with additives and easy shaping of recyclable material for processing. Further, feedstock or chemical recycling alters the chemical components of the product using varied approaches such as pyrolysis, hydrolysis, hydrogenation, and gasification among others (Grigore, 2017). It appears that chemical recycling is underdeveloped with only a few organizations adopting that method of recycling (Grigore, 2017). Ignateyve et al. (2014) also suggest that mechanical recycling can be categorised again into primary and secondary with secondary mechanical recycling going a step further to include purification, following size reduction, and thermal treatment.

According to Montan-Hoyos and Scharoun (2014), recycling is different from salvaging. While salvaging uses minimal processing, recycling destroys to remanufacture (Montan-Hoyos and Scharoun, 2014). To this end, Lidstrom (2020) argues that over time, recycling decreases a product's value. Down-cycling occurs when the worth of the output of a recovery process is lower than that of the original value; and this could be a result of degradation during the lifecycle of the product (Vats, 2016). This contrasts the purpose of recycling which is to ensure that reprocessing activities lead to an output with a value that is equal to the value of the original product (Sung, 2015; Vats, 2016). Recycling also differs from upcycling which aims to create reprocessed products with a value that exceeds the value of the original product (Sung, 2015; Vats, 2016).

Upcycling is defined as a waste management strategy that alters recyclable products in a way that not only reduces waste but also gives monetary advantages (Pol, 2010; Martin & Parsapour, 2012; Vats, 2016). Therefore, upcycling efforts include activities such as refashioning clothes, remaking furniture, converting textile scraps into rugs, using organic waste to generate fertilizer, and using scrap metals to create artwork (Anderson, 2009; Vadicherla & Saravanan, 2014; Gomez, 2014). Anderson (2009) and Bramston and Maycroft (2013) also suggest that upcycling activities in fashion have led to the creation of various things including jewellery, bags, and clothing. According to Vats (2016), down-cycling and up-cycling are variants of reprocessing activities that could occur in waste management. Nevertheless, the concepts, in addition to re-cycling, appear to be focused on the same thing; that is a desire to recover products, materials, or chemicals from waste. Like reuse, recycling and upcycling minimise the use of new raw materials in new production (Szaky, 2014) leading to conservation of resources (Martin & Parsapour, 2012, Ali et al., 2013).

2.9.3 *Energy recovery*

Putting recycling intentions into practice can be difficult for some due to cost incurred during collection, sorting, and transportation in comparison to revenues obtained. Further, reuse and recycling may not always be possible for materials found in the waste (Chan, Selvam & Wong, 2016; Chai, Tonjes & Mahajan, 2016). To this end, Abassi (2018) argues that energy recovery is a laudable idea that should support waste prevention, reuse, and recycling efforts rather than compete with it. Abassi (2018) purports that most (about 60%) municipal solid wastes contain materials that can be converted into fuels such as methane that can be used to generate energy. Therefore, the landfill could be considered a source of renewable energy for a given economy (Bolan et al., 2013; Beyene, Werkneh & Ambaye, 2018; Chai et al., 2016).

Energy recovery involves the application of processes and technologies to waste to "generate a usable form of energy", such as electricity and fuel for transport, heating, and cooling (Department for Environment, Food and Rural Affairs, 2014; Abassi, 2018). It follows a basic process of receiving waste, treating thermally to generate energy, converting the energy into a transportable form, and cleaning up waste gases emitted in the process (Department for Environment, Food and Rural Affairs, 2014). Energy recovery can be achieved using thermal techniques and chemical processes such as gasification and pyrolysis (Department for Environment, Food and Rural Affairs, 2014). Nevertheless, incineration is a popular choice for practitioners (Department for Environment, Food and Rural Affairs, 2014). According to Zhao, Zhao, Chen, Yin and Yang (2012), incineration not only facilitates the production of energy but also speeds up waste reduction at landfills and kills pathogens. Despite the advantages mentioned, energy recovery has the disadvantage of emitting pollutants such as carbon dioxide and sulphur oxides among others into the environment (Abassi, 2018).

2.9.4 *Disposal*

Disposal seems to be a strategy of last resort in waste management. It emphasises the dumping of waste at specific landfill sites (Bartl, 2014) far from communities where waste can be contained (Pizarro, 2017). Nevertheless, Nwachukwu, Chidi and Charles

(2010) and Abdel-Shaffy and Mansour (2018) suggest that the practice of dumping at specific refuse damps is not always observed. To this end, findings from the literature show that in developing countries especially, waste is sometimes disposed of at inappropriate locations such roadsides, available pits (Onwughara et al., 2010), water bodies (Bello, Ismail and Kabbashi, 2016), canals, and drains (Abdel-Shaffy & Mansour, 2018).

In developing countries, it is also reported that most households and organisations that generate waste are unwilling to separate them into different components. Therefore, it is possible to spot a waste of different materials collectively dumped (Nwachukwu et al. 2010). Such wastes are sometimes kept on non-controlled sites where scavenging activities take place (Nwachuku et al., 2010) with the final clearing of the waste conducted via incineration without energy recovery. In some cases, waste increases in quantity without proper management; thus, leading to pollution and foul smell in the neighbourhood (Nwachukwu et al., 2010). These practices have serious health implications (Onwughara et al., 2010) on humans as they lead to contaminations that change the colour of water bodies that sometimes serve as the only source of water for drinking and cooking (Abulude et al., 2007). Further, there are cases in developing countries where refuse damps are converted to farmlands without proper precautionary measures and this can be harmful to society (Nwachukwu et al., 2010). According to, Abdel-Shaffy and Mansour (2018), such poor disposal habits may be a result of systemic problems such as the limited supply of waste collection bins and the difficulty in transporting waste bins to dumpsite that are sometimes far away.

Disposal via dumping may be carried out either by the individual who generates the waste or by third parties who collect waste at specific time and locations and dump it at the designated spots. Third-party collectors can include recyclable collectors and scavengers in the informal sector who gather waste for purposes of reselling or processing to recover useful components for sale. In addition, collectors could also include institutional players that operate privately or are mandated by government and non-governmental organisations to collect waste at a specific time for a fee to ensure sustainability (JICA, 2005). In Ghana, collection frequency is reported to range usually between weekly and twice a week among households and organisations (Kanhai et al., 2019). However, Moghadam et al. (2009) report that the activities of third-party organisations can be limited due to factors such as infrastructural constraints (for example, a limited number of vehicles, poor roads, and poor route planning that make access problematic). Furthermore, Hazra et al. (2009) suggest that lack of clarity on collection schedule and poor waste collection practices could be a reason for the poor disposal habits explained earlier. Pokhrel and Viraraghavan (2005) also argue that financial reasons, poor legislation, and lack of waste management technologies are contributing factors to the use of unsafe disposal strategies in developing economies.

JICA (2005) and Pokhrel and Viraraghavan (2005) emphasise the importance of statutory backing in ensuring adherence to best practice guidelines in final waste disposal. Nevertheless, they argue that in developing economies, waste management is marketed as a strategy for promoting public health rather than reducing negative environmental impacts. To this end, policy makers consider sanitation efforts that ensure that wastes in communities are removed adequately with limited concerns about the emission of toxins associated with open burning activities (JICA, 2005). In contrast, advanced economies see waste management from resource and pollution perspectives (JICA, 2005).

A few studies can be found in the literature on the willingness of households to participate in recycling activities, specifically in the separation of waste for collection by recyclers. Saphores, Ogunseitan and Shapiro (2012) in a research work that focused on willingness to participate in pro-environmental behaviour among households in the United States of America, discovered that about three-fourth of their sample was willing or very willing to recycle e-waste. In a Ghanaian case, Gyimah et al. (2019) found that most of the households in their sample did not separate their waste at the time of data collection. However, they reported that they were willing to do so although interviews with officers from a waste collection organization, regulatory agencies, and traditional council suggested contradictory results. This result supports assertions made by Gamba and Oskamp (1994) on the tendency that individuals must overstate their level of optimism about participating in recycling. In contrast, Laurieri et al. (2020) found that members in their study based in Southern Italy were not willing to separate their waste at home but were willing to pay for assistance with recycling by a third party. These empirical results suggest inconclusiveness concerning the issue of the willingness of households to participate in recycling.

On the issue of payment, Darfor et al. (2015) found that most households in their sample were willing to pay for the collection of waste with a few arguing that collection should be the responsibility of the government. It is important to note that this finding does not necessarily relate to the willingness to pay for recycling activities such as separation. This may be due to the nonexistence of legislation in Ghana that specifically requires households to separate waste for recycling as can be found in other countries. To this end, Wang, Huo and Duan (2020) advocates the use of government incentives and penalties as ways of getting individuals and organisations to engage in recycling.

Ibanez-Fores, Bovea, Coutinho-Nobrega (2018) emphasised that door-to-door collection can be an effective tool for encouraging household participation in recycling activities such as sorting and separation. According to Yadav and Karmakar (2020), this system of collection, in comparison to others such as curb side pick-up and dumping at designated places, is attractive because of the characteristic of convenience it affords households. Therefore, Boateng (2016) found that Ghanaian households in his study based in Kumasi were willing to pay more for this service with the perception that it offered a more hygienic waste collection process for them.

2.10 Uses of Leather Offcuts and Footwear Buffing Dust

Using the case of a children's shoe manufacturing company in Brazil, Ashton (2018) described a production footwear process based on a unique reuse model. Within the reuse model, larger pieces of leather offcuts were analysed to understand their characteristic features (e.g., quantity and colour). These details were passed on to a material planning section that used the data to design footwear models that made maximum use of the offcuts. Leather offcuts that were considered unsuitable for cutting shoe patterns due to their small size were used for manufacturing decorative items for the footwear such as flower petals and ribbons. Here, the material planning team focused intentionally on developing shoe models that required small details.

The reuse model adopted a design-driven approach that led to a reduction of weekly waste disposal by 15% (Ashton, 2018). Nevertheless, it was associated with time and cost disadvantages for the manufacturers. This was due to the manufacturers' inability to automate production processes as materials varied greatly (Ashton, 2018). A 15% waste reduction could be considered a good starting point. However, it still leaves a large portion of waste unused. This leads to questions of whether time and cost disadvantages associated with the reuse model were worth it. To this end, it could be hypothesised that the use of offcuts in non-footwear sectors will provide a broader scope for usage.

Some studies on the management of leather offcuts and footwear buffing dust use scientific approaches to extract chemical components that can be channelled to other positive uses. Notable among these studies are the works of Kowalski (1997), Jiang et al. (2016), and Balamurugan et al. (2014). Kowalski's (1997) work centred on utilizing leather scraps for fertilizer production. In their study which focused on Poland, they presented three innovative methods for converting offcuts from chrome and vegetable tanned leather offcuts into fertilizer. Jiang et al. (2016) also introduced novel approaches for extracting protein and chromium from leather offcuts and using these chemicals as fertilizer and tanning agents. Balamurugan et al. (2014) discovered that leather offcuts can be used for making flexible pavement blocks. Further, Yilmaz et al. (2007) showed that leather offcuts can be treated to make fuels and activated carbon. Other scholars such as Rethinam et al. (2015) and Khatoon et al. (2017) have also recently found that leather offcuts can be used for blended fabrics and amino acid seasoning, respectively.

Regarding footwear buffing dust, studies in the literature show its use through scientific approaches as a binder in concrete mixes (Karthiga, Kamaraj, Lakshmi & Rose, 2015) and lightweight cement blocks (Sivaprakash, Pounsamy, Ravithia & Ramasam, 2016). Here, emphasis is placed on changing the form of leather to add value. Scholars pursuing this new area of the study argue that there is the need to ensure that the chemicals used in leather tanning do not impact the environment negatively at the end of its lifecycle due to the hazardous substances they possess.

Kushwaha and Swami (2016) and Stan et al. (2014) also support the idea of converting leather offcuts into something useful. However, in contrast to the studies above, they present non-scientific approaches to recycling leather waste. For example, Kushwaha and Swami (2016) combined leather and fabric offcuts to make what they termed 'up-cycled' home and fashion accessories such as cushion covers, table mats, holders, folders, handbags, wallets, and jewellery. Similarly, Stan et al. (2014) used leather offcuts to create leather goods such as footwear, handbags, leather accessories, and handcraft.

Kushwaha and Swami (2016) suggest that up-cycling is better than recycling because of the benefits it gives not only to the environment but also to individual entrepreneurs who can sell the up-cycled product at a premium. Stan et al. (2014) also argue in favour of non-scientific approaches suggesting that these are non-invasive for the environment and have the potential to minimize the consumption of raw materials and spur economic development through job creation. Besides, non-scientific approaches to recycling extend the life of already processed leather, thus decreasing the need for new leather and chemical tanning processes (Business Recycling, 2018).

Teklay et al. (2018a), suggest that scientific and non-scientific approaches to recycling leather offcuts can be used hand in hand to maximize benefits. In a case study on Ethiopia, they used scientific approaches to convert leather offcuts into composite sheets that they used to make items such as light handbags, false roofing coverage, mouse pads, key chains, wallets, components of furniture, and other interior decoration items. Similarly, others have used buffing dust and natural rubber latex to produce leather boards for use in the leather products industry (Senthil et al., 2014; Kiliç et al., 2017).

Irrespective of the approach used, many advocate the conversion leather offcuts and footwear buffing dust into useful things through processes of recycling and reuse. Nevertheless, as explained above, waste can only be minimized creating a need for effective final disposal of residual waste from recycling processes. Yilmaz et al. (2007) argue that the most common way of managing solid waste such as leather offcuts and footwear buffing dust is through disposal on dumping sites and landfills. This approach is unsustainable with negative implications for the environment (Yilmaz et al., 2007).

2.11 Techniques for Two-dimensional Artwork

Two-dimensional art has existed in visual art for many decades. It involves working with elements of art (e.g., line, shape, and colour) to create a flat design that can express only length and width. Traditionally, it comprises branches such as painting, drawing, printmaking, photography, and illustration (Blobner, 2016). These divisions usually rely on wet (e.g., water colour, acrylics, tempera fresco, and oil paints) and dry media (e.g., pastel, charcoal, pencils, crayon, graphite, conte', pen and silverpoint). However, some researchers have investigated the use of new media such as glass, fabric, paper, wood, shells, stones, metals (Seitz, 1961; Maraffi, 2016; Allahverdiyev & Yucesoy, 2017) for 2D art.

Seitz (1961) suggests that the art of assemblage is one of the key methods through which new media can be used in two-dimensional artwork. This method involves cutting and fastening together pieces of the materials on support. Techniques like mosaic and marquetry have emerged in two-dimensional art practice. The mosaic technique originated from glass art. It is a form of collage underpinned by assemblage through a process of cutting and pasting. It involves working with smaller pieces of materials (hereafter referred to as tesserae) to form a larger image. An advertisement document by one of the leading glass mosaic tile companies in Canada show that mosaic tiles can come in different shapes (square, round, irregular, oval, flower) and sizes (10 mm X 10mm, 15mm X 15mm, 31 mm X 15mm, 23 mm X 40 mm, etc.) (SICIS, 2005). In addition, the organisation offers different surface finishes for their mosaic tiles (SICIS, 2005). This suggests that it may be possible to use various materials with diverse texture effects for mosaic art.

Irrespective of the materials used, mosaic art focuses on the larger image rather than the individual tesserae. Thus, tesserae need to be arranged in specific patterns to create flow in the work (Office of Literacy and Essential Skills, Canada, 2010). Some of the common laying styles (technically referred to as andamento) include the grid-like (Opus Regulatum), brick-like (Opus Tessellatum), and worm-like patterns (Drostle, 2008). In the regular brick pattern, direction i.e., whether horizontal or vertical is important (Drostle, 2008). The worm-like pattern (Opus Vermiculatum) also lays the tesserae along the contours of the image (Drostle, 2008). These techniques could also be combined to create the Opus Classicum which uses the brick style for the background and the worm style for the image (Drostle, 2008). In mosaic, special gaps which are usually filled with grout (referred to as grout lines) are created in the tesserae laying process. Changing the spacing between tesserae and creating differences in the width of rows help improve rhythm (Office of Literacy and Essential Skills, Canada, 2010). Therefore, Drostle (2008) argues that even grout lines indicate a well-crafted mosaic artwork. However, not all mosaic works have grout lines (Office of Literacy and Essential Skills, Canada, 2010).

Marquetry as a technique date to the renaissance era (Edwards, 1993). Originating from wood art, the technique involved the cutting and juxtaposition of veneer (thin layers of fine wood) to create decorative patterns fitted together in a single image (Ozarska, 2013). It requires the covering of the entire surface of an object with natural decorations featuring colour tone variations inherent in veneer (Ozarska, 2013). Today, other materials can be used for marquetry with the main characteristic feature of the technic being putting together materials of different shapes, colours, and sizes in a jig-saw puzzle pattern (Edwards, 2012). Therefore, the marquetry process involves making the puzzle pieces first; followed by a mounting of the pieces on the panel (Edwards, 1993). According to Edwards (1993), puzzle pieces for marquetry are usually curved and of contrasting colours (Edwards, 1993). Sometimes, the marquetry technique needs to be augmented with a hot sand shading procedure to improve the overall effect of the technique. From the review above, it can be inferred that the materials for two-dimensional art techniques such as mosaic and marquetry must be easy to shape, adhere to surfaces and provide colour shades that can be used to depict an image through tonal gradation.

2.12 Sculpting Techniques and Materials

Three-dimensional artwork is one of the branches of visual art. It involves the creation of artifacts with visible dimensions of height, width, and depth such that they can be perceived from all sides and angles. Sculpture can be considered one of the visual art options that fall under three-dimensional art. It can be defined as any artwork produced by manipulation, through a process of addition and/or subtraction of the core material, to create form. Sculpture manifests itself in different forms and can be classified as freestanding and relief depending on the dimensions of the artefact (e.g., height, width, and depth).

Over the years, practitioners have employed varied techniques in creating sculptures works. Notable among techniques is carving, assemblage and construction, modelling, and casting. Assemblage and construction use found or altered objects to construct a form. The technique emphasises additivity and involves cutting and shaping materials by gluing and nailing them together to form a unique composition. In contrast, carving encompasses a subtractive process of cutting away unwanted areas from a big material with the help of sharp tools and equipment to bring out the desired shape. Modelling techniques also capitalise on adding and subtracting to build up a form by pushing, pulling, and pinching. Besides, casting involves creating form by solidifying a liquid material in a mould. These techniques have advantages and disadvantages that make them suitable to produce different sculpture works. For example, casting facilitates replication of sculpture work in a timely and precise manner while modelling.

Traditionally, materials such as stone, marble, bronze, wood, clay, metal, and plaster have been preferred for sculpting (Jin, 2017). Stone and wood are preferred for carving due to their ability to withstand chipping without breaking. Clay is also popular for modelling due to its malleability and non-drying attributes (Jin, 2017; Stuart, Thomas, Barrett & Head, 2019). Thus, clay can remain workable for a long time when wet as well as achieve good cohesion, adhesion, and plasticity when dry. Plaster is also a good material for casting due to its fluidity, quick setting ability, and resistance to shrinkage upon hardening. Despite the unique characteristics of sculpting materials, Goetz (1998, cited in Mensah, Adu-Agyem and Osei-Barnieh, 2013) opines that there are no specific materials for modern sculpture. Over the years, contemporary materials such as glass, plastic, and paper have emerged (Jin, 2017). According to Jin (2017), artists need to consider the availability of these materials in their local environment when making decisions.

Mensah, Adu-Agyem and Osei-Barnieh (2013) suggest that clay, wood, plaster, and cement are core materials for sculpting in Ghana. However, they highlight increased experimentation among Ghanaian researchers with waste materials such as bones, drinking straw, plastic bottle, and egg shell for sculpture work. These new materials have the potential to influence the artist's creativity; and their use is driven by their cost-effective benefits in comparison to traditional materials (Mensah et al., 2013). Notwithstanding, practitioners face challenges in getting to these materials in the right quantity (Mensah et al., 2013). Further, Mensah et al. (2013) explain that it possible, but challenging, to combine different materials in each sculpture work. Through their practice, they discovered that different materials could be challenging to put together in a sculpture work due to different characteristics such as weight and thickness. It can be argued that materials can behave differently under different conditions; thus, the need to experiment with even more materials to understand their suitability for sculpting.

2.13 Conceptual Framework

Based on the literature review, the research is guided by the conceptual framework presented in figure 4 below. This diagram shows that the generation of leather offcuts and footwear buffing dust depend on footwear production activities. Local footwear producers and footwear buffing operators may either reuse or dispose of these solid wastes. Once disposed, recycled artist can collect the waste, analyse it to understand its characteristics and use it for two-dimensional or three-dimensional artworks that add value to the waste.

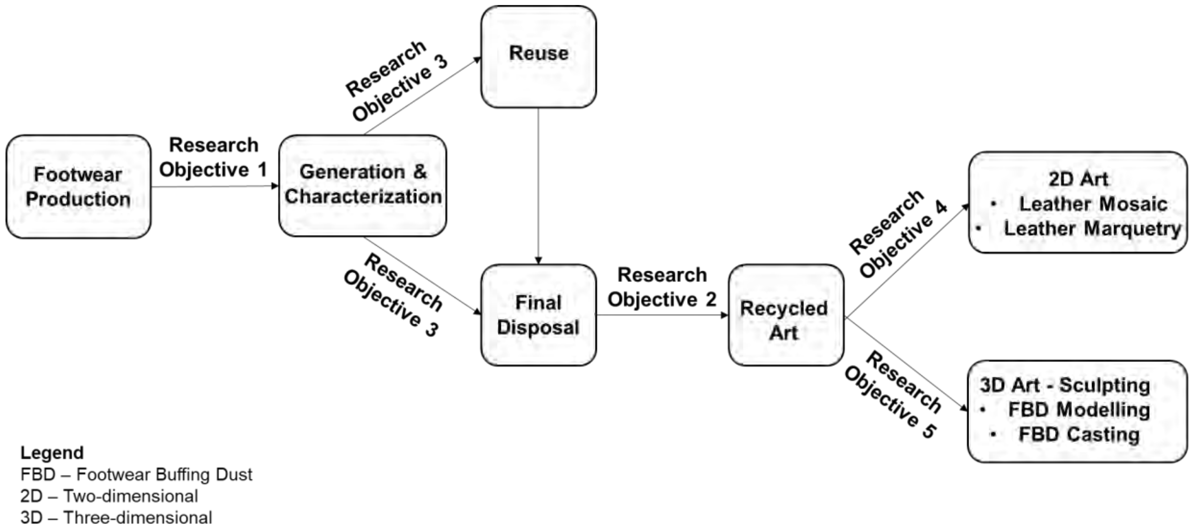


***Figure 4*: Concept map of themes from literature in relation to research objectives**

Source: Researcher, 2020

CHAPTER THREE

METHODOLOGY

3.1 Overview

This chapter looks at the methods used for investigating the research questions. It explains the research design, population, and sampling approach. The chapter also outlines the data collection instruments and the data analysis procedures used for the study.

3.2 Rationale and Assumptions

Philosophical assumptions are important aspects of research (Mikkelson, 2005; Bracken, 2010). Also referred to as paradigms (Kaushik & Walsh, 2019), they encompass the researcher's belief system about how knowledge is developed (Saunders, Lewis & Thornhill, 2009). This influences the kind of knowledge the researcher pursues and how he or she interprets evidence gathered during the research process. (Morgan, 2007). Philosophical assumptions also clarify the "why" in research (Holden & Lynch, 2004) and guide research design to desired ends (Easterby-Smith, Thorpe & Lowe, 2002). Holden and Lynch (2004) argue that philosophical assumptions should be taken seriously in academic research to produce quality outputs. Such philosophical perspectives should be made explicit very early on in the study (Guba & Lincoln; 1994; Scotland, 2012). Kuhn (1962) proposes four ways that paradigms can be conceptualised. They explain that paradigms are either a worldview, epistemological position, shared belief, or model example of research.

Worldviews are broad and general belief systems regarding the world while epistemology concerns unique belief systems that guide the framing and answering of research questions (Morgan, 2007). In contrast, shared beliefs are narrow and focus the researcher's viewpoint on what research questions are appropriate and how they should be addressed. Model examples also relate to belief systems underpinning how research should be conducted in a particular setting (Morgan, 2007). These versions of paradigms translate into philosophical science concepts of ontology, epistemology, and methodology in social science research (Guba & Lincoln, 1994). Originating from the Greek words "onto" and "logia" meaning "being" and "science" respectively (Wand & Weber, 1993; Antwi et al., 2015), ontology refers to the form and nature of reality. Within this space, there exist two contrasting viewpoints which are objectivism and constructionism (Neuman, 2003). While objectivism assumes a reality that is independent of the researcher, constructionism assumes a subjective social reality that is constructed as the researcher experiences the world (Guba & Lincoln, 1994).

Epistemology relates to what the researcher can come to understand about reality and how such understanding is achieved. It emphasises the relationship between the researcher and the subject under study (Guba & Lincoln, 1994). On one hand, researchers can choose a positivist epistemological stance that emphasises acquiring knowledge that explains and confirms natural laws through processes of observation and experimentation for statistical inferences about human behaviour. On the other hand, researchers can adopt an interpretivist epistemological position that focuses on gaining deep insight into a phenomenon within a specific context, rather than proving a point for generalisations through personal contacts over extended periods (Antwi & Hamza, 2015). While both approaches have benefits, they equally have disadvantages with some researchers arguing that ontological and epistemological assumptions that underpin positivist and interpretivist approaches are extreme (Johnson, Onwuegbuzie & Turner, 2007; Pansiri, 2005; Betzner, 2008; Feilzer, 2010). To this end, Johnson et al. (2005) suggest that pragmatism emerged as an alternative paradigm that moved beyond extremes to accommodate assumptions that were logical and practical.

According to Kusi (2012), philosophical positions influence the researcher's choice of approaches, methods, frames for analysis, and entire research design. Therefore, the quantitative research methodology is usually associated with studies that are underpinned by the ontological position of objectivism and epistemological viewpoint of positivism. In contrast, studies that follow assumptions supported by constructionism and interpretivism are expected to adopt qualitative research methodologies (Ulin, Robinson & Tolley; 2004; Antwi & Hamza, 2015). Further, pragmatism advocates the use of a mixed-method research methodology that combines quantitative and qualitative approaches.

A careful study of what the researcher intends to understand suggests that interpretivism, underpinned by an ontological position of relativism is an appropriate methodology for this study. This means that the study assumed a subjective social realm where knowledge was constructed as the researcher interacted with himself and his respondents (Guba & Lincoln, 1994); thus leading to multiple interpretations of the phenomenon (Pham, 2018). Therefore, the researcher in this study aimed to gain an in-depth understanding into the value of footwear related waste and how it could be turned into a resource. According to Hammersley (2013), this approach of learning through diverse experiences in different contexts provides more reliable data for better insights.

Besides, Sullivan (1996) argues that interpretivist theoretical parameters are appropriate for research conducted in natural settings such as those found in the arts. This provides justification for the use of these philosophical stances in the study.

The paragraphs below provide details on the research design, and associated methods for different aspects of the study. Research questions 1, 2 and 3 sought to understand the factors that influence the generation of leather offcuts and footwear buffing dust, their visual characteristic features and their usage and disposal by local footwear producers and footwear buffing dust in Kumasi and Tamale. Research objectives 4 and 5 adopted a practice-led approach to experiment with leather offcuts, footwear buffing dust and various art techniques (Gray & Malins, 2004). Here, the creative works served as an "explicit and intentional method for generating data" (Gray & Malins, 2004, p. 104).

The practice-led approach is a type of practice-related research. Practice related research stems from the argument that creative arts practice is a means through which knowledge can be generated (Barret, 2007). Haseman (2006) argues that practice related research is a methodology that is different from quantitative and qualitative research approach. Despite this, Stewart (2006) explains that it is rooted mainly in qualitative research; with an additional epistemological stance that some knowledge can only be acquired in and through practice (Colin Painter, cited in Piccini, 2002). Therefore, practice-related research is an approach that allows practitioners to initiate practice and conduct research through it (Perry, 2008).

Skains (2018) argues that practice-led research is becoming the most employed approach in comparison to others such as practice-as-research, practice-and-research, practice-based research. Practice-led research is like practice-based research with subtle differences highlighted in Table 2 that sometimes create a blurry line between them. This approach is also sometimes used synonymously with other terminologies like "arts-based research, practice-based research, practice-led research, practice centred research and studio-based research" (Niedderer & Roworth-Stokes, 2007, p.7).

Table 2: Distinctions Between Practice-based and Practice-led Research

Key Issues	Practice -based Research	Practice-led Research
Aims	Address research questions and problem through practice	Address research questions and problem through practice
Outcomes	Creative Output supported with an Exegesis	Exegesis with or without Creative output
Contribution to knowledge	Creative output	Exegesis
Basis of Exegesis	Practitioner-Researcher's Opinion	Literature and theory
Nature of investigation	Experiential	Experiential
Focus of reflection	Creative output Creative mind Creative process	Creative output Creative mind Creative process

Source: Researcher, 2021

The practice-led approach is appropriate for this study because it aims to solve a problem (i.e., understand how leather offcuts and footwear buffing dust can be recycled) through practice. The practice used involved experimentation with creative art materials, techniques, and processes as well as a reflection on the creative output, and the creative process (Green, 2007; Skains, 2018). Unlike practice-based research which prioritises the creative outcome of a practice (Smith and Dean, 2009), the practice-led approach employed in this study focused on the exegesis i.e., the report that showed the insights generated from the practice. Nevertheless, the creative output was included in the work for reference purposes.

Perry (2008) argues that there are non-verbal aspects of a creative work that cannot be communicated in the exegesis, hence the need to include the creative output in the research report. Therefore, the operational insights generated from the creative practice formed the bases of the claim of originality and the main contribution to knowledge in this study in line with arguments by other researchers (e.g., Candy, 2006; Smith & Dean, 2009; Skains, 2018). The developed exegesis was guided by standardised processes drawn from the literature and constant interactions between practice and theory as suggested by Stewart (2006). Green (2007) opines that practice-led research is suitable for higher research degrees.

3.3 Type of Design

3.3.1 *Research Objectives 1, 2 and 3*

The case study research design was employed for research objectives 1, 2 and 3 of the study. According to Stake (1999) and Doolin (1998), this research design is appropriate when dealing with research questions that are phrased in the "what" and "how" format, especially for studies that are underpinned by interpretivist epistemological stances. By using this design, the study, in line with propositions by researchers (Leedy & Omrod, 2005; Cohen et al., 2007; Yin, 2009), undertook an empirical inquiry into the contemporary phenomenon of waste generation, characterization, and management in a real-life context, specifically the local footwear production industry.

Crowe et al. (2011) suggest that a case study design will allow the researcher to get an in-depth understanding of the studied phenomenon in a way that is holistic. Nevertheless, Meyer (2001) opines that single-case studies can limit the ability of the researcher to make analytic generalisations in qualitative studies. Analytic generalisation differs from statistical generalisation and involves only the application of findings to general constructs defined in the study rather than making inferences to populations beyond the sample (Meyer, 2001). Such generalisations are important in discussing findings and drawing out conclusions for fashioning out recommendations. Therefore, the study used a multi-case study design that allowed for research questions to be explored in two selected cases. Cases in the study referred to geographical locations which included the Kumasi and Tamale metropolitan assemblies.

Yin (2009) clarifies that 2 to 3 cases represent a good number when dealing with straightforward research questions, such as those which Vogt et al. (2012) explain will not require several layers of investigations. Guidelines suggested by Miles and Huberman (1994) were taken into consideration in choosing cases. These guidelines emphasise the need to select cases that are relevant to the study and can bring about rich insights. To this end, Kumasi was chosen as a case because it served as the hub for footwear production in Ghana (BFT Online, 2017). Tamale was also selected due to its recognition as a key city in the production and use of vegetable tanned leather in Ghana (Asubonteng, 2010).

3.3.2 *Research Objectives 4 and 5*

The experimental art design suggested by Raes (n.d.) was used where the researcher used the leather offcuts and footwear buffing dust for different techniques to create several artworks for the purpose of learning about the materials. According to Raes (n.d., p. 58), experimental art, unlike scientific experiments, are not necessarily used to test hypothesis but to "show, demonstrate and extend possibilities". Therefore, the study used practice as a data collection instrument to 1) discover a new material from waste in footwear production and 2) revise traditional leatherwork practices in new contexts (Malins and Gray, 2004).

3.4 Researcher's Role

According to Simon (2011), quantitative studies minimise bias through independent interactions between the participant and the researcher; thus, making the issue of the researcher's role in quantitative research an insignificant one. Nevertheless, assumptions that underpin ontological and epistemological positions of constructivism and interpretivism, such as a subjective social reality, make the researcher's role very important in qualitative research. To this end, it is good practice for the qualitative researcher to understand and clarify his or her role in any research undertaken to put in place measures to minimise bias.

In this study, the researcher considered himself an instrument through which data was collected (Denzin & Lincoln, 2003); being conscious that his assumptions, expectations, and experiences could influence the data collection and analysis process (Greenbank, 2003). The researcher engaged in constant self-reflection to ensure consciousness of these tendencies to minimise, if not eliminate them. Also, the researcher played the role of an etic researcher with issues investigated from an outsider perspective to ensure objectivity (Punch, 1998). Besides, the researcher played the role of a non-participant observer in evaluating leather and polymer waste collected for characterisation (Fink, 2000).

For objectives 4 and 5, the researcher played the role of an artist (Ross, 2001) as he experimented with leather offcuts and footwear buffing dust. In this process, the researcher acted not only as a creator of artwork but also as a facilitator of knowledge generation on the artistic process when working with leather offcuts and footwear buffing dust.

3.5 Site and Sample Selection

3.5.1 *Research objectives 1 and 3*

The population of a study refers to all members of a group with a unique set of characteristics that are relevant to a study. It comprises a target population of individuals or objects within a specific geographic setting, some of which may only be accessible practically (referred to as accessible population); and from which sampling is conducted (Fraenkel, Wallen & Hyun 2011). The sample population refers to elements in the accessible population that are selected and included in the study. Local footwear producers in Kumasi and Tamale constituted the population used to address research questions 1 and 3. Footwear manufacturing was chosen because the sector generates the most revenue and uses the highest amount (at least 60%) of leather produced locally or imported into Ghana (Asubonteng, 2010).

Kumasi and Tamale were selected because Asubonteng (2010) identifies the two metropolises as cities for leatherworking in Ghana. News in the BFT Online (2017) also indicates that the Ashanti region has become a hub for shoemaking in Ghana. Reconnaissance visits to the metropolises indicated that in Kumasi, local footwear producers clustered in specific markets with a few others scattered in residential areas. In contrast, local footwear producers in Tamale mostly worked from home in families. Some local footwear producers were also stationed at the art centre and a few of them scattered in markets within the township. Based on the researcher's initial understanding of footwear production activities in the selected geographical areas, a total of 10 cluster markets were identified in Kumasi: namely the 31st, Abinchi, Asafo, Bantama, Mooro, Atonso, Pankrono, Akokodweso, Patasi, and Afful Nkwanta markets. For Tamale, local footwear producers who operated at home in the "Hausa Zongo" community were used in the study.

Reconnaissance visits to Kumasi revealed that most local footwear producers used the services of third-party footwear buffing operators (FBOs) as part of the footwear production process. These vendors provided access to machinery that allowed local footwear operators to automate their buffing processes. Therefore, waste generated from buffing activities for local footwear producers sometimes ended up at the premises of these third-party operators. To this end, the target population in Kumasi was extended to include not only footwear producers but also footwear buffing operators in the studied metropolises. In total, the researcher gained access to all 10 clusters identified in Kumasi. Access to the Hauza Zongo community in Tamale was also obtained. Tracing of local footwear producers scattered in other markets and residential areas in both Kumasi and Tamale was tough, hence their non-inclusion in the study. Therefore, the accessible population that was used for the study included local footwear producers and footwear buffing operators in the above-mentioned clusters and communities.

Within this accessible population, a total of 20 and 17 respondents were sampled for local footwear producers in Kumasi and Tamale respectively (Table 3). The sample size for footwear buffing operators in Kumasi was 23. Sampling was done using snowball and purposive approaches. According to Naderifar, Ghaljaei, and Goli (2017), snowball sampling is an appropriate technique to use when access to respondents is challenging. The technique provides the advantage of openness on the part of the respondent resulting from their acquaintance with the initial respondent (Naderifar et al., 2017). Nevertheless, it has the potential to contribute to biases as only a select few respondents get to participate in the study. This tendency for bias is limited when dealing with a homogenous group such as those in the study (Naderifar et al., 2017).

Table 3: Research Approach and Design for the Study

Research Objective	**Sampling Technique**	**Sample Size**
1 & 3	Purposive and Snowball	LFPs (K): 20 LFPs (T): 17 FBOs (K): 23
2	Simple Random	LOs (K): 13kg LOs (T): 9.6kg FBD (K): 6kg
4 &5	Purposive	As required for the artwork design

LFP (K – Local Footwear Producers in Kumasi
LFP (T) – Local Footwear Producers in Tamale
FBO (K) – Footwear Buffing Operators in Kumasi
LO (K) – Leather Offcuts in sampled in Kumasi
LO (T) – Leather Offcuts samples in Tamale
FBD (K) – Footwear Buffing Dust sampled in Kumasi
Source: Field study, 2020

Using the purposive sampling strategy also ensured that the study included respondents who specialized in the production of all the footwear types produced in Ghana identified in the literature. According to a study by UNIDO (2000), footwear type could influence the quantity of footwear waste and its characteristic features such as colour, size, and shape. Adler and Adler (cited in Baker, Edwards, & Doidge, 2012) suggest that these sample sizes are justified because they fall within the standard range of 12 to 60 interviewees which they found appropriate for qualitative research. Data collection was guided by the principles of data saturation (Saunders et al., 2017); thus, the researcher observed no new ideas emerging in responses by the time the last participant in the sample was interviewed.

3.5.2 *Research objective 2*

The population for research objective 2 comprised leather offcuts and footwear buffing dust collected from respondents during the data collection process for research objectives 1 and 3. Sampling for the characterisation of waste in the study was done randomly as the researcher collected a handful of leather offcuts collected from each respondent. A total of 13kg and 9.6kg of leather offcuts was characterised for Kumasi and Tamale respectively. For footwear buffing dust, samples were also collected randomly from the footwear dust obtained from the Mooro, Abinchi, and Patasi markets. The footwear buffing dust sampled totalled 6kg, representing 2kg from each market.

3.5.3 *Research objectives 4 and 5*

All leather offcuts and footwear buffing dust sampled for analysis under Research Objective two of the study were targeted and accessed in addressing Research Objective four and Research Objective five. A purposive sampling technique was used to determine which leather offcuts should be used for the artworks created.

3.6 Data Collection Techniques

3.6.1 *Research Objectives 1 and 3*

Semi-structured interviews, steered by an interview guide comprising open-ended questions, was used in collecting data for research question 1 and 3. Interviews are considered appropriate instruments for data collection in qualitative research (Milena et al., 2008) as it creates room for respondents to express their views and experiences freely and in detail. To gather appropriate data for objective 1, the interview questions focused on finding out about the factors that influence the generation of leather offcuts and footwear buffing dust.

For objective 3, the interview questions paid attention to whether leather offcuts and footwear buffing dust were kept or thrown away, the factors considered to determine whether to keep or throw away leather offcuts and footwear buffing dust, what leather offcuts and footwear buffing dust kept are used for and how leather offcuts and footwear buffing dust found to be unuseful are disposed of among others highlighted in Appendix 4. Interviews for each respondent was conducted twice with the first interview session lasting between forty-five (45) minutes to an hour. The second interview session occurred after an initial analysis of the data as a follow-up to the first interview. This allowed the researcher to seek clarification on responses and fill in gaps identified. Interviews were conducted in English and Twi depending on the respondent's preferred language. All interviews conducted were audio-recorded after permissions were granted.

3.6.2 *Research Objective 2*

Data collection for research objective 2 was conducted using an observation checklist. According to researchers (Schmuck, 1997; Kawulich, 2005; Hair et al., 2007), observation as a data collection tool is appropriate in qualitative studies. Data collection via observation was guided by the five characteristic features identified in the literature as relevant to the study: namely, grain surface quality, shape, size, type, and colour. Below are specific procedures followed by the researcher in collecting data on each of the characteristic features.

3.6.2.1 Grain surface quality of Leather Offcuts

A review of the literature in section 2.8.1 indicated that the presence of cuts, scratches, holes, wrinkles, peeling, and stains constitute defects that decrease the value of leather. Therefore, the data collection process for understanding grain surface quality involved an examination of each leather offcut sampled, using a magnifying glass to identify defects. Defects identified for each offcut sampled were then recorded on the observation checklist.

3.6.2.2 Size of Leather Offcuts

Size of leather offcuts was assessed using a scale of small, medium, and large with different width and lengths as shown in Table 4 below. Using these scales and dimensions as a guide, the researcher created leather templates that indicated what small, medium, and large offcuts could look like (Figure 5). Thus, data collection for size was done as each sampled offcut was visually compared with the templates and observations recorded on the checklist (Appendix 3).

Table 4: Dimensions for Size Categories Used for Leather Offcut Characterisation

Size Category	Dimension
Small	Width – Less than or equal to 60mm
	Length – Less than or equal to 150mm
Medium	Width – Between 60mm and 160mm
	Length – Between 160mm and 420mm
Large	Width – Between 160mm and 260mm
	Length – Between 420mm and 760mm

Source: Vincent et al., 2019

***Figure 5*: Templates used for estimating the size of leather offcuts**

Source: Field study, 2020

3.6.2.3 Shape, type, and colour of leather offcuts

Data collection on the shape, type, and colour of leather offcuts, involved a visual examination of each offcut sampled to identify their shapes, types, and colour. Observations were then recorded on the observation checklist (Appendix 3) for the offcuts sampled.

3.6.2.4 Particle size and colour of footwear buffing dust

Data collection on the particle size of footwear buffing dust involved the sieving and recording of the outcome. Each 2kg sample was first weighed to confirm its weight. Following, the weighed footwear buffing dust was poured into the sieve with the smallest net size of 75 micrometer (mic) and sieved. After the sieving, the quantity of footwear buffing dust that passed through the sieve (hereafter referred to as passing-through footwear buffing dust) and the quantity of footwear buffing dust that could not pass through each sieve (hereafter referred to as retained footwear buffing dust) was weighed and recorded. The retained footwear buffing dust was then poured into the sieve with the next smallest size (i.e., 300 mic). The footwear buffing dust was then sieved and resulting passing-through footwear buffing dust and retained footwear buffing dust weighed and recorded. The process of transferring the retained footwear buffing dust, sieving, weighing, and recording of passing-through and retained footwear buffing dust was repeated for the next two sizes (425 mic and 600 mic). Regarding colour of footwear buffing dust, data collection was conducted through visual examination of the different particle sizes.

3.6.3 *Research Objective 4 and 5*

Data collection for research objectives 4 and 5 occurred as the researcher experimented with materials and production techniques. During the experimentation process, data was collected using reflective journaling (Gray and Malins, 2004). Reflective journaling involved post-experiment contemplations on key challenges and successes associated with each experiment that is written on paper. Thus, texts of reflections captured in reflection journals served as data for analysis for this aspect of the study.

3.7 Managing and Recording Data

Data management in qualitative research is an important activity that ensures effective capturing, processing, preservation, and sharing of data to achieve research objectives in line with legal and ethical requirements (Knight, 2018). It involves preparing data for analysis through processes of documentation, transcription, and anonymisation among others (Knight, 2018). Data management and recording for objectives 1 and 3 commenced as audio files of interviews were copied from the digital voice recorder and saved in a folder on the researcher's laptop in MP3 format. Each respondent was given an anonymous identifier based on the region and market they belonged to, and their position in terms of the order in which they were interviewed. Audio files earlier transferred onto the laptop were renamed using the identification codes created. Following, transcription of audio recordings was conducted. It took a total of about 300 hours (13 days) to complete transcription representing an average of 3 hours for transcribing each recording.

Transcription was done in Microsoft word using the Be Writ basic level transcription method (Knight, 2018) where respondents' words were captured accurately; but with the exclusion of non-relevant words such as non-lexical sounds ("ah", "uh") and repetitions. For some respondents in Kumasi, interviews were conducted in the Twi language. Transcription occurred side by side translation as the researcher listened to the audio recording. Transcribed word documents were named using the anonymous identifiers earlier created and saved in a folder called Interview transcripts on the researcher's laptop. Transcripts were then printed, and hard copy sheets were bound together to create a booklet for coding and analysis. For research objective 2, data management and recording started with typing the data recorded on the observation checklist in tabular form into an excel sheet. The excel sheet was saved within a folder for easy reference and analysis. Data collected during the reflective journaling process was managed in Microsoft word documents that were saved in a folder on the researcher's computer. Recordings took place at the end of each practice session with details like date and duration included for easy reference.

3.8 Methods for Verification

The researcher ensured trustworthiness (Lincoln & Guba, 1985; Robson, 1993; Gray & Malins, 2004) using triangulation (Bush, 2002). Triangulation was emphasised as the researcher ensured that respondents producing different types of footwear, in different clusters for each region were included in the study. This allowed for an understanding of practices among a wide range of respondents.

Questions posed by Robson (1993) such as "have you done a good, thorough and honest job, have you tried to explore, describe and explain in an open and unbiased way or are you more concerned with delivering the required answer or selecting the evidence to support a case" were considered in the quest to uphold trustworthiness of the study. The researcher conducted validation exercises at the end of the qualitative data analysis stage where respondents were engaged via telephone and asked to confirm key findings emerging from the data regarding their use and disposal of leather offcuts and footwear buffing dust.

The use of rigorous data analysis techniques suggested by experts in experimental art (e.g., Gray & Malins, 2004) fostered objectivity and trustworthiness in this aspect of the work. Additionally, trustworthiness was established by the researcher's use of technical references for experiments. Studio work was also guided by the findings of similar studies conducted by other researchers.

3.9 Data Analysis and Procedure

Data collected for all research objectives were analysed manually using the thematic analysis approach (Creswell, 2005; Grbich, 2007). The manual analysis approach was deemed appropriate because the volume of data collected was manageable and allowed the researcher to interact well with the data. The analysis process used included data reduction, data display, and conclusion drawing (Miles & Huberman, 1994) where data collected was read and re-read several times to identify emerging themes. Findings were reported using the focus by research question approach (Kusi, 2012). Data analysis started side by side data collection and served the purpose of informing data collection in an iterative and reflexive process (Gray & Malins, 2004).

Data analysis of text recorded in the reflective journal was done using the thematic analysis technique. Here, the researcher read through the notes made in the journal to understand the challenges faced and successes chalked during the studio work. Open coding for research objective four was based on emergent themes on the implications of using leather offcuts on the process and outputs of the two-dimensional artworks. For research objectives 4 and 5, open coding started with pre-set codes derived from the literature on the characteristics of current materials for modelling and casting.

3.10 Details of Studio Work Conducted

Implementation of the study involved employing leather offcuts and footwear to create artworks using different techniques. Leather offcuts were used to create 2D art pieces using mixed techniques. This was done by the researcher and an assisting mosaic and marquetry artist. The researcher and an assisting sculptor also used footwear, either on its own or in combination with leather offcuts, for modelling and casting. The researcher owned the ideas used in the artwork while the assisting artist and sculptor helped with the execution of the ideas. Protective clothing was used in each production session to ensure safety.

3.10.1 *Using Leather Offcuts for 2D Artwork*

Production of the two-dimensional leather mosaic and leather marquetry artworks focused on a mask-up and hand-wash campaign for the prevention of the spread of COVID-19 in Ghana. Two different artefacts were produced. The leather mosaic artwork featured a female individual wearing a nose mask with an inscription that reads: "wear your nose mask". The leather marquetry artwork portrayed a human at a tap washing hands with soap and water with the inscription "wash your hands frequently with soap and water under running water".

3.10.1.1 Two-dimensional Leather Mosaic Artwork

The tools used in this studio work included the following: knife, scissors, steel rule, pencil, grinding machine, brush, and plastic containers. Materials employed comprised bonded glue, plywood, and leather offcuts. The leather mosaic work was produced by following several steps outlined below. Figures 6 and 7 on pages 86 give pictorial evidence of the production process and the final artwork produced respectively.

Figure 6: **Evidence of the leather mosaic artwork production process**

Source: Field study, 2021

Figure 7: Final leather mosaic artwork

Source: Field study, 2021

1. The artwork production process started with a selection of the composition for the artwork.
2. Leather offcuts to be used for the work were then selected based on the colours that the researcher required. Nevertheless, selected leather offcuts came in different types, shapes, sizes, and surface quality. Synthetic leather dominated because it provided more colour options.
3. Once leather offcuts had been selected, the support (plywood) for the artwork was prepared by filing using a grinding machine. Sandpaper was also used to enhance the smoothness level of the support. This activity was necessary to ensure good adhesion between the support and the leather offcuts.
4. Following, the composition on which the artwork was based was transferred onto the support (plywood) via drawing. Transfer of the composition was done using the scaling technique.
5. Leather offcuts were then sorted into colours, cut into small pieces, and stored by colour in separate containers for easy retrieval.
6. Next, the researcher began putting together the composition using the cut leather offcuts. This started with the coat and shirt worn by the individual in the image. Building of the artwork involved gluing each of the small pieces of leather offcuts (hereafter referred to as tesserae) side by side with each other using the mosaic technique. Different colour shades of tesserae were arranged and glued on the support skilfully to depict the attire. Gluing of tesserae was carried out until the spaces within the pencil marked areas were filled. Once the shoulder to chest part of the human figure was constructed, the researcher and an assisting mosaic artist

started building the neck of the individual using the same technique explained above. Afterward, the face, forehead, and nose masks were depicted by gluing tesserae on top of each other. The head of the human figure was then created to complete the image.

7. Once the main figure of the composition was complete, the researcher and the assisting mosaic artist focused on building the background effect. Here, tesserae were glued side by side and on top of each other behind the coat, in a way that created tonal gradation from dark to light so that the human figure can stand out.
8. Construction of the inscription followed. The text "Wear Your Nose Mask" was cut out from a strawboard and covered with two different shades of black leather. Cut-out words were then fixed onto the leather-covered support at the top of the artwork to complete the composition.
9. Following, the entire work was observed visually to identify any errors. Errors were then corrected by adding some more tesserae to bring out specific features in the composition.
10. The artwork was then finished by lacquering after which it was put in a wooden frame. The wooden frame was polished with lacquer.

3.10.1.2 Two-dimensional Leather Marquetry Work

The tools used for the leather marquetry artwork were as follows: soldering iron, tracing paper, grinding machine, pencil, and sandpaper. The following materials were also employed in this work: plywood, leather offcuts, and bonded glue. The artwork production process followed the steps presented below. Figures 8 and 9 on pages 89 provide evidence of the leather marquetry work production process and the final artwork produced respectively.

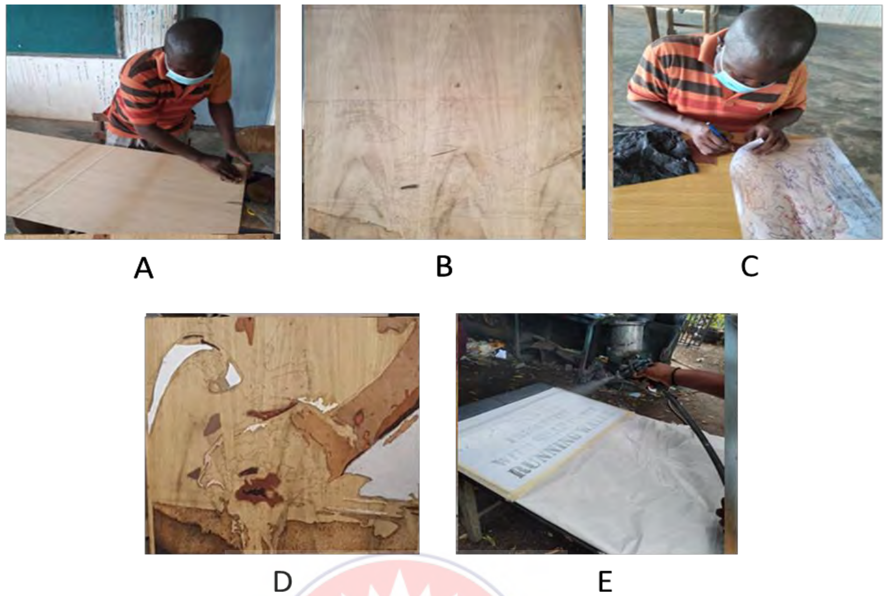


Figure 8: Evidence of the leather marquetry artwork production process

Source: Field study, 2021

Figure 9: Final leather marquetry artwork

Source: Field study, 2021

1. The leather marquetry artwork production started with the selection of the composition and breaking down the composition into colour tones using adobe photoshop.
2. The selection of the leather offcuts for the work took place next. This was done using the composition as a guide. Leather offcuts were selected based on colour and size. However, mineral-tanned leather dominated.
3. The support for the work (plywood) was then treated by filling the surface with a grinding machine. Following this, sandpaper was used to improve upon the surface quality to achieve proper adhesion.
4. The composition was transferred onto tracing paper with the help of a pencil. This was followed by a transfer of the composition onto the support using tracing paper.
5. The design on the support was reviewed to ensure accuracy, and the necessary corrections were made. Each puzzle-like segment in the design was labelled and leather offcuts were selected for each segment. Leather offcuts were cut and sorted separately for easy retrieval.
6. Next, areas that were earmarked for pyrography were identified. With the help of the soldering iron, the pyrography technique was used to depict a wash basin at the base of the image.
7. The researcher and the assisting marquetry artist started to build the image by tracing the shape of individual segments in the composition using tracing paper and carbon paper. The shape of individual segments was then transferred onto specific leather offcuts that matched the colour tone and size requirements of the segment.

8. Leather offcuts were then cut, with the help of scissors, along the edges of the traced segment and fixed on the support at its rightful place with the help of bonded glue. The process of cutting leather offcuts and pasting them on the right segment of the support was repeated several times until the image and background work was completed.
9. Building of the text came next. To do this, leather offcuts were joined by patching to cover the entire area designated for the text. With the help of a prepared screen stencil, the text was printed onto the patched leather using a squeegee and acrylic paint. The work was then allowed to dry.
10. The artwork was then finished with lacquer. Once dry, the artwork was housed in a wooden frame. The frame was then polished to enhance its aesthetic appearance.

3.10.2 *Modelling with Footwear Buffing Dust*

To understand the suitability of footwear buffing dust for modelling, the researcher produced a human foot and a miniature rabbit. The foot was selected because it represented a simple artwork that related to the context of the study. The miniature rabbit was chosen to because it allowed the researcher to experiment with intricate designs like the fur, groove of the eye and ears to understand how the footwear buffing dust can depict these details.

3.10.2.1 Miniature foot

The artworks mentioned above were constructed using the following tools: a large container, steel spatula, and knife. Materials used for the experiment included footwear buffing dust, Styrofoam, white glue, nails, and a small sheet of plywood. The selection of bonded glue as a binder was based on findings from a study conducted by Sakoalia, Adu-

Agyem, Amenuke, and Deffor (2019). Experimenting with groundnut shell powder for modelling, the authors discovered that bonded glue was a good binder for direct modelling. Below are the steps that were taken in producing the artwork. Evidence of the modelled foot when wet and dry is shown in Figure 10. Figure 11 also shows the final modelled foot finished with lacquer.

A B

***Figure 10:* Evidence of the modelled foot in a wet and dry state**

Source: Field study, 2021

Figure 11: Final modelled foot

Source: Field study, 2021

1. The production processes began with preparing an armature with the help of a steel rod and Styrofoam to serve as reinforcement and help with the stability of the

sculpture work. The armature was constructed on a 3 by 10 inches of plywood as support.

2. The next process involved mixing the footwear buffing dust with glue. The studio work used the 425mic footwear buffing dust particle size. The mixture was prepared by combining 125mls of bonded white glue with 0.43kg of footwear buffing dust. With the help of a spatula, the composite was stirred to ensure that the two materials were mixed properly.
3. Once the mixture was ready, modelling started as the researcher and the assisting sculptor used the spatula to spread the first application of the white glue- footwear buffing dust mixture onto the armature in line with the principles of additivity and subtractivity. After the first application, the work was dried in the sun for two hours.
4. After drying, the second application was done using the earlier prepared mixture. Emphasis was placed on bringing out the details on the artefact with the spatula as the main tool used. At the end of this application, the artefact was again left to dry.
5. After a couple of days, the last and final application of the white-glue footwear buffing dust mixture was done using a thicker mixture of 125ml of white glue and 0.054kg of footwear buffing dust. The emphasis at this stage focused on fine-tuning tiny details using the spatula. The completed miniature sculpture was then allowed to dry and finished via spraying.

3.10.2.2 Modelled Rabbit

The miniature modelled rabbit was created for the purpose of serving as a decorative piece on a table. Tools used for the miniature rabbit construction included: large container, steel spatula, and knife. Materials used for the experiment included footwear buffing dust, clay, white glue, nails, and a small sheet of plywood. White glue was chosen as a binder using findings from a study by Sakoalia, Adu-Agyem, Amenuke and Deffor (2019). Experimenting with groundnut shell powder for modelling, the authors discovered that bonded glue was a good binder for direct modelling. The following steps were followed to produce the artwork. Evidence of the miniature rabbit production and the final artwork is provided in Figures 12 and 13 on page 94.

Figure 12: Evidence of the modelled rabbit production process
Source: Field study, 2021

Figure 13: Final modelled rabbit
Source: Field study, 2021

1. Several working drawings of the miniature rabbit were constructed on paper and one of the drawings was selected to guide the study.
2. Following, modelling started as the researcher and an assisting sculptor manipulated a ball of clay, placed on a slab. Manipulation involves bit-by-bit subtraction of clay from the ball of clay to bring out the form of the rabbit. The artist's impression of the rabbit served as a guide to the researcher and the assistant sculptor. The process of subtractivity continued with the help of spatula until the form of the rabbit required was obtained artistically.
3. Once the clay modelled rabbit was ready, a mixture of white glue and footwear buffing dust mixture was prepared using footwear buffing dust of particle size between 300mic and 425mic. The mixture was prepared by combining 125ml of the bonded glue with 0.21g of footwear buffing dust. The composite was stirred using a spatula to ensure that the two materials were properly mixed.
4. Next, the white glue- footwear buffing dust mixture was applied to the modelled clay miniature rabbit with the help of a spatula. The work was allowed to dry for 24 hours.
5. After drying, the second application of white glue- footwear buffing dust mixture was applied. The mixture used the same proportion of bonded glue and footwear buffing dust. The second application was then left for 24 hours to dry.
6. Following, the final application of the white-glue footwear buffing dust mixture was applied. The mixed also used the same proportion of white glue and footwear buffing dust. After this application, the spatula was used to bring out the fine details of the work. The final application was left for 72 hours to dry.

7. Once the entire work was dry, the clay was dug out of the sculpture work using a big spatula to create a hollow opening at the base of the artwork.
8. The final work was painted with an auto-based colour paint to enhance its aesthetic qualities.

3.10.3 Casting with Footwear Buffing Dust

To experiment with footwear buffing dust using the casting technique, the researcher chose an abstracted crab-shaped flower vase and a circular-shaped footwear buffing dust -metal table. The flower vase enabled the researcher to investigate the use of footwear buffing dust for a sculpture in-a-round artifact. The table top was also chosen because it allowed the researcher to experiment with low-relief sculptures. While the flower vase was decorated using the painting technique, the table was decorated using the mosaic, spraying, and painting techniques.

3.10.3.1 Cast Flower Vase

The tools used for the execution of the cast flower vase included the following: container, spatula, and grinding machine. Materials used also comprised footwear buffing dust, resin, fibre, metal rod, plaster of Paris (PoP), clay, silicon, and auto-based paint. Resin was chosen as a binder for casting following a preliminary experiment with bonded glue, contact glue and resin. To construct the flower vase, the production process described below was used. Figures 14 and 15 on page 97 present evidence of the flower vase production process and the final work.

1. Clay was used to model the artwork into the required size, and this was left to dry to the leather-hard stage.

2. Intricate designs were created on the modelled clay artwork.
3. The modelled clay artwork was then divided into parts. Silicon was then applied to it and left for a day to dry.
4. A mixture of plaster of Paris and water was poured onto the solidified silicon in two layers. Following, a fibre sponge was applied to serve as reinforcement and the third layer of plaster of Paris and water mixture poured on top of the fibre sponge. The artwork was made to settle for 5 minutes to prevent the silicon from shrinking.
5. With the mould ready, the researcher and the assisting sculptor proceeded to prepare the resin-footwear buffing dust mixture in preparation for casting. It is important to note that casting involved preparing resin-footwear buffing dust mixtures of different thicknesses for the first, second, and third layers of coating. The mixture generally comprised a resin and accelerator concoction, buffing dust, and a hardener.

Figure 14*: Evidence of the cast flower vase production process*
Source: Field study, 2020

Figure 15: Final cast flower vase
Source: Field study, 2020

6. Once the resin-footwear buffing dust mixture for the first coat was ready, it was poured into the silicon glazed plaster of Paris mould in a systematic way and with the help of a spatula to ensure that it penetrated all corners and picked the details in the design.
7. Next, the resin-footwear buffing dust mixture for the second coat was prepared and scooped with the spatula into the mould.
8. Curved areas with the potential to break were then reinforced using nails. For hollow cast designs, the entire mould was also stuffed with fiberglass for additional reinforcement.
9. Following, the resin-footwear buffing dust mixture for the third coat was scooped into the mould using a spatula, and the mixture was allowed to settle and solidify.
10. Upon solidifying, the modelled work was removed from the mould with the help of a spatula. A grinding machine was then used to remove unwanted parts.

11. The artwork was then completed using various finishing techniques and allowed to dry in preparation for examination based on the designed experiments.

3.10.3.2 Cast Resin-Footwear Buffing Dust Table

The tools that assisted the production of the footwear buffing dust table were plastic mould, plastic container, scissors, tracing paper, pencil, spatula, and grinding machine. Materials that formed part of the finished table included footwear buffing dust, resin, fibre, metal rod, leather offcuts, and white glue. The following points summarise the steps followed in constructing the Resin- footwear buffing dust table (Figures 16 and 17 on page 99 for evidence of the production process and final artwork).

A B C

Figure 16*:* Evidence of the resin-FBD table production process
Source: Field study, 2021

A B

Figure 17: Final decorated resin-FBD tables
Source: Field study, 2021

1. With the help of a brush, the production process started as the researcher and the assisting sculptor applied a separating agent to the insides of the plastic mould.
2. Following this, a resin-footwear buffing dust mixture (in combination with a hardener) was put together for the first application. This comprised 0.78 kg of footwear buffing dust with particle size between 425mic to 600mic and 500mls of resin. The composite was mixed in a lighter consistency to help bring out the details in the mould. With the help of a spatula, the first application was applied through a process of plastering.
3. Following the first application, the mixture for the second application was prepared. This mixture was much thicker and comprised 1.17 kg of footwear buffing dust and 500mls of resin (with hardener) and was applied by plastering to get a uniform thickness.

4. Next, fibres were measured, cut, and placed inside the mould to cover the inner part. In positioning the fibres, an additional resin-footwear buffing dust mixture was applied with the help of a spatula; and the mixture was allowed to sit for about 5 minutes.
5. Further, the final application of the footwear buffing dust -resin mixture which had a thickness like that used for the second application was carried out using a spatula. A metal rod was measured and cut across the inner part as a form of reinforcement. Fibres were again measured, cut, and used to cover the entire metal rod. Following, an additional resin-footwear buffing dust mixture was applied to the fibres as a covering.
6. The final work was left to sit for 6 minutes. With the help of a spatula, the cast work was removed from the mould gradually from one side. Following this, the grinding machine aided in the removal of unwanted parts from the cast table.
7. In total, the researcher casted two tables, and this allowed him to further experiment with different finishing techniques: namely, leather mosaic and spraying. Implementing the leather mosaic finishing started with the selection of leather offcuts based on colour, size, and type (surface textures). Next, the researcher examined the selected leather offcuts to create a composition of colours to fit the designs in the cast sculpture being guided by the principles of design.
8. The composition was then divided into segments (based on colour and shape) and segments were labelled using the initials of the colours. The shape of each segment of the composition was marked out on tracing paper, and this was transferred onto

the leather offcuts with the right colour. Using a scissor, traced designs on the leather offcuts were cut out.

9. Contact glue was applied to the back of the cut leather offcuts and on the specific segment of the composition for which the shape was cut. The glued surfaces were left to settle for a few minutes after which cut leather offcuts were pasted in the appropriate segments with the help of a mallet. The process of marking out, cutting, gluing, and pasting was repeated until the composition was complete.
10. For the second footwear buffing dust table, spraying was used as a finishing technique. This process started with cutting a stencil based on the design. Next, the first segment was sprayed while blocking all other parts that were not earmarked for spraying.

3.11 Details of Experiments Conducted

Considering that footwear buffing dust was a new material, the researcher had to conduct some experiments to understand the material and its suitability for various intended purposes. Below are details of the experiments carried out.

3.11.1 *Water Resistance Test*

- Technical Reference: Water Resistance Test by Timmerman, 2018
- Purpose: To establish the extent to which footwear buffing dust sculpture can resist water absorption to understand its suitability for outdoor use
- Procedure: The water resistance test was conducted for footwear buffing dust sculpture made from two different binders; white glue and resin. First, the sculpture work was weighed, and the weight was recorded. Secondly, the sculpture piece was

immersed in water for 24 hours. Following, the artwork was brought out of the water, immediately weighed again and the weight recorded. The weights before (i.e., dry weight) and after (i.e., wet weight) immersion were used in a formula (dry weight – wet weight divided by dry weight times hundred) to compute the rate of porosity.

3.11.2 *Enzymatic Test*

- Technical Reference: Enzymatic Test by Asubonteng, 2010
- Purpose: To establish the extent to which footwear buffing dust sculpture can withstand mould development to understand its suitability for indoor use
- Procedure: The enzymatic test was conducted for footwear buffing dust sculptures made from both white glue and resin. The tests were carried out by first observing the characteristic features of the sculpture works and recording observations. The sculpture works were then tied in an airtight plastic bag and placed under the bed for one month. At the end of each week in the one month, the artefacts were removed, examined via observation, put back in the airtight plastic bag, and placed under the bed. Results of the observations were recorded and compared.

CHAPTER FOUR

RESULTS AND DISCUSSIONS

4.1 Overview

This chapter reports on the outcome of the data analysis process and the key findings that emerged. Results are presented based on research objectives below.

4.2 Objective 1: Factors Influencing Solid Footwear Related Waste Generation

Objective 1 of the study investigated the factors that influenced waste generation among local footwear producers and footwear buffing operators in the selected cases. The results of this objective are presented in the paragraphs below.

4.2.1 Factors influencing the generation of leather offcuts

4.2.1.1 Results from local footwear producers in Kumasi

Results from the study indicated that the footwear required pattern influenced leather offcuts generation rate the most among all local footwear producers in the Kumasi study area. Respondents explained that specific footwear types (for example shoes, slippers, and sandals) and associated designs required the use of patterns with different characteristic features which made it easy or difficult for local footwear producers to maximize the cutting value of leather sheets. One respondent argued that although his calculations indicated that he needed one yard of leather to produce 25 pairs of standard sandals, some designs always required more leather than expected. Another respondent also emphasised that while some footwear patterns allowed for templates to be arranged close to each other, others made it problematic for this to occur, leaving spaces between traced patterns and generating more waste.

Two other respondents highlighted some of the patterns that lead to higher waste generation using sentences like the following: “if the pattern is curvy, waste generated is more; but if the pattern has straight edges, the offcuts produced are few” and “I generate more offcuts from ladies’ design than men’s design”. Therefore, one respondent explained that sometimes, he chooses to produce only footwear types that minimise offcuts so that he can get value for money. For another respondent, generating more offcuts is not a problem because he perceives that they could be used in other ways. Thus, he hypothesised that local footwear producers who have multiple product lines generate less waste because leather offcuts that may not be useful in terms of size and shape for creating patterns for a particular footwear type (e.g., shoes) could be used to produce other footwear types (e.g., sandals and slippers).

Some respondents (7 out of 20) referred to the size of the leather sheet from which patterns are cut as another factor contributing to waste generation in footwear production. This was evident in a statement by one respondent who said: “when you mark and cut your pattern from a large sheet of leather you generate less waste, but small leather scraps generate more waste”. Another respondent added: “when the size of the leather sheet is small like in the case of the imported leather pieces we buy, we cannot arrange patterns in a way that reduces waste”.

A few respondents (2 out of 20) also mentioned that the marking and cutting skills of the manufacturer also influence the waste generation rate. One respondent remarked: “for a given yard of leather, one local footwear producers can mark and cut out more patterns than another based on their experience". Further, quality as a determinant of waste generation rate was not left out in the discussions. One respondent clarified that sometimes leather offcuts may have expired, but local footwear producers are unable to notice it upon purchase until they start using and this becomes waste. On one occasion, the respondent noticed that the leather he was using started to break after cutting, folding, and placing around the last causing him to throw it away.

4.2.1.2 Results from local footwear producers in Tamale

Findings suggested that the leather offcuts generation rate was mostly influenced by the footwear patterns used among local footwear producers in the study area in Tamale. This assertion was highlighted by all 17 respondents. One respondent explained that style and pattern influenced how much waste local footwear producers generated. Similarly, another respondent mentioned that "some styles are simple such that waste generated from them are few, but other styles are complex and tend to generate a lot of waste". To this end, the respondent further mentioned that most local footwear producers in Tamale like working on simple styles so that they can get the most out of the leather they buy.

A third respondent indicated that straight patterns generate less waste while patterns with curves generate more waste. This argument was supported by a fourth respondent who gave specific examples of footwear designs that generate more waste. He mentioned that the "hook and crap, draft, and 91 designs have more curves, so they lead to more waste". Further, another respondent indicated that while single-phase and double-phase designs lead to more waste, half current, side and side weaving, and Nairobi styles lead to the generation of less waste.

Quality issues also came up as the next important factor influencing waste generation rate among local footwear producers in the study area within Tamale. According to respondents (10 out of 17), the characteristic features of some leather sheets (e.g., rough surfaces, scratches, holes, and hardness) sometimes make leather un-useful and necessitate disposal. One respondent explained that it is important for local footwear producers to buy leather from the same source to ensure consistency as inconsistency can affect the quality and add to the quantity of waste generated. Two of the respondents also gave reasons why quality issues come up. The first highlighted that local footwear producers end up with defective leather sheets because they buy in bulk and cannot check all of them one after the other. According to the second respondent, local footwear producers sometimes do not have an option; they can spot defective leather before purchase but are faced with a limited supply and they buy it like that.

The size of the leather sheet was also identified by some local footwear producers (9 out of 17) in the study area in Tamale as a factor that influenced leather offcuts generation rate. One respondent argued that he can cut down on waste by 10 sheets of big-sized leather instead of 20 sheets of small-sized leather. Another respondent argued that "if the leather is big, you can manage it well, but if it is small, you are limited, and you end up with more waste". Maximizing the cutting value of leather was linked to the skill of local footwear producers by some respondents. One respondent suggested that the lack of experience on the part of the leatherworker can lead to more waste as he will arrange the patterns anyhow on the leather sheet without planning. To another respondent, "while some people are matured in the industry, others join the profession in their adult life, learn a few things and rush to establish themselves without passing out successfully and this affects the quality of their work".

4.2.1.3 Results from footwear buffing operators in Kumasi

Finding from the study indicated that the thickness of the outsole is a major determinant of footwear buffing dust generation rate among respondents (12 out of 23). Interviewees explained that the thicker the sole, the more footwear buffing dust generated due to the large surface area made available for buffing. Some respondents (7 out of 23) also highlighted that the type of sole material could influence the quantity of waste generated. Therefore, a few respondents explained that sole types such as the bright coloured polymer (referred to as bona macco by respondents) that is used for footwear soles generate more waste than the foam-based polymer (referred to as mercury by respondents).

A few respondents (4 out of 23) indicated that their work setting also played a key role in determining the quantity of buffing dust obtained (Figure 18 on page 108). One respondent reported: "our work setting affects the quantity of buffing dust we gather because of the way our structure is constructed, a lot of the buffing dust goes into the air, if we were to be in a proper structure, we could get more dust than we get now" Another respondent indicated strategies used in the past to minimise the escape of buffing dust from wood into the air. He explained that in the past, they hang jute sacks at the door to help block the holes through which the buffing dust would have escaped. Other respondents also mentioned that they used a hard card to cover the top of the buffing machine to prevent the dust from escaping.

Figure 18*:* Setting for footwear buffing operations in Kumasi
Source: Field study, 2020

4.2.2 Discussion: Objective 1

Results from objective 1 suggested similarities in the factors that influenced the quantity of waste generated by local footwear producers in the Kumasi and Tamale study areas. Factors such as pattern of footwear design, size of leather size sheet, quality and manufacturer skill were mentioned. Nevertheless, size of leather sheet and quality were emphasized by more respondents in Tamale than in Kumasi. This may be due to the predominant use of vegetable tanned leather in Tamale which is usually small in size depending on the animal source. The quality issues highlighted in the Tamale case may be due to the lack of specialised care for animals for the purpose of producing quality leather and the use of less advanced tanning processes. In addition, the skill of local footwear producers as a factor of contributing to waste may have come up in Kumasi and Tamale due to the long history of footwear and leather production activities in the two regions.

Findings from the literature (UNIDO, 2000; Teklay et al., 2018b) highlighted quality and size of the leather, skill of the manufacturer, assembling technology, and type of footwear used as factors that influence waste generation in footwear manufacturing. Most of these factors except assembling technology and size of footwear came up in the results from the study regarding this issue. Type of footwear was not specifically mentioned. It was implied in arguments made by respondents on the important role of footwear pattern in waste generation as footwear types determined footwear patterns used. Also, assembling technology may not have been an issue because all the respondents adopted manual approaches to footwear production, therefore not making room for comparison.

4.3 Objective 2: Characteristic Features of Leather Offcut and Footwear Buffing Dust

Objective 2 of the study investigated the characteristic features of leather offcuts and footwear buffing dust generated by Local Footwear Producers and footwear buffing dust in the Kumasi and Tamale Metropolitan areas. Evidence of sorting for characterisation is shown in Figure 19 on page 111. Evidence of sieving is also presented in Figure 20 on page 110. The characterisation of leather offcuts focused on grain surface quality, shape, size, type, and colour. Footwear buffing dust characterisation concentrated on size and colour.

A B

Figure 19*:* Evidence of sorting of leather offcuts sampled for characterisation

Source: Field study, 2020

A B

C D

Figure 20*:* Evidence of sieving of footwear buffing dust sampled for characterisation

Source: Field study, 2021

4.3.1 *Characteristic features of leather offcuts in the Kumasi Metropolis*

4.3.1.1 Quality of leather offcuts

The examination of leather offcuts to understand their quality was conducted with the help of a magnifying glass to help amplify defect that are less visible. Each of the sampled leather offcuts were scrutinized and notes were taken for analysis. Results from the analysis indicated that most (i.e., about two thirds) of the leather offcuts in the sample were free of defects and in good shape for reuse. Defects identified were minor with stains featuring as the dominant defect. Stains identified were white, black, grey, or brown (see Figure 21) spots caused by hardened glue and paint spills. In some cases, stains were very tiny and not visible to the naked eye but showed up only when the observation was done using the magnifying glass.

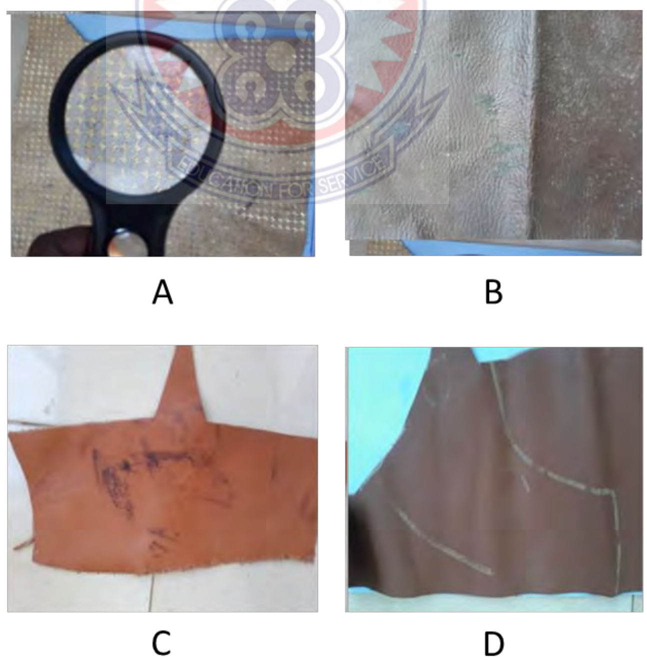


Figure 21: Sampled leather offcuts with stains in Kumasi
Source: Field study, 2020

Dirt stains were observed on some of the leather offcuts. Besides, pen and pencil marks were found on some of the leather offcuts, specifically discarded patterns. Discolouration of leather offcuts, especially at the edges and traces of fingerprint marks were also observed. Other defects including cuts, holes, and scratches of different sizes were discovered on the surface of some of the LOs (Figure 22). These defects were mostly placed at the edges of the leather offcuts. There was also evidence of peels, creases, and fold marks on the surfaces of a few leather offcuts.

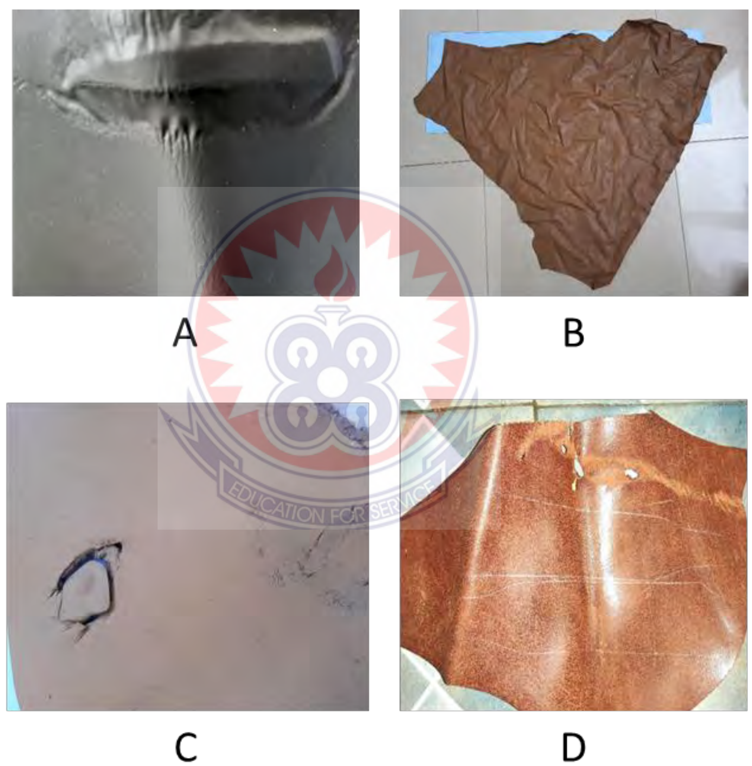


Figure 22: Sampled leather offcuts with minor defects in Kumasi
Source: Field study, 2020

4.3.1.2 Shape of leather offcuts

Characterising leather offcuts by shape involved direct observation to determine the shape. Regular-shaped leather offcuts were characterised using their specific shapes while irregular leather offcuts were described using phrases that gave a general picture of the shape imperfectly. Findings showed that most of the leather offcuts (98%) in the sample were irregular (Figure 23). Within the few regular-shaped leather offcuts identified, perfect rectangles dominated, followed by triangles, trapeziums, semicircles, squares, and ellipses in descending order (Figure 24 on page 115). The researcher found a handful of discarded patterns, some of which were shaped in the form of a human foot, with metal buckles attached, were circular, and were shaped in the form of a heart (Figure 25 on page 115). Although most leather offcuts were irregularly shaped, they had a rectangular or trapezoidal perimeter outline.

Figure 23*: *Irregular-shaped leather offcuts sampled in Kumasi
Source: Field study, 2020

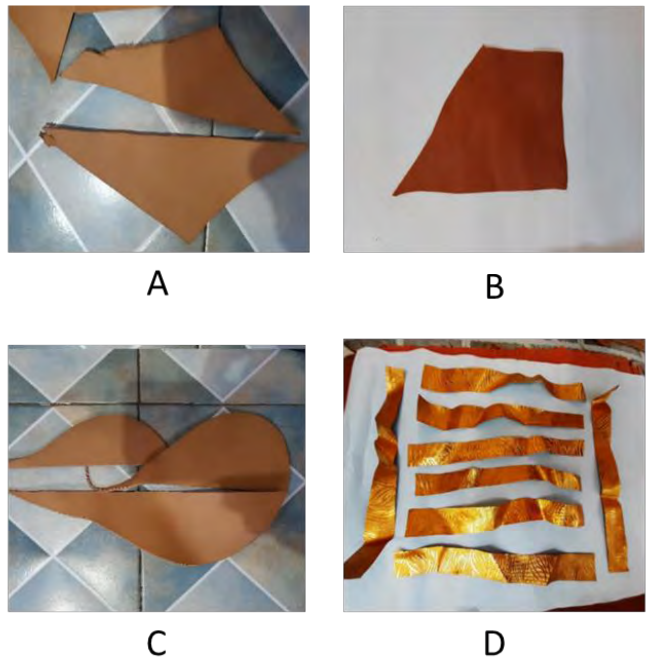


Figure 24: Regular-shaped LOs sampled in Kumasi

Source: Field study, 2020

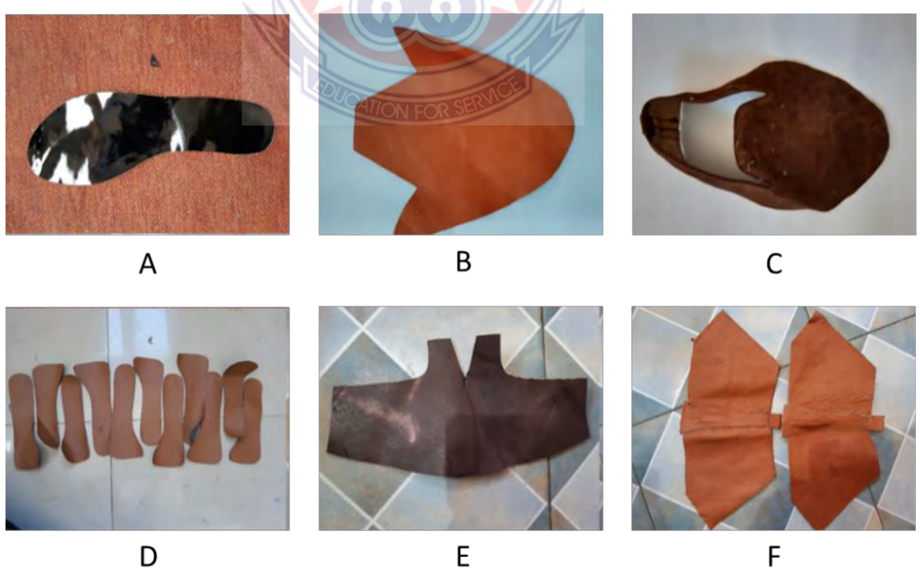
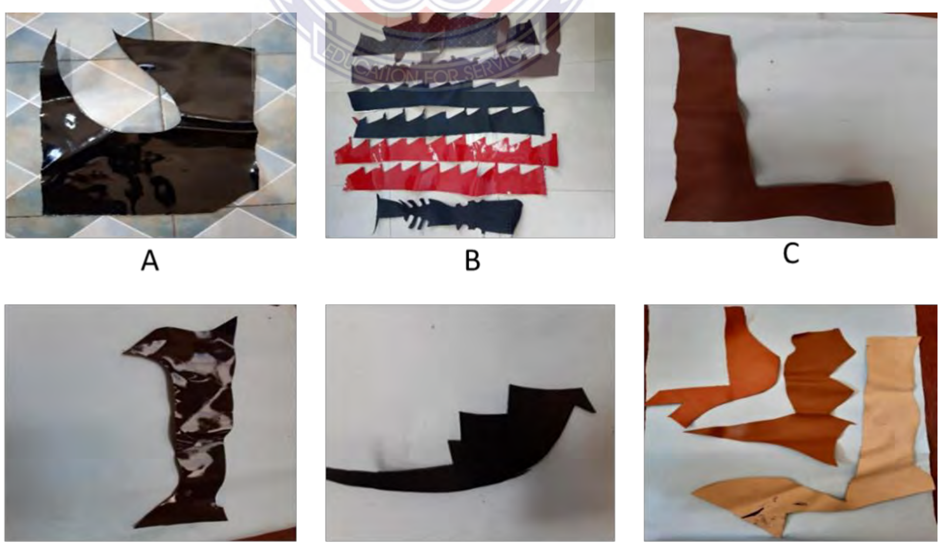


Figure 25*: *Discarded patterns in leather offcuts sampled in Kumasi

Source: Field study, 2020

Leather offcuts that fell within the large category were found to easily decompose into several regularly shaped pieces of different sizes. For example, the researcher found that it was possible to obtain one large-sized rectangle and another long rectangular strip of 10mm to 20mm in width from one of the samples. Another sample offcut showed the potential to contribute one large-sized rectangle and three small rectangles with a shorter width if decomposed. A third leather offcuts also exhibited the potential to give one large-sized trapezium and several small irregular pieces with curved sides. A fourth sample looked like an opened-up discarded boot that was rectangular with curved and straight edges on different sides. Some of the irregular shaped leather offcuts had zig-zagged or curved edges. In some cases, medium-sized leather offcuts came in a U, V, L, or arrow-shaped form (Figure 26). However, for leather offcuts in the small category, perimeter outlines identified indicated a dominance of thin rectangular-like strips and tiny triangles.



A B C

D E F

Figure 26*:* Uniquely shaped leather offcuts sampled in Kumasi
Source: Field study, 2020

4.3.1.3 Size of leather offcuts

Classifying leather offcuts by size was done by mapping the sampled leather offcuts to cardboards depicting three different size categories: namely, small, medium, and large. Findings from the size analysis indicated that most of the leather offcuts sampled fell within the mid to upper limit of the medium-sized category (Figure 27). A few unique samples exceeded the upper limit of the medium range on one side but fell short on the other side. For example, in one sample (Figure 28 on page 118) length of the leather off cuts went beyond the upper limit of the medium-size category, but some portions of the width were smaller than the maximum expected. In another case, the width of the leather offcuts exceeded the upper limit dimension for a medium-sized leather offcut but the length of the leather offcut fell below the maximum length dimension.

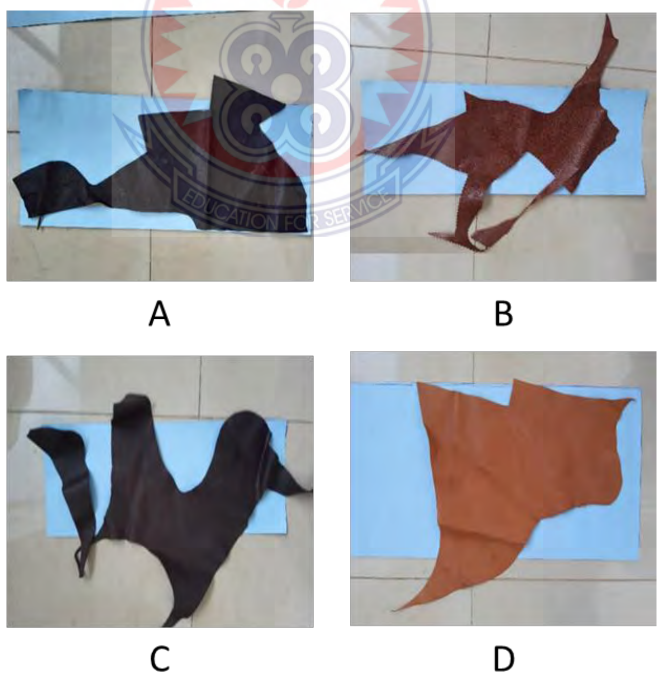


Figure 27: Medium-sized leather offcuts sampled in Kumasi
Source: Field study, 2020

A B

Figure 28: Sampled LOs that exceeded the upper size limit in Kumasi
Source: Field study, 2020

Small-sized leather offcuts came second in terms of quantity. However, most of the small leather offcuts fell within the lower limit of the range. In some cases, leather offcuts came as small strips ranging from 5mm to 30mm wide and connected to small triangles (Figure 29 on page 118). For some other leather offcuts in the small category, the size was even observed to be smaller than that indicated above with strips and triangles falling within 1mm to 10mm in width or height. Although most of the leather offcuts in the small category were in the form of strips connected to small triangles, there were stand-alone pieces. These pieces were also generally in the lower-limit range.

A B

Figure 29: Small-sized leather offcuts sampled in Kumasi
Source: Field study, 2020

Large leather offcuts were the least represented in the sample. However, they fell within the upper limit of the large range with a few going well beyond. For example, one sample had a length of 858mm and a width of 223mm while another sample possessed a length of 740mm and a width of 630mm. Some large leather offcuts comprised very long strips and very narrow widths joined together in a net-like form (Figure 30 on page 119). These exceptions were placed in the large category based on their surface area.

Most of the regular-shaped leather offcuts fell within the medium. Some of the rectangles identified had dimensions of 230mm by 135mm, 280mm by 70mm, 370mm by 50mm, 125mm by 230mm, 105mm by 180mm, 260mm by 95mm and 250mm by 85mm recorded for length and breadth respectively in each case. For one triangle, dimensions of 190mm by 100mm for base and height respectively were observed. In another square sample, dimensions of 150mm by 150mm for length and breadth was recorded.

Figure 30*:* Sampled leather offcuts in a netlike form found in Kumasi
Source: Field study, 2020

4.3.1.4 Types of leather offcuts

Leather offcuts were analysed based on type by direct observation to determine whether they fell within the vegetable-tanned, mineral-tanned, or leatherette categories. No vegetable tanned leather offcuts were found in the sample collected in Kumasi. Leather offcuts examined for the metropolis were either mineral tanned or leatherettes with the latter only slightly more in terms of weight than the former. A third of the leather offcuts in the synthetic category were tiny strips. Classification of leather offcuts type based on finishing techniques also showed a dominance of pigmented leather offcuts constituting a little above half of the sample. This was followed by leather offcuts with a patent finish (locally referred to as mirror leather). There were also leather offcuts with aniline and semi-aniline features in the sample. A few of the leather offcuts examined had additional characteristics such as textures and rough or smooth glitters (Figure 31 on page 120). Textures observed included perforated and embossed designs that had a woven look or mimicked the scales of reptiles like alligators, snakes, and crocodiles.

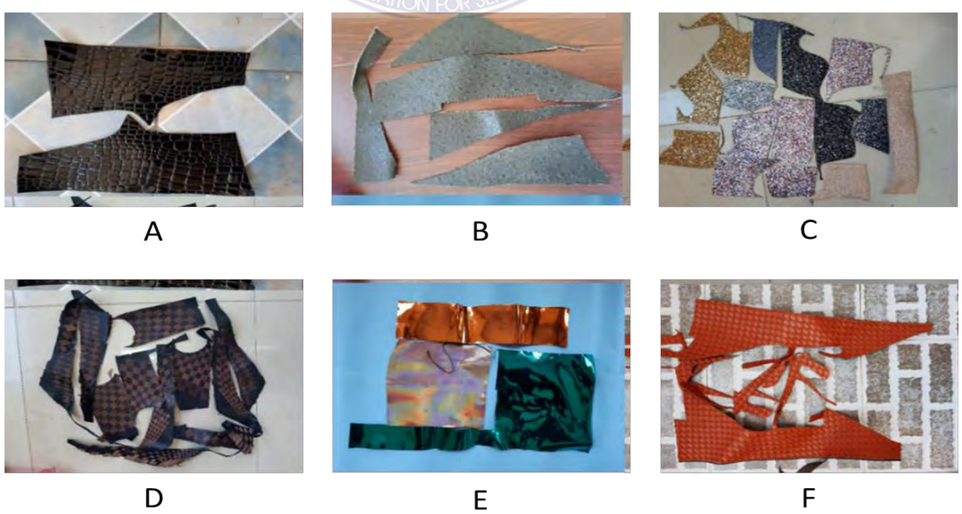


Figure 31: Sampled leather offcuts with different textures in Kumasi

Source: Field study, 2020

A third leather offcuts appeared strong and tough with a rubbery feel that made it look like buffalo leather. Another sample had fur with features of leopard skin. A few of the leather offcuts observed were fabric-like exhibiting characteristics of suede leather. Most of these offcuts were from mineral-tanned leather imported from China and Italy into Ghana as large-sized scraps that local footwear producers bought for their production activities.

4.3.1.5 Colour of leather offcuts

Examination of leather offcuts based on colour was done by direct observation of each piece of leather offcuts sampled for the study. Results showed that leather offcuts came either in a single, dual, or multiple colour scheme. Within the single colour category, brown dominated constituting about half of the total offcuts sampled. There were over fifteen (15) shades of brown in the sample (Figure 32 on page 121). Shades found included coffee brown, chocolate brown, light brown, deep brown, and medium brown, among others. Black was the next popular single colour making up one-fourth of the offcuts sampled. Other single leather offcuts colours identified in the sample included gold, red, ash, khaki, white, grey, silver, cream, purple, orange, blue, pink, green, and yellow in different shades.

A B

Figure 32*: *Leather offcuts in different shades of brown sampled in Kumasi
Source: Field study, 2020

Dual-colour combinations of gold and cream, gold and black, black and brown, and black and off-white were easily noticeable in the leather offcuts sampled (Figure 33 on page 122). In one example, the leather offcuts had a white background and brown was used as stripes intermittently. In another example, the background colour of the leather offcuts featured different shades of brown, but these were arranged in a way that gave the offcut a chequered look.

A B C D

Figure 33: Leather offcuts with dual colour designs in the Kumasi
Source: Field study, 2020

The chequered feature was also observed in a multi coloured leather offcuts where white, black, and brown were combined. Other multi-coloured leather offcuts showing a background colour of black with drawings in ash and blue, or ash and green were also visible in the sample. For a few of the leather offcuts, the multi-colour feature only came to life when the leather offcuts were turned in different directions. When turned at a specific angle, one of the leather offcuts looked pinkish but changed colour to blue when tilted differently. For another of such leather offcuts, a first look showed a silver colour which quickly changed into a rainbow colour when turned at different angles.

4.3.2 *Characteristic features of leather offcuts in the Tamale Metropolis*

The subsections below report the findings on the different characteristics of leather offcuts assessed in the study; namely, quality, shape, size, type ad colour.

4.3.2.1 Quality of leather offcuts

Quality assessment of leather offcuts in the Tamale metropolis was also conducted by direct observation of each offcut sampled using a magnifying glass. Findings from the examination indicated that a little above half of the leather offcuts sampled, were free of defects and suitable for reuse. For leather offcuts that had quality issues, wrinkled edges, and holes, featured as the dominant defects (Figure 34). Defects identified were such that leather offcuts could be reused.

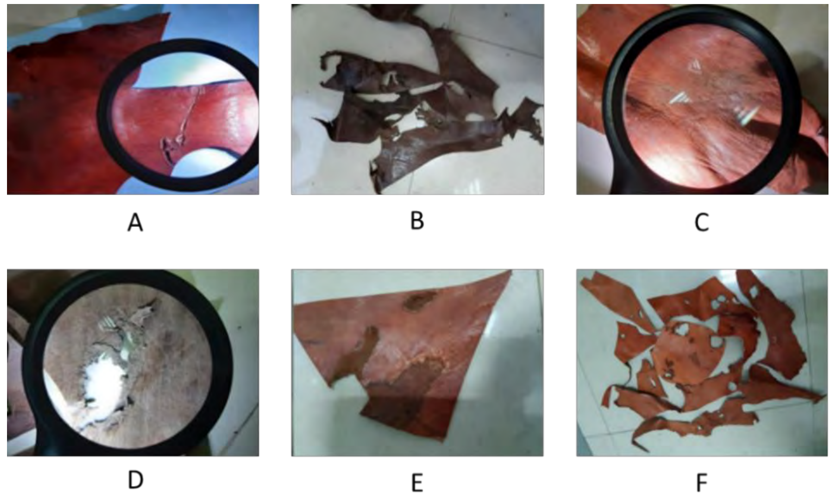


Figure 34: Leather offcuts with defects sampled in Tamale
Source: Field study, 2020

Holes observed in the leather offcuts ranged from big to small and looked like defects arising from ante-mortem and post-mortem injuries. Holes were also positioned (for example in the middle of the leather offcuts rather than at the edges) such that reuse would require cutting to get rid of the holes. There were cases of hardened leather offcuts in the sample. Cuts, peels, scratches, and minor stains were also observed on some of the leather offcuts sampled. Stains included white and black spots on different parts of the offcut surface and discolouration.

4.3.2.2 Shape of leather offcuts

Evaluation of leather offcuts by shape in the Tamale study also used direct observation to classify samples as regular or irregular. Results from the examination showed that almost all the leather offcuts sampled in the Tamale metropolis were irregularly shaped (Figure 35). The few regular shaped pieces identified were triangles and trapeziums. Most of the irregular shaped leather offcuts had rectangular and triangular perimeter outlines. Elliptical and trapezoidal-shaped perimeter outlines were also observed only in a few cases. Further, a few of the leather offcuts were shaped in the form of a U or V with curved and zigzagged edges.

Figure 35: Sampled leather offcuts with different shapes in Tamale
Source: Field study, 2020

4.3.2.3 Size of leather offcuts

The size examination of leather offcuts for Tamale was also done using the small, medium, and large measurement scale explained earlier. Findings from the analysis indicated that about 80% of the leather offcuts sampled fell within the small category, having dimensions of less than or equal to 60mm for width and 150mm for length (Figure 36). The remaining leather offcuts fit in the medium-sized category with no large leather offcuts identified. Some of the small leather offcuts were small strips ranging from 1mm to 50mm in width. Most of the regularly shaped leather offcuts were small with dimensions like 90mm by 140mm, 65mm by 135mm, 55mm by 180mm, and 55mm by 170mm recorded for bases and heights of the triangles respectively in each case.

Figure 36: Small-sized leather offcuts sampled in Tamale
Source: Field study, 2020

Medium-sized leather offcuts generally fell within the lower limit space in terms of the dimensions for that category (Figure 37). In some of the samples, leather offcuts had rectangular perimeter outlines with lengths and widths of 100mm by 170mm, 85mm by 170mm, and 170mm by 220mm. In another example, the researcher spotted a leather offcut with a trapezoidal perimeter outline with dimensions of 100mm by 120mm by 90mm for length one, length two and height, respectively. It was discovered in another example that although the leather offcuts fit within the medium category, one side was excessively long and went beyond the upper limit of the medium category with the other side being smaller. In this sample, dimensions of 540mm for length were recorded against the width of 15mm on one side and 40mm on another side.

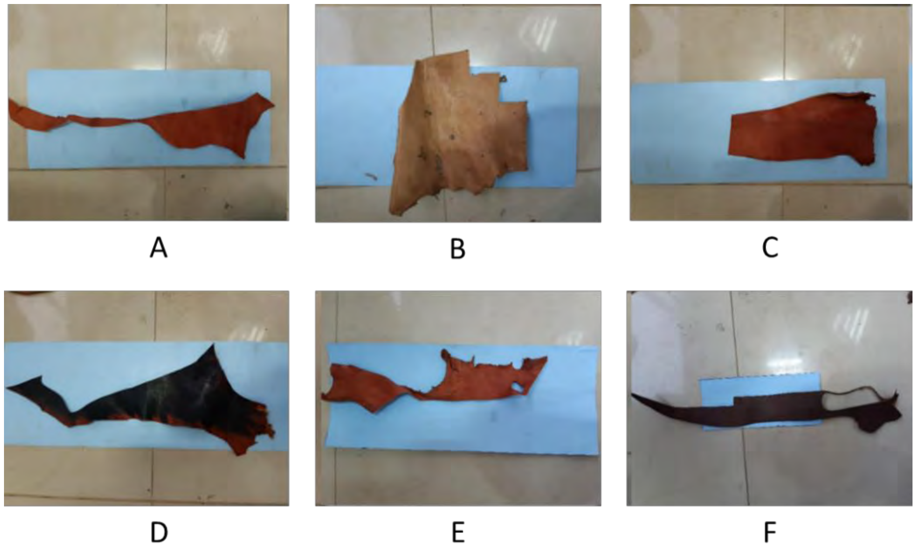


Figure 37: Medium-sized leather offcuts sampled in Tamale
Source: Field study, 2020

4.3.2.4 Type of leather offcuts

The assessment of leather offcuts by type in the Tamale metropolis also involved direct observation to classify leather offcuts based on the tanning method, finishing technique and surface characteristics. Results from the study showed that all the leather offcuts sampled in the Tamale region were vegetable tanned. Leather offcuts featured smooth surfaces with hairs removed and limited use of textures or designs. Only one leather offcut was found to have hair on the surface (Figure 38). Further, all the leather offcuts sampled had very basic finishing with less sophisticated finishing treatment conducted to enhance their look and obscure imperfections.

Figure 38: Sampled leather offcuts with fur in Tamale
Source: Field study, 2020

4.3.2.5 Colour of leather offcuts

Evaluation of leather offcuts by colour also occurred by direct examination of the leather offcuts to understand the single, dual, and multi coloured features available. Findings from the examination of indicated a dominance of single coloured leather offcuts in the sample with a few dual-coloured and no multi- coloured leather offcuts (Figure 39). Within the single colour category, reddish wine featured as the predominant colour for about 80% of the leather offcuts sampled. Brown was the next popular colour with two different variants: namely, reddish-brown and coffee brown.

Other colours found in the sample were light Khaki, pale black, dark purple, and black in descending order. Overall, most of the leather offcuts were in their natural colour. However, some of the leather offcuts in the single colour category were dyed in a reddish wine colour with patches of black in them. In other examples, offcuts with a pale black background colour had patches of reddish-brown in them.

Figure 39*:* Sampled leather offcuts of different colours in Tamale
Source: Field study, 2020

4.3.3 Characteristics of Footwear Buffing Dust in the Kumasi Metropolis

Characterisation of footwear buffing dust sampled in Kumasi involved sieving of three samples of 2000g of footwear buffing dust to determine the proportion of footwear buffing dust in each of the four sieve size categories used. Sieves with the following net sizes were used: 75mic, 300mic, 425mic, and 600mic. Footwear buffing dust samples were collected from three different cluster markets in Kumasi (i.e., Abinchi, Patasi and Mooro markets). Findings from this analysis conducted by the researcher at the Cape Coast branch of the Ghana Highway Authority show that most of the footwear buffing dust for sample 1 (74.5%) were fine in texture (Appendix 5). Medium sized footwear buffing constituted the second largest proportion (i.e., 9.24%) of the footwear buffing dust in sample 1. Very fine footwear buffing particles only totalled 7.195% of the sample. Further, 4.2% of the footwear buffing dust in sample 1 were coarse.

Regarding sample 2, fine particles again featured as prominent constituting 58.7% of the 2000g sample. This was followed by medium-sized particles totalling 14.87%. Coarse particles came next with a percentage 9.1% of the sample. Very fine particles in this sample were few at 3.55%. Sample three also comprised more fine and medium-sized particles with percentages of 52.6% and 20.26% respectively. Coarse particles came next constituting 9.2%. Very fine particles were the least represented at 7.515%.

Characterisation of footwear buffing dust by sieving revealed differences in the colour of footwear buffing dust for each sieve size. Very fine particles obtained from the study were grey in colour while fine particles came in a combination of black and red colours. Medium-sized, coarse, and very coarse particles featured multiple colours of black, yellow and red. In addition, very coarse particles contained other materials such as sticks, nails, iron rods and car tyres.

4.3.4 Discussion: Objective 2

Findings indicated only slight differences in the shape and size of leather offcuts obtained in Kumasi in comparison to Tamale. In contrast, quality, type and colour of leather offcuts varied significantly based on location. In both Kumasi and Tamale, the shape of leather offcuts identified were largely irregular with the potential to obtain rectangles, triangles, and trapeziums if decomposed. Small-sized leather offcuts in both metropolises had similar shapes of thin rectangular-like stripes connected to small triangular-like pieces. However, the researcher observed more regular shaped pieces in Kumasi than in Tamale. This may be due to differences in footwear types produced by local footwear producers in Kumasi and Tamale.

Discarded patterns were only found in the leather offcuts collected in Kumasi and not in Tamale. This may be because demographic information collected in objective 1 showed that most of the footwear producers in Tamale worked as individuals while producers in Kumasi worked with apprentices. Thus, discarded patterns may have emerged as apprentices made mistakes during while learning on the job. Small and medium sized leather offcuts were found in both cases. However, medium sized leather offcuts dominated in the Kumasi study while Tamale saw more of the small-sized leather offcuts. Large leather offcuts were only obtained in the Kumasi sample. This situation may be due to increased reuse activities identified among local footwear manufacturers in Tamale in comparison to Kumasi.

While footwear manufacturers in Kumasi used a combination of leatherette and mineral-tanned leather, producers in Tamale focused solely on vegetable tanned leather. This may be because leatherwork is a traditional occupation for inhabitants in the study area in Tamale who specialise in different aspects of the leather and leather products industry. Thus, local footwear producers in Tamale have easy access to vegetable-tanned leather produced by other families within the community. Leather offcuts sampled from footwear producers in Kumasi also had more variety in terms of texture than in Tamale. This could be attributed to the lack of advanced infrastructure among tanners in Tamale to enhance the surface finishing of vegetable-tanned leather produced.

Overall, leather offcuts in Kumasi offered more colour variety in comparison to leather offcuts obtained from Tamale. This difference arises from the fact that leather is naturally limited in colour. In contrast, leatherette, which dominates in the Kumasi sample, offers more colour options. Quality of leather offcut was also observed to be better for

Kumasi than Tamale. Defects in leather offcuts from Kumasi were minor while defects in leather offcuts from Tamale were major. Leather offcuts sampled in Kumasi were less challenging to reuse without the need for restoration whereas offcuts in Tamale had characteristic features such as holes, wrinkled edges and hardened parts that made them difficult to reuse.

Findings from the study suggested similarities in quality issues identified in the study in comparison with findings from the literature. In both Kumasi and Tamale, defects such as holes, cuts, peels, scratches, discolouration, wrinkled edges, and creases identified in the literature (Asubonteng, 2010; Adu-Asabre, 2011) came up. This is an interesting result because although arguments in the literature associate these defects with vegetable tanned leather, they were also observed in the Kumasi case where mineral tanned, and leatherette dominated. In the Tamale case, defects occurred because of poor anti-mortem and post-mortem handling practices as suggested by Adu-Asabre (2011). However, the cause of defects for leather offcuts sampled in Kumasi was not clear.

The issue of fungi attack which was suggested by Adu-Asabre, (2011) as another important quality issue was not mentioned by respondents. This could be due to the short periods within which leather offcuts in both cases were kept prior to disposal. In contrast, the quality problem of stains from dirt, hardened glue, and pen and pencil marks which featured prominently in the findings from the study, did not appear in the literature review. Adu-Asabre (2011) referred to the feature of spotlessness as crucial in determining the quality leather. Nevertheless, he was not specific in pointing out defects that could affect the spotlessness of leather. Stains appeared to be a result of poor handling practices of leather during the footwear production process.

On the topic of shape, finding from the study highlighted parallels with findings from the literature with an emphasis on the irregular shaped nature of leather offcuts. However, the literature qualified irregular shaped leather offcuts as polygons (Choklat, 2012) in contrast to the researcher's realization that leather offcuts observed, though irregular were not polygons. Although they had sides of different lengths, the sides were not straight but came in varied forms such as curved and zigzagged. Again, even though the literature did not make any reference to regular shaped leather offcuts, the study found leather offcuts that were regularly shaped. For these regular shaped offcuts, the dominant shape was rectangles for Kumasi and triangles for Tamale. Further, when perimeter outlines were used to determine shape, rectangular shaped leather offcuts dominated in both Kumasi and Tamale cases.

The outcomes above contrasts findings from a study by Promjuna et al. (2012) which suggested the likelihood of getting more leather offcuts that are circular, elliptical, or triangular rather that squares and rectangles. Unique shaped leather offcuts (e.g., U, V and L shapes and discarded patterns) found in the study did not feature in the literature. Leather offcuts found in the study fell within one of the three size categories i.e., small, medium, and large suggested by Vincent et al. (2019). This could be because the study by Vincent et al. (2019) focused on the footwear manufacturing sector although their classifications was for a different material i.e., thermoplastic composites. There was evidence of very small centimeter sized leather offcuts in the Kumasi and Tamale samples in line with arguments by Di Roma (2012), Choklat (2012) and Vincent et al. (2019). However, medium sized leather offcuts dominated in the Kumasi case.

The literature referred to leather types based on tanning methods, animal type and finishing; and all of these were observed in the study when looking at the study holistically. Vegetable-tanned leather featured in the Tamale sample only while mineral-tanned leather was observed only in Kumasi. Again, results from the literature highlighted three finishing techniques which included aniline, pigmented, and patent finishing (Zengin et al., 2017) all of which were observed in the study specifically in Kumasi with evidence of the use of texturing as a finishing technique. It was also discovered that cow, sheep, and goat leather dominated the samples collected in Tamale with leather types from pig, alligator and buffalo mentioned in the literature (Adom, 2015; Kabutey, 2013) not found. Further, a substantial quantity of synthetic leather offcuts was found in the study, but the researcher was unable to determine whether they were made from natural rubber, polyurethane, polyvinyl chloride, or ethylene-vinyl acetate (Zengin et al., 2017) due to limited technological knowhow and testing infrastructure.

About colour, the researcher observed more variety in samples from the Kumasi study in comparison to colours highlighted in the literature. Colours such as brown, black, white, red, blue, and silver mentioned in the literature (Ackay, 2012; Goguen, 2012; Soni, 2014) were found in the leather offcuts sampled especially in Kumasi. Nevertheless, brown dominated in contrast to black and red which Ackay (2012) considers the most popular colour for male and female teenagers respectively. This may be because of the ease with which brown matched with other colours (Soni, 2014). Colours like gold, purple, orange, pink, green and yellow which were observed in the study for Kumasi were not mentioned in the literature. Similarly, some of the colours found in the Tamale case such as reddish wine and Khaki did not appear in the literature. Dual and multi coloured leather offcuts which appeared in the study mirrored findings from the literature (Deng et al., 2010). Additionally, colour combinations such as black and white, gold and cream, and ash and blue represented use of contrast rather than different shades of leather offcuts to make their footwear visually appealing (Deng et al., 2010).

4.4 Objective 3: Utility and Disposal of Leather Offcuts and Footwear Buffing Dust

Objective 3 of the study investigated the utility and disposal practices adopted by local footwear producers and footwear buffing operators in the management of leather offcuts and local footwear producers. Respondents in the local footwear producers group totalled 20 for Kumasi and 17 for Tamale. A total of 23 footwear buffing operators in Kumasi were also used for the study. The following paragraphs present findings obtained.

4.4.1 *Results from local footwear producers in Kumasi*

Findings from the study indicated that less than half of the local footwear producers in Kumasi (8 out of 20) reused leather offcuts generated. Nevertheless, usage was occasional for most of the respondents (6 out of 8) who reused the leather offcuts. Respondents who reported not to reuse leather offcuts gave reasons that they did not find it useful either because "they cannot mark new patterns from it", or "they did not have the requisite knowledge and technology to reuse". Reuse of leather offcuts among the few were mainly in footwear manufacturing. Here, leather offcuts served as a material for "cutting patterns", "creating decorative designs on the footwear", "cutting thongs for joining", "lining the footwear and insole", supporting the ends of crown metals, and "fixing fasteners such as buckles".

One respondent argued that because he sometimes used colour combination designs in producing footwear, he kept leather offcuts for future use. A few respondents (3 out of 8) also mentioned that they used leather offcuts predominantly to make children's footwear. They argued that, because children's footwear was small, they could rely on leather offcuts in its construction to cut down the cost of raw materials. Most respondents (18 out of 20), irrespective of whether they used leather offcuts or not, opined that leather offcuts were useful only if they are sizeable enough to work with. Using phrases like "it is useful if I can mark and cut a pattern from it" and "my ability to use the leather offcuts depends on the pattern I want to cut", respondents explained that big offcuts are most useful and can be kept. In contrast, respondents explained that leather offcuts that are small are invaluable and should be discarded.

One respondent mentioned that some leather types offer leather offcuts that are big enough to keep than others. He stated:

> "Leatherettes can be managed well because they are produced in large sheets, and we can arrange our templates well to minimise waste. Imported mineral tanned leather, on the other hand, is sold as scraps of varied sizes and shapes. Sometimes, we can only fit one or two templates on it and the rest becomes waste."

To another respondent, size is important, but equally important is the ability to get enough of the desired leather offcuts to allow for uniformity in the work. A few respondents referred to characteristics like colour (3 out of 20), shape (3 out of 20), and type (1 out of 20) as important factors in deciding whether to use leather offcuts or not. These respondents used words like "similar" and "attractive" to describe their colour expectations. Two respondents highlighted the need for leather offcuts to be free of defects to be considered useful. One of them explained:

> "We discard a lot of leather offcuts from imported tanned leather. This is because they come in scraps and sometimes, when you buy them in bulk you discover that some are damaged, and you cannot mark and cut any pattern from it".

The second person also recalled a time when he experienced breakage and peeling on leather during the folding and hitting stage in the footwear construction process. For a few respondents (6 out of 20), the usefulness of leather offcuts was driven by the requirements associated with the manufacturer's next production cycle. One respondent explained that the decision to reuse leather offcuts occurred after he had surveyed the market, identified fashion trends in terms of colour and design. He emphasised: 'if I have leather offcuts that will match my new work, I use it". Another respondent also explained that when leather offcuts with specific designs are no longer in demand, they become un-useful.

Only one respondent indicated that characteristics such as size was not a key factor in determining the usefulness of leather offcuts. According to this respondent, his decision to throw all leather offcuts away, irrespective of size was due to his unwillingness to keep something he may not use that will take space. This sentiment about limited space was shared by 5 other respondents who mentioned that because they did not have space, they could only keep leather offcuts that they found valuable for a short period of between a day and a fortnight. In contrast, two respondents reported that they could keep the leather offcuts for a month if the offcuts were considered fashionable and in season. This however required proper care and maintenance according to another respondent. For one of them, he had to consciously spend time thinking through what could be done with the leather offcuts; and if he could not come up with anything meaningful then he discarded it.

Some respondents who reported not to use leather offcuts (3 out of 12) gave reasons. A respondent mentioned that he did not see the offcuts as useful because he had money to buy new leather. The others argued that they lacked the requisite knowledge and technology for reuse. Nevertheless, they knew of possible uses such as reprocessing to manufacture leather boards and fertilizer or converting into products like a purse, wristband, and wallet outside of footwear manufacturing. According to one respondent, his knowledge of reuse strategies was influenced by a documentary he watched where straw was used to create a sewing thread. Responses from participants also showed that leather offcuts were sometimes give out as donation to others such as catapult producers and colleagues who specialized in children footwear production. One of the respondents remarked: "what I consider waste may be useful to others". To another, giving waste to colleagues meant that if he needed help at a future date, they would also reciprocate the kindness.

The results suggested that most respondents (19 out of 20) mixed leather offcuts with other waste types. They perceived that leather offcuts were the same as other waste types like food wrappers. By mixing waste up, most respondents believed that they could reduce the cost of disposal. Nevertheless, two respondents reported the contrary; the first explained: "I do not add my leather offcuts to my normal waste like food and sachet water bags". Similarly, the second added that he separated his waste because it usually took a while, i.e., between three weeks to one month for the waste collectors to pick it up and mixing them would result in foul-smelling garbage.

All the respondents disposed of their waste at designated sites in their communities. Most respondents (17 out of 20) highlighted that dumping was done through third-party private sector operators such as Zoomlion and others referred to as Aboboya boys. These collectors picked up the waste using trucks or tricycles at the shops. Collection frequency varied from daily, weekly, fortnightly, or monthly for different respondents. However, weekly pick-ups dominated among respondents. Local footwear producers interviewed paid between 2 and 10 Ghanaian cedis as waste collection fee.

Respondents in one cluster market (3 out of 20) explained that they left their leather offcuts in front of their shops for sweeping and dumping by women cleaners employed by the Kumasi Municipal Assembly. This service attracted a daily toll of one Ghanaian cedi paid to the metropolitan officials. Only three respondents reported dumping of leather offcuts at refuse dumps by themselves or their workers. These respondents chose this disposal option because their shops were close to the refuse dump.

A few respondents (3 out of 20) indicated that they engaged in the burning of leather offcuts occasionally. Using phrases like "if the collectors don't come", "the main refuse dump is far away", "it takes longer for the collectors to pick up" and "sometimes the Zoomlion people don't come", these respondents explained that their decision to burn was due to ineffective waste collection services. Burning was usually done at night behind the market and close to their shops. One respondent had the perception that the type of waste they burnt did not spread easily. Therefore, leather offcuts were usually left to burn unattended immediately after setting the fire. This burning exercise was a collective activity with another respondent emphasising that once one of them set the fire, others who have waste to burn come and add theirs before going home. Generally, respondents did not know much about where their wastes ended up and how it was managed. Nevertheless, one respondent explained that collectors deposited the waste at a refuse dump not very far from them, and city officials further moved these wastes to dumping sites at the outskirts of town.

Although most respondents reported a practice of mixing all waste types, findings showed that all respondents were willing to separate leather offcuts from municipal solid waste if required. All the respondents also indicated a willingness to give out the leather offcuts to third party collectors who could make something useful out of it. One respondent stated that separation will attract collectors who can make good use of leather offcuts, and this will help maintain a clean environment. Additionally, all respondents indicated a desire to give out the leather offcuts for free.

The desire to give without expecting anything in return was evidenced using quotes as follows: "I will not take money for giving my waste out since I even pay for it to be collected", "I will give my waste out for free because I see it as waste", "why not give it for free since it will remove a burden from my head", and "giving it for free may lead to using it for something that will create jobs for the unemployed youth". Despite the positive sentiments, a few respondents (5 out of 20) reported that over time, they may expect a token of appreciation or consider taking a fee as the collector starts to generate profit from using the waste.

Most of the respondents (16 out of 20) preferred collectors to pick up the leather offcuts at their shops provided they would clarify the intended use of the offcuts, provide sacks, and give a contact number. However, a few respondents (4 out of 20) reported a willingness to drop off leather offcuts at a designated collection point if the drop off point was close (e.g., within the market). For a few respondents (3 out of the 12), drop may be possible for farther locations provided transportation costs will be covered. One respondent recalled a time at the early stage of his work life when the Kumasi Metropolitan Assembly provided a big container in the market where they had to dump their leather offcuts for pick up every three weeks. He explained that although this was a good initiative, people in the neighbourhood started adding household waste which caused the area to smell; thus, leading to the removal of the container by Kumasi Metropolitan Assembly".

Respondents could not give specific timeliness on the preferred frequency of collection of leather offcuts. They explained that the availability of leather offcuts for collection depended on their production cycle which varied from time to time and from person to person. While some of the respondents (8 out of 20) indicated an average production cycle of 2 weeks, others mentioned average production cycles of one, three, and four weeks. Also, they explained that once the leather offcuts became available for pickup, they could only keep it for short periods, usually from a few days to a week; and if the offcuts were not collected, they would throw it away.

4.4.2 *Results from local footwear producers in Tamale*

Findings from the study showed that most of the respondents (15 out of 17) reused leather offcuts. However, usage was occasional for 13 out of the 15 respondents. Emphasis was placed on using the leather offcuts to support footwear production, through techniques like braiding, thonging, and joining. Respondents highlighted the reuse of leather offcuts for "crown design", "thongs", "nose of slipper", and "lining". Besides, three respondents mentioned that they used leather offcuts to make children's sandals and slippers. One respondent explained: "because I deal mainly in children's footwear, I usually need small pieces, so I keep the leather offcuts". These practices show the dominance of footwear manufacturing activities in the reuse of leather offcuts among respondents. Nevertheless, two of the respondents indicated that they reused leather offcuts generated for non-footwear related items such as talismans and key holders.

All the respondents highlighted that size was of great significance in determining the usefulness of leather offcuts. One interviewee reported: "if l can draw and cut a pattern from the offcut, I keep it". Another said: "when the size of the leather offcuts is too small, I dispose of". A third respondent emphasized: 'I keep the big pieces and throw away the small ones that will not serve any purpose", while another respondent explained: "I place the pieces on my template and if it will fit, then I consider it useful". Although the above quotes suggests that the characteristic features of leather offcuts determine their usefulness, a respondent argued that it is equally important to think through the time it will take the manufacturer to work with the waste, in comparison to using new leather sheets.

A few respondents (4 out of 14) also mentioned the colour and texture requirements of the manufacturer's next production cycle in deciding whether to keep leather offcuts or not using words like 'next contract, 'future work', and 'the new job'. These respondents explained that the leather offcuts kept needed to be attractive or scarce such that keeping it was worthwhile. To this end, a respondent mentioned that khaki-coloured leather can be hard to get, so it is important to keep its small pieces.

Another respondent also suggested that it was not enough to have the leather pieces; what mattered was the quality of the pieces obtained. He explained:

"We do not have control over the quality of leather available at the market. Sometimes what is on sale has holes, scratches, and marks; but you must buy it because that is what exists. In this case, parts that are not of good quality are cut off and thrown away."

Another respondent explained that "when leather pieces are kept and there are colour changes, they cannot be used again". To a third respondent, pieces could harden over time, in which case it cannot be used. It was identified from the study that storage space was also an issue of concern for some respondents. A respondents explained: "because we work in front of our house, we keep the materials we work with in a box, so we must consider if we need the pieces or not". Another respondent added that it is important to check the usage rate before keeping the leather offcuts, arguing that: "if you see that you have stored the leather offcuts for some time, but the usage is less, you have to throw it away and manage space".

Concerning non-use, the two respondents who indicated throwing their leather offcuts generated away did not give reasons why or express knowledge of possible uses. However, they clarified that their leather offcuts were sometimes donated to others. This was evidenced in a statement by one of them who mentioned that he usually gave the leather offcuts to his brother who specialised in the production of children's footwear. Similarly, another respondent highlighted that leather offcuts were also given to colleague footwear producers, shoe repairers, and those who produced talismans in the neighbourhood. According to him, he was usually willing to give leather offcuts out to others for free or for a small token because he felt that he may need their help at a future date.

In connection with the disposal of leather offcuts, all the interviewees reported mixing their leather offcuts with other household wastes such as sachet water bags and food wrappers. All the respondents at disposed of leather offcuts themselves at designated refuse dumps. Some of the respondents indicated that, on some occasions, dumping was done by family members including "their sisters who swept every morning". For one respondent, collection and dumping was sometimes done by a boy in the neighbourhood. Besides, dumping of leather offcuts and other wastes came at a fee ranging from 1 to 3 Ghanaian cedis for most respondents (9 out of 17) with the other eight participants paying between 20 and 50 Ghanaian pesewas. Wastes were dumped daily for most respondents (16 out of 17). Only one person mentioned burning as a disposal strategy. He explained:

> "I burn in the gutter in front of my shop because the air blows away the plastic waste in my dustbin when it gets full. I prefer the gutter because it prevents the burning waste from being blown away".

Results from the study indicated that almost all the respondents separated their leather offcuts from other Municipal Solid Waste generated. The majority (15 out of 17) of the respondents expressed a desire to give out leather offcuts to individuals who were ready to turn them into useful products. However, most of the respondents (15 out of 17) were only willing to do so, provided they will be paid for it. They quoted fees of between 20 and 50 Ghanaian cedis for 5kg of leather offcuts. For one respondent, a suitable price could only be determined after consultations with his uncles. According to one respondent, his decision to charge a fee for giving the leather offcuts was due to costs he will incur in gathering it. He explained: "I can send some boys to go around and gather the leather offcuts, but I will have to pay them".

A few of the respondents (2 out of 17) were willing to give their leather offcuts for free if it was small in quantity. One of them questioned: "if we currently give our leather offcuts to shoe repairers and talisman producers, why not give it out to other individuals who may also use them innovatively? Nevertheless, for larger pieces, some financial incentives will be expected because it will mean having to buy new leather. To this end, one of the respondents mentioned that, recently when he gave leather offcuts to some University of Development Studies students who gave him a voluntary token of 20 Ghanaian cedis.

Findings regarding the preferred mode of collection highlighted that more than half of the respondents (10 out of 17) preferred pick-up at their places of work by collectors. Only a few respondents were willing to drop off at designated points within their community. For a few respondents, drop off at a designated location could be considered if only transportation expenses would be catered for by the collectors. Therefore, one respondent stated: "even if it is going outside Tamale, I can send it through STC and add the cost to the charges".

Respondents explained that they could not indicate the ideal timing and frequency of collection of leather offcuts since the availability of leather offcuts varied and depended on the orders and contract received. Also, they mentioned that the availability of leather offcuts was sometimes dependent on the length of their production cycles which ranged from one to four weeks. Respondents clarified that because of the lack of space, they could only keep the leather offcuts for a few days, after which leather offcuts would be discarded if proper arrangements were not forthcoming. One respondent was willing to keep the leather offcuts for a little longer if the collector has already paid for them.

4.4.3 *Results from footwear buffing operators in Kumasi*

Results on the utility of footwear buffing dust revealed that all the respondents did not use the footwear buffing dust. However, almost half of the respondents (11 out of 23) knew of possible uses of footwear buffing dust. Respondents highlighted that footwear buffing dust could be used for fertilizer for planting, car doors, polymer composites that are like the sole board already used, and filling potholes to control erosion". Most of the respondents who knew of possible uses argued that they did not have the requisite technology and knowledge to reuse footwear buffing dust in some of the ways they suggested because they were in Ghana. To this end, some participants explained that reuse would have been easier if they were in other Western and Asian countries.

Nevertheless, one respondent recalled a time when the footwear buffing dust was used to make polymer composites in Ghana. He stated: "the sole boards that were made from the footwear buffing dust in those days were quality just like the ones we bought from Italy, but now they have stopped; so, there is the need to start again". Another participant also reported having given some of the footwear buffing dust to one of his suppliers who promised to investigate how it could be reused; but he never returned with any feedback. A few of the respondents (7 out of 23) also highlighted alternative actions other than dumping, that they took about their waste. They mentioned that they sometimes donated the footwear buffing dust to individuals who used them on their farms, traders in the market who produced local speakers from it, food vendors who used them for setting fire, and students from neighbouring universities who collected them for experiments.

On the issue of disposal, most of the respondents (10 out of 23) reported mixing their footwear buffing dust with Municipal Solid Waste. Disposal of footwear buffing dust was handled by private operators such as Zoomlion and the "Aboboya boys" for all respondents. In markets where access to vehicles was easy, disposal was also carried out by head porters. Collection services attracted a fee of between five and 15 Ghanaian cedis for all respondents. Collection frequency was weekly or fortnightly for most respondents, with only a few (6 out of 23) reporting monthly collection schedules. Very few respondents indicated using burning as an option for disposal. These respondents burned due to delays in waste pick-up which leads to a foul-smell in the neighbourhood. Burning was usually done in the evening, after the close of work. Once the fire was set, the burning waste was left unattended.

Although waste separation was not observed in the study, footwear buffing operators were willing to separate the footwear buffing dust from municipal solid waste if needed. A greater number of respondents were happy to offer footwear buffing dust to individuals who could use them in innovative ways. One respondent commented that if the footwear buffing dust will be used for something that will not bring problems but rather contribute to the society, then he will be ready to give it out. To this end, another respondent explained that he would want to know the collector's usage intention before giving the waste out. Most of the respondents (14 out of 23) were willing to give the footwear buffing dust out for free without any conditions. One major reason cited for giving out the footwear buffing dust for free without conditions is captured in this quote: "if I pay money for the waste to be collected, why not give it out since it will cost me nothing". Therefore, one respondent was even willing to coordinate the footwear buffing dust gathering process among footwear buffing operators and deliver it to the collector.

A few of the respondents (7 out of 23) also indicated that they will only give out the footwear buffing dust for free with conditions i.e., in the short term with the introduction of fees as the collector starts to profit from its use. One respondent explained that this is what happened in the case of adhesive containers used by local footwear producers in the industry. Initially, the containers were given out for free to the producers of lamps, aluminium buckets, and watering cans until their trade became profitable. Some respondents also explained that they will give out the footwear buffing dust on condition that the collector gives a voluntarily token to show appreciation. A third group of respondents (6 out of 23) also indicated that they will only give out the footwear buffing dust for a fee ranging from 3 to 20 Ghanaian cedis, depending on the quantity of footwear buffing dust given out. Others indicated that they needed to consult their colleagues in the industry to decide on a suitable amount.

Findings on the preferred mode of collection highlighted that most of the respondents (15 out 23) would opt for pick-up by collectors provided the collector would provide sacks and give contact details. Nevertheless, a few of the respondents were happy to drop off at designated points within the market; if they had to go outside the market, they expected the collectors to pay for the transportation costs. Respondents' suggestions on the frequency of collection of footwear buffing dust indicated that the duration of their production cycle will influence the availability of waste for collection. Therefore, most respondents preferred a collection frequency of fortnightly or weekly, with a few requesting for monthly collection. They highlighted that they could only hold on to the waste for a few days due to limited space; therefore, collectors had to minimise delays in pick up.

4.4.4 *Discussion – Objective 3*

Overall, findings suggest similarities in the usage leather offcuts and footwear buffing dust among local footwear in Kumasi and Tamale. Nevertheless, results show that reuse of leather offcuts was practiced by more of the local footwear producers in Tamale than in Kumasi. For example, while only half of the respondents in Kumasi reported to reuse leather offcuts, more than two thirds of the respondents indicated reuse of leather offcuts in Tamale. However, in both cases, usage of leather offcuts was occasional rather than regular. Utility of leather offcuts by local footwear producers in both metropolises focused predominantly on the footwear manufacturing sector. Respondents used leather offcuts for decorating the footwear, making fasteners, or supporting manufacturing processes. In a few instances in Tamale though, there was evidence of use of leather offcuts to make small items such as wallets and key holders which usually fell within the leather goods industry.

For local footwear producers in Kumasi and Tamale, usage of leather offcuts depended on three main factors: namely, leather offcuts characteristics, requirements for next production and storage space available. Regarding characteristics, size dominated in both study areas although other features like colour and texture were mentioned. Only in case two did respondents refer to defects as an important characteristic for determining the usefulness of leather offcuts. This result may be because local footwear manufacturers in Tamale use mainly vegetable tanned leather that is produced by local tanneries that lack appropriate technologies to ensure compliance to high standards.

Limited storage space identified in both case studies is not surprising. This is because, local footwear producers in both metropolises exhibited traits of micro entrepreneurs with limited resources to enable the renting of big shop spaces. Despite this constraint, the study found that the local footwear producers in Tamale were able to keep their leather offcuts for longer periods (i.e., up to a month) than local footwear producers in Kumasi who kept their leather offcuts for a maximum of two weeks. Perhaps, respondents in Tamale can store leather offcuts for longer periods because they work at home and could turn to facilities in their homes with ease for additional storage space if needed. It is interesting to note the willingness of some respondents in both cases to donate leather offcuts generated to others. Local footwear producers in Kumasi who mentioned their engagement in this activity dealt mainly with their colleague footwear manufacturers, specifically those specialising in children's footwear production. For respondents in Tamale who reported to donate, findings indicated interactions with a wider range of people including talisman producers and shoe repairers.

Disposal of leather offcuts and varied slightly among respondents in the two cases studied. Dumping was the preferred method for disposing of waste among respondents with leather offcuts and footwear buffing dust mixed with other solid wastes in both case studies. Dumping was carried out mainly by third party collectors for respondents in the first case while participants in case two disposed of their waste themselves or through family members. Practices in both cases involved a pay as you dump system where fees charged depended on the quantity of waste generated. Fees paid by respondents in Kumasi were significantly higher than the fees paid by respondents in Tamale. The price difference may be due to varying regional policies regarding waste management.

The researcher also observed differences in the frequency with which wastes were sent to the dumping site. This could be linked to the issue of dumping by themselves versus collection by a third party. While respondents in Tamale had more control over when to dump their waste depending on the quantity generated, respondents in Kumasi did not have that flexibility. This could be a reason why some respondents in Kumasi resorted to burning in situations where waste generated overflowed bins that had not been picked up, bearing in mind the issue of limited space that came up earlier in the study. According to the study, poor waste disposal strategies such as open dumping and outdoor burning was used by more respondents in Kumasi, when compared with respondents in Tamale.

Results suggest that separation of leather offcuts was not done by most of the local footwear producers in Kumasi in comparison to Tamale. This may be because findings in objective 3 showed that local footwear producers in Tamale reused the leather offcuts more; hence their motivation to keep it clean. However, similarities existed among local footwear producers in Kumasi and Tamale in relation to their willingness to separate leather offcuts moving forward. Willingness of local footwear producers to give out their leather offcuts was positive. For local footwear producers in Kumasi, readiness to give out leather offcuts for free and without any conditions while local footwear producers in Tamale indicated a willingness to do so if specific conditions were met. Local footwear producers in Tamale reported that they will only donate leather offcuts that were small-sized or few in quantity for free and charge a fee for huge quantities and large-sized leather offcuts.

The mode of collection that was predominantly emphasised was pick up by collectors at the footwear production centres. However, few respondents in both Kumasi and Tamale indicated their readiness to send leather offcuts to designated points provided transportation costs will be paid for by collectors. Frequency of collection preferred by local footwear producers in both Kumasi and Tamale depended on the production cycle which varied from person to person. While majority of the local footwear producers in Kumasi emphasised an average of two weeks as the duration within which they can get enough leather offcuts for collection, local footwear producers in Tamale indicated three to four weeks. This suggests the need for more collection visits in Kumasi than in Tamale. This finding is important because local footwear producers in both cases reported that they had limited space to be able to keep the leather offcuts for collectors beyond the agreed upon collection period.

Findings from the study suggests some use of leather offcuts and no use of footwear buffing dust among respondents in both case studies. Usage practices associated with leather offcuts identified in the study contrasted findings in the general literature (Kowalski, 1997; Balamurugan et al., 2014; Jiang et al., 2016) on the use of scientific approaches. This finding is not surprising because local footwear producers included in this did not have the knowhow and infrastructural requirements associated with secondary and chemical recycling approaches (Ignatyve et al., 2014; Grigore, 2017). Despite this, the alternative uses of footwear buffing dust suggested by some respondents in both case studies mirrored the ideas explored in literature (Senthil et al., 2014; Kiliç et al., 2017; Kowalski, 1997). Evidences of the use of leather offcuts for making crown designs, supporting the nose of slippers, making thongs, and fixing of fasteners support arguments in other studies about employing leather offcuts for decorative purposes (Kushwaha and Swami, 2016; Stan et al., 2014) and for small items (Arthur, 2021). Nevertheless, while leather offcuts were used broadly in the leather products industry in the studies above, most respondents in this study experimented with leather offcuts only in the footwear production industry.

Use of leather offcuts for footwear related items indicates a narrow framing of reuse possibilities among respondents in contrast to strategies highlighted by Arthur (2021) to be adopted by second cycle students in Ghana. Items such as watch straps, bag handles, book jackets, and purses as well as reuse of leather offcuts for practicing techniques, making prototypes and testing dyes identified in Arthur's (2021) study did not come up in this work. This difference may be because students have an incentive to explore new things in comparison to practitioners. Like the study by Ashton (2018), size and colour played a key role in determining the suitability of leather offcuts for reuse in this study. Nevertheless, only large leather offcuts were considered useful among respondents. In Ashton's (2018) reverse logistics flow model, reuse was design driven as the manufacturers created specific footwear designs that allowed them to maximise the use of their leather offcuts. In contrast, respondents in this study worked with already existing designs and mapped this on to the leather offcuts available to see if they could find anything useful. Therefore, the respondents explained that leather offcuts were used occasionally because the characteristics of leather offcuts generated did not match changing fashion trends.

The use of collectors like Zoomlion, the "aboboya boys" and the Kumasi Metropolitan Assembly identified in the case of Kumasi is not new. In a study by JICA (2005), it was reported that third party institutional players in private sector, governmental or non-governmental circles play key role in municipal waste management. In addition, arguments by Hazra et al. (2009) about the potential that ineffective waste collection systems have to foster poor waste management strategies is evidenced in this study as findings showed that open dumping and outdoor burning (Onwughara et al., 2010) occurred only when third party collectors failed to pick up wastes. Darku (2015), in a study focused on the Kumasi Metropolitan Assembly also found that the pay as you dump systems encourages waste minimisation among households. Therefore, respondents in the study who used the pay as you dump system may be more prudent in their waste generation activities.

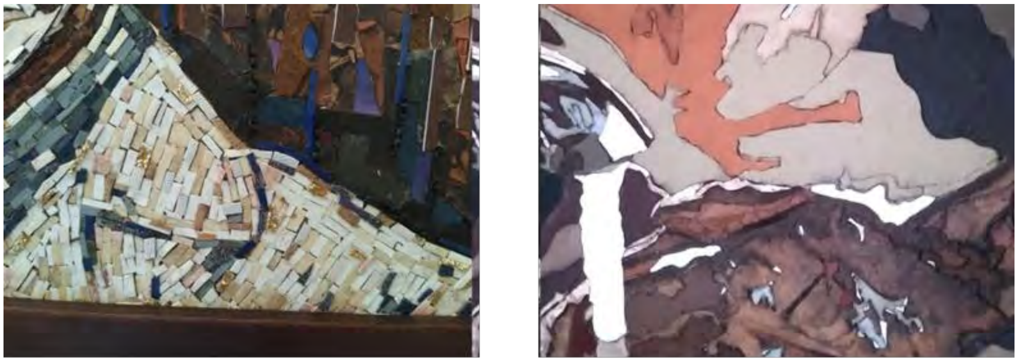
Regarding disposal of leather offcuts and footwear buffing dust, findings showed that dumping at uncontrolled sites was a preferred strategy. This finding is like arguments by Yilmaz et al. (2007) who suggested that dumping and landfilling were the most common strategy for managing waste. It was observed that most respondents in both case studies mixed leather offcuts and footwear buffing dust with other solid wastes such as food wrappers and sachet water bags. Although a study by Nwachuku et al. (2010) showed that households and organisations in developing countries were unwilling to separate their waste, findings from this study indicated the opposite in line with studies by Gyimah (2018). Perhaps, respondents in this study were overestimating their willingness to participate in recycling in line with assertions by Gamba and Oskamp (1994); hence there may be a need for triangulations to validate the results. Despite this, reasons given by respondents for their positive outlook seemed compelling as they saw money saving opportunities from keeping disposal fees when they give out their leather offcuts and footwear buffing dust to recyclers.

Concerning mode of collection, findings from the study showed a preference for door-to-door collection rather than drop off at curb side or designated points (Ibanez-Fores et al., 2018). This finding supports the results in a study by Boateng (2016) which focused on Kumasi. However, reasons in the literature (Yadav and Karmakar, 2020; Boateng, 2016) like convenience and hygienic benefits which drive household preference for pick-up collection did not come up in this study. Respondents opted for pick-up for cost saving reasons. This was evidenced in the willingness of a few respondents to choose drop-off should financial incentives be made available. Regarding preferred collection frequency, results from the study indicated some amount of uncertainty among respondents with an emphasis on production cycles; thus, suggesting that there could be a potential mismatch between current waste collection schedules and when separated leather offcuts and footwear dust would be available for collection.

4.5 Objective 4: Use of Leather Offcuts for Two-dimensional Artwork

Objective 4 of the study explored the suitability of leather offcuts for two-dimensional art techniques. The mosaic and marquetry techniques were employed. Through experimentation, findings from the studio work revealed that leather offcuts had the ability to be shaped. Due to their flexible nature, most of the leather offcuts were easy to shape to fit specific patterns. Nevertheless, some of the leather offcuts were difficult to cut due to their thickness. Increased thickness was due to the type of leather or the use of lining at the flesh side of the leather offcuts. Ease of cutting also depended on the tool used with the shears emerging as an effective tool for cutting of the leather offcuts.

The size of patterns also featured as an important factor that affected the ease of cutting leather offcuts. It was observed that the cutting of leather tesserae for the mosaic artifact required more work due to their small sizes. While the mosaic work required small centimeter-sized tesserae, patterns used in the marquetry work were larger (Figure 40).



A B

Figure 40*: Size of tesserae (A) vis-a-vis size of puzzle segments (B)*
Source: Field study, 2021

Results from the studio work showed that the leather offcuts could adhere well to each other and to surfaces. With the help of bonded glue, the leather offcuts used in both artworks were able to stick properly to the support. However, the small sizes of the tesserae for the mosaic work made picking and gluing by hand tough, when compared with the patterns used for the marquetry work. Hence a broom stick served as a useful improvised tool for easy picking and gluing of leather tesserae.

Findings from the study also indicated that leather offcuts could depict a composition. Access to different shades of colours in the right quantity was a bit challenging. However, this was not a problem for implementing the mosaic technique because of the small sizes of the tesserae used in building the image. For the mosaic work, tonal gradation was easier to depict when the tesserae were very small. Additionally, using small leather pieces helped to bring out the solidity of the composition portrayed. Multiple layers of overlapping leather offcuts used in the work enabled portions of the face (e.g., forehead, nose mask) to stand out from the support in a relief form (Figure 41 on page 156).

For the marquetry technique, the colour options available was important in depicting the composition. This was because, specific colour shades of leather were needed to fill segments in the artwork, but this was not always possible. Nevertheless, there were alternatives that worked well. In one instance, the artists' design required a particular shade of brown for segments of the marquetry work. But this was not available; thus, leading to the use of different shades of brown (Figure 42 on page 158). In another example, leather offcuts of the same shade were available in small sizes and necessitated joining to be able to complete the pattern. Joining introduced additional lines into the work which altered the original design.

Figure 41*: Relief effect in the leather mosaic artwork*
Source: Field study, 2021

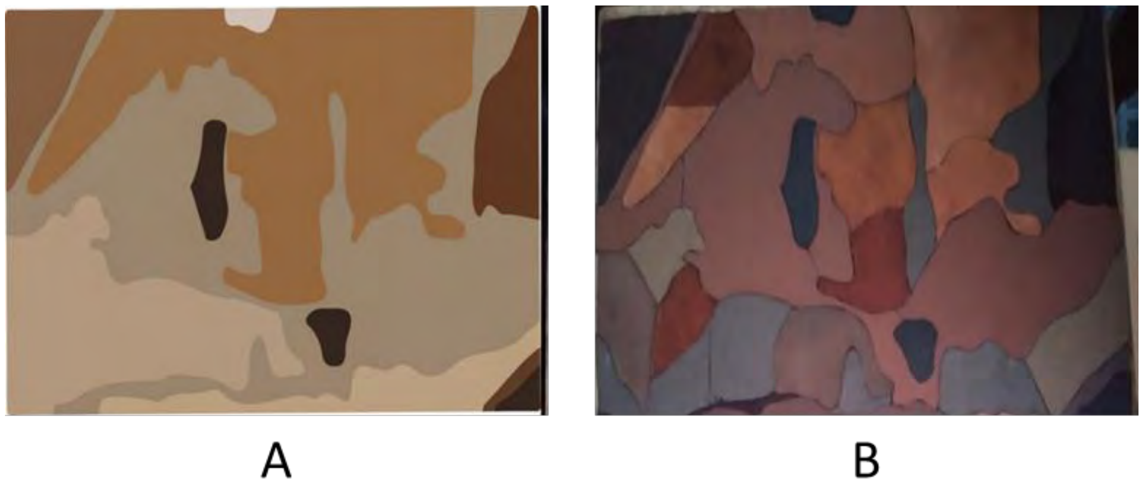


Figure 42*:* Marquetry composition on computer (A) against actual artwork (B)
Source: Field study, 2021

The researcher experimented with scorching and pyrography in the leather marquetry artwork. Scorching was done by applying heat to the leather while pyrography was conducted by applying heat to the support (plywood). This experiment revealed that scorching provided more solidity to the work (i.e., the lower arm) making it more visible. Extreme care was required in this process as some of the leather offcuts were synthetic and not compatible with heat. Pyrography, when implemented, gave a look that was not deep enough; therefore, a black colour pencil was used to deepen the pyrography effect. Nevertheless, pyrography blended well with the leather marquetry artwork.

In all two techniques, the researcher tried using the grain and flesh side of the leather offcuts concurrently. This experiment revealed that leather offcuts provided opportunities variety in the overall appearance of the finished two-dimensional artworks. With this new combination, colour options were expanded, and different texture effects recorded. Texture effects included varied surfaces such as smooth, glossy, rough, and matte. To this end, the studio assistant remarked: “the texture effect in the work is interesting; once you turn the grain side of the leather, everything changes". These variations in texture were also evident when the flesh side of the leather offcuts were used due to the different types of leather offcuts. It was also observed that the different thickness of leather offcuts used created a rise and fall effect that was unique.

4.5.1 Discussion: Objective 4

The primary recycling method suggested by Grigore (2017) worked well as leather offcuts were used without any change in their physical and chemical properties to restore their lifecycle. Findings from the studio work showed that cutting is inevitable irrespective of the size and shape of leather offcuts in two-dimensional artwork production, in line with the principles of assemblage (Seitz, 1961). Nevertheless, leather offcuts were less stressful to cut using simple tools because it was softer in comparison to other materials like glass, porcelain and wood. Cutting of leather offcuts did not require any specialised training or sophisticated tool. Leather offcuts successfully depicted the image portrayed in the composition that guided the mosaic and marquetry artwork construction. For the mosaic work, leather tesserae fit together well to create the needed flow in the work (Office of Literacy and Essential Skills, Canada, 2010). There was evidence of vertical and horizontal arrangements of tesserae; however, laying patterns did not perfectly follow the common approaches in mosaic art suggested by Drostle (2008). Tesserae were placed not only side by side each other but also on top of each other with uneven and less visible grout lines. Besides, the mosaic work featured a relief look in contrast to the flat surface usually depicted in other mosaic work.

Leather offcuts were able to depict colour tone variations and the jigsaw puzzle pattern suggested in the literature to be unique to the marquetry technique (Edwards, 2012; Ozarska, 2013). These arrangements connected well to form the image depicted in the composition that guided the artwork construction. Scorching changed the colour tone of an aspect of the work (i.e., the hand) to improve the overall solidity of the artwork. Thus, scorching could be considered a technique, synonymous to the hot sand shading technique used to enhance the effect of a wood marquetry artwork (Edwards, 1993). The use of scorching, pyrography and colour pencil shading created a mixed media work that fit well together.

Considering the time and cost implications of using the mosaic and marquetry techniques in for recycling the leather offcuts, it is important to think about the economic value of the artwork produced. It is possible that the price of the two-dimensional artworks produced would be higher than existing prices of similar artworks made from different media on the market. Nevertheless, the uniqueness derived from using the leather offcuts for these artworks put the recycled artist in a position to charge a premium; thus making the industry attractive economically. This may require customizing the artworks so that they move beyond serving a functional need to addressing the emotional needs of clients.

The results above show slight differences in the suitability of leather offcuts for two-dimensional artwork using different techniques. While findings from the study revealed that all leather offcuts, irrespective of their characteristics, were useful for mosaic work, only leather offcuts of specific sizes and quality were suitable for the marquetry technique. In the case of the marquetry work, small sized patterns were joined when needed to fill a segment. However, the researcher foresees that tiny leather offcuts could lead to too many puzzle pieces and joint lines that could detract from the beauty of the artwork. Additionally, the use of tiny puzzle pieces could make the technique time consuming. Notwithstanding, the mosaic technique came across as the most demanding technique in terms of time. In both techniques, effective planning of the implementation of the artwork based on an analysis of the leather offcuts available was of utmost importance. Further, leather offcuts provided several opportunities for uniqueness in the artwork. This was evidenced by the rise and fall, and varied texture effects mentioned in the results.

Overall, the mosaic and marquetry techniques were useful for waste management through recycled art. The studio work conducted showed that leather offcuts generated by others can be used to create an upcycled artwork. Umoru-Oke & Adekanmbi (2018) cautions artists to be mindful of the waste they also generate in their artwork production activities. Cutting of leather offcuts found in the study suggests the generation of residual offcuts in the up-cycling process used. Nevertheless, it appears that each of the techniques support the waste management agenda at different levels of the waste management hierarchy (Abdul-Rahman, 2014; Vats, 2016; Halkos and Petrou, 2018). While mosaic works as a good technique for waste prevention in the artwork production process, marquetry focuses more on waste minimisation. This difference is due to the size of tesserae used in the mosaic work in comparison to the patterns in the marquetry work. Therefore, the researcher in the studio work used the residual offcuts from the marquetry work in the mosaic work since both artworks used similar colour tones to minimise residues.

4.6 Objective 5: Experimenting with Footwear Buffing Dust

Objective five of the study experimented with footwear buffing dust to determine its suitability for sculpturing. The researcher experimented with the modelling and casting techniques in sculpture work. Results obtained are summarized below.

4.6.1 *Modelling with footwear buffing dust*

Data analysis on the modelling experience assessed the cohesion, workability, malleability, adhesion, and aesthetic properties of footwear buffing dust through practice. Findings from the art experimentation process showed that footwear buffing dust mixed well bonded glue despite differences in the footwear buffing dust particle size. With the help of the bonded glue, footwear buffing dust had good cohesion and proved capable of sticking together to form a united whole. The art experimentation also revealed that footwear buffing dust was workable. This was evident in the ability of the bonded glue-footwear buffing dust mixture to withstand handling for a long period of time before hardening. On average, the researcher and the studio assistant were able to manipulate the bonded glue- footwear buffing dust mixture for 10 to 15 minutes in the modelling process. After manipulation, the bonded glue - footwear buffing dust mixture dried at a very slow pace with the first application taking an average of 3 hours to obtain a reasonably dry surface for both modelled works. The second and third applications also took 72 hours and 24 hours respectively to completely dry.

Results also show that footwear buffing dust had limited malleability properties. It was observed that footwear buffing dust could not be easily pressed into shape without breaking. To make modelling possible, the bonded glue- footwear buffing dust mixture had to be applied in thin layers on the armature. Each layer needed to surface dry before the next layer of bonded glue- footwear buffing dust mixture could be applied. Findings from the usage experience indicated that ease of spread of the bonded glue- footwear buffing dust mixture varied based on texture. While the very coarse footwear buffing dust sample used for the foot were uncomfortable to spread, the fine footwear buffing dust particles used for the rabbit were easy to manipulate.

Limited malleability made it problematic to cut through the partially dry bonded glue- footwear buffing dust mixture to create intricate designs. For example, lines that portrayed the toes of the foot could not be deepened to make the toes stand out properly. Initially, the researcher assumed that this difficulty may be a result of the hard nature of the Styrofoam used for the armature of the foot. Therefore, the modelling of the rabbit adopted a slightly different approach where clay was used first to model the rabbit; after which the bonded glue-footwear buffing dust mixture was applied. Despite this, there were still challenges with creating the details required to make some parts of the rabbit distinct.

Figure 43 shows differences in the extent to which clay was able to reveal a deep groove for the eye of the rabbit in comparison to that modelled from footwear buffing dust.

Figure 43*: Differences in the ability of footwear buffing dust to reveal details against clay*

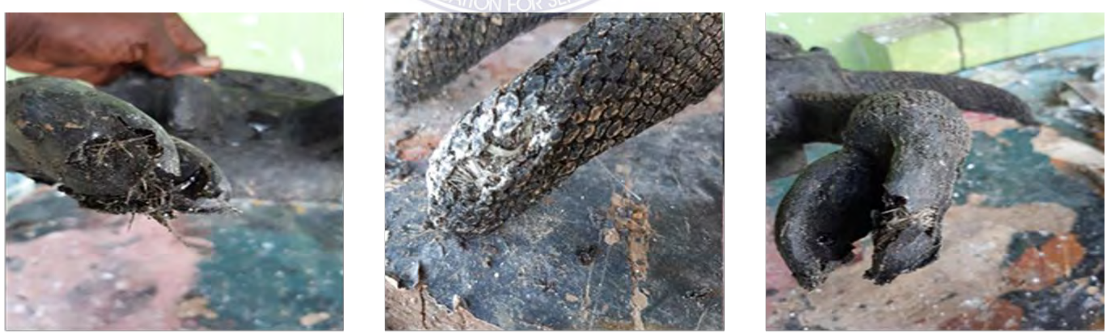
Source: Field study, 2020

Findings revealed that the adhesion property of the bonded glue- footwear buffing dust mixture depended on the material to which the mixture was adhered to. It was observed that the bonded glue- footwear buffing dust mixture did not adhere properly to Styrofoam when freshly mixed due to its smooth surface. This was evidenced by the dripping of the mixture at one side of the miniature foot in the early stages of the application. Therefore, the researcher and the studio assistant had to use clay to support that portion of the work until the mixture started to settle. Footwear buffing dust on the other hand proved capable of adhering easily to clay. The study showed that the bonded glue- footwear buffing dust mixture stuck to the surface of the clay right without need for a support.

Regarding aesthetic appearance, findings revealed that footwear buffing dust gave a unique texture effect that made the artifact look real irrespective of the footwear buffing dust particle size. There were differences in the colour of the artefacts with the foot showcasing a multi-coloured appearance of red, yellow, and orange. In contrast, the modelled rabbit featured a dark grey colour. Colour differences were a result of the variances in footwear buffing dust particle sizes (see section 4.3.3 on the characterisation of footwear buffing dust by colour). According to the studio assistant, the natural colour options inherent in footwear buffing dust is a plus because it makes the artifact attractive without finishing.

4.6.2 ***Casting with footwear buffing dust***

Findings from the preliminary footwear buffing dust binder experiment indicated that contact glue ad bonded glue were not effective for casting using footwear buffing dust. They produced footwear buffing dust composite with very slow setting times and poor adhesion. Resin showed potential for casting, hence its use in the main artwork construction. Reflection on the usage of footwear buffing dust in casting the artwork centred on the issues of fluidity, setting speed, shrinkage, and portability. To understand the fluidity property of footwear buffing dust, the researcher experimented with different proportions of resin in putting together the resin- footwear buffing dust mixture for casting. The first mixture used a proportion of 500mls of resin to 0.17kg bottles of footwear buffing dust for the first coat of the resin- footwear buffing dust cast work. Observations showed that this ratio of resin to footwear buffing dust was less fluid. Therefore, the resin- footwear buffing dust mixture derived was unable to enter some of the corners of the abstracted crab mould to pick intricate designs leading to some defects (Figure 44 on page 164). Nevertheless, the researcher was able to correct the identified defects using a spatula to apply additional resin- footwear buffing dust mixture to defected spots. For the second and third applications, the proportion of 250mls of resin to 0.17 kg of footwear buffing dust worked. This was because, the mixture for the second and third applications were meant to fill the space in the mould rather than pick intricate designs.



A B C

Figure 44*: Defects in work cast with resin-footwear buffing dust mixture of 500mls to 0.17kg*

Source: Field study, 2020

To improve fluidity of the mixture, the casting process was repeated a second time using a resin to footwear buffing dust ratio of 500mls of resin to 0.086kg of footwear buffing dust for the first application. This revised ratio led to an improvement in the fluidity of the mixture. Observations revealed that this formulation was light enough to penetrate all the corners of the mould. Thus, the cast work came out upon solidifying with no defects. A total of seven 0.6kg of footwear buffing dust and 1000mls of resin was used to produce the entire work i.e., for the first, second and third applications.

Setting time for the resin- footwear buffing dust sculpture was fast. Overall, production time stood at one hour twenty-five minutes. This included the time spent in creating the resin- footwear buffing dust mixture, conducting the first application, positioning the fibre into the mould, and applying the second and third layers of the resin-footwear buffing dust mixture. The use of an accelerator and a hardener, in line with practices established in casting with plaster helped to speed up the setting time.

Applying lessons learnt about the proportions of resin to footwear buffing dust, casting of the resin- footwear buffing dust table was easier. Findings showed that the same proportion of resin to footwear buffing dust used in casting of the abstracted crab vase was applicable. However, total production time was less at forty-two minutes since the artefact had a much simpler design and was hollow. Both cast works showed no evidence of contraction on cooling; thus, suggesting that shrinkage was not an issue with footwear buffing dust in casting.

To allow for a comparison of the features of footwear buffing dust with plaster of Paris, the researcher repeated the casting process for the abstracted crab using a resin-Plaster of Paris mixture. Findings from this study showed that a resin-Plaster of Paris ratio of 250mls of resin to 0.0867kg of Plaster of Paris worked well for the first application. A total production time for resin- Plaster of Paris sculpture was one hour twenty-two minutes. Thus, although the chemical composition of footwear buffing dust varied from Plaster of Paris, the setting time for the cast resin- Plaster of Paris flower was the same as that for the resin- footwear buffing dust flower vase because of the equal quantity of accelerator and hardener was used. Findings also showed that although the same quantity of resin (i.e., 1000 mls) was used, more Plaster of Paris (0.95kg) as opposed to 0.6kg in the footwear buffing dust case was needed to produce the same artwork. Thus, less footwear buffing dust was used in comparison to Plaster of Paris to produce the same abstracted crab vase.

Regarding portability, findings indicated a difference in favour of footwear buffing dust. While the cast sculpture made from footwear buffing dust weighed 1.785kg, the Plaster of Paris sculpture weighed 3.2kg. Therefore, footwear buffing dust offered an opportunity to create more portable artworks than Plaster of Paris. From the studio assistant's perspective, the light nature of footwear buffing dust is an important feature that will be beneficial to sculptors and their clients. According to him, some of his clients have made remarks in the past that suggest their preference for lighter sculpture pieces. He remarked:

> "With footwear buffing dust, transporting a finished work from the production site to the client will be stress-free. I specialize in portable table top sculpture and sometimes when they are too heavy, they are not suitable for placing on glass living room tables".

4.6.3 *Results from Experiments*

Experiments focused on testing the suitability of footwear buffing dust sculpture for indoor and outdoor use. Appropriateness of footwear buffing dust sculpture for indoor purposes was determined through the enzymatic test while suitability for outdoor use was established using a water resistance test. The tests were conducted for outputs from the modelling and casting works. The following paragraphs show results from the experiments.

4.6.3.1 Enzymatic test (Modelled Work)

Findings from the observation of footwear buffing dust modelled work revealed no change in the look of the modelled work after subjection to humid conditions over the one-month period. There was no evidence of microbial action and effect on the modelled work. This suggests that footwear buffing dust and bonded glue composites are resistant to decomposition and may be suitable for indoor use.

4.6.3.2 Enzymatic test (Cast Work)

Findings from the observation of cast work showed no evidence of mould generation on the surface of the cast work in the first three weeks of subjection to humid conditions. Nevertheless, the cast work revealed some changes in the appearance of the artefact in the fourth week. Changes comprised small white spots on certain parts of the artwork and reduction in the glossy effect of the artefact (Figure 45 below). This suggests some reactions in the footwear buffing dust and resin composite that needs further investigation in the laboratory.

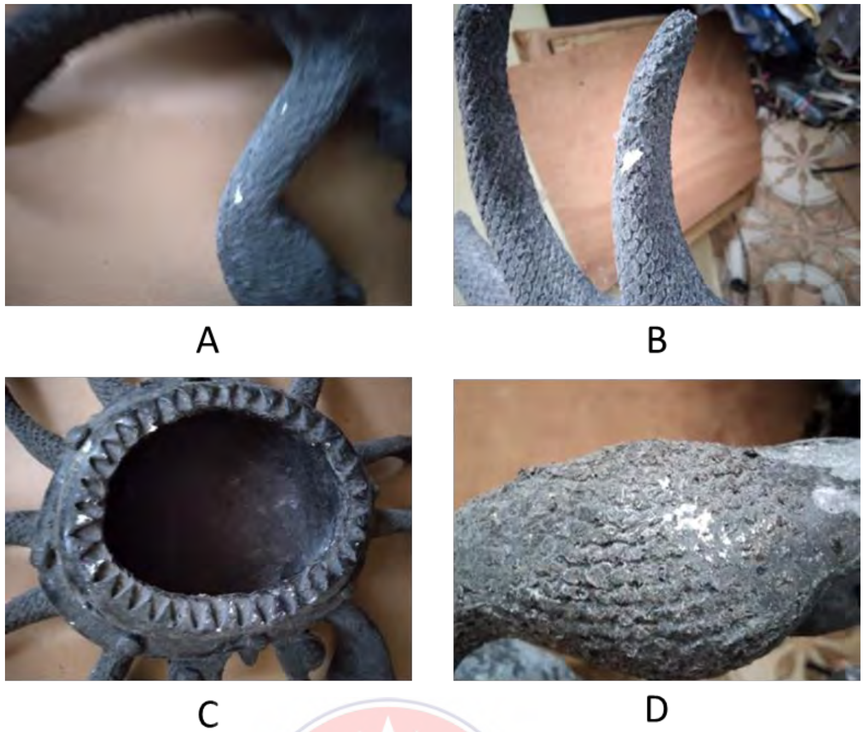


Figure 45: Evidence of White Spots after Enzymatic Test
Source: Field study, 2020

4.6.3.3 Water resistance test (Modelled Work)

The researcher anticipated that bonded glue-footwear buffing dust composite will absorb water due to the water-soluble nature of the glue. Therefore, experimentation with the modelled work without finishing involved the pouring of drops of water on the artifact. This suspicion was confirmed as the drops of water mixed with the glue and gave a whitish look. Therefore, the researcher chose to experiment on the extent to which the water-resistant features of the bonded glue-footwear buffing dust composite could be improved by lacquering. Findings from this second experiment indicated that the bonded glue-footwear buffing dust composite improved in its water-resistant ability. The drops of water poured on the lacquered artefact suspended (Figure 46).

A B

Figure 46*: *Effect of water on lacquered and on-lacquered modelled work
Source: Field study, 2021

4.6.3.4 Water resistance test (Cast Work)

Findings from the water-resistant test regarding the cast work showed that the resin-footwear buffing dust composite had water resistant features irrespective of the use of a finish or not. Therefore, the cast sculpture made from the resin-footwear buffing dust mixture weighed 1.785kg before exposure to water and 1.856kg after exposure to water for 24 hours. A porosity rate of 0.071% was obtained signifying that approximately 0.1% of the resin-footwear buffing dust composite has void spaces that can absorb water.

4.6.3.5 Experimenting with Finishing Techniques for Footwear Buffing Dust Table

Findings showed that finishing with lacquer was an effective approach in preserving the glossiness of the resin-fibre footwear buffing dust composite. The table top produced did not exhibit any changes in colour or brightness within the one-month period following the application of lacquer. Similarly, finishing with paint (auto shine) and lacquer gave room to improve the attractiveness of the table. The resin- fibre footwear buffing dust composite was able to absorb and retain the paint in a uniform way to depict the design used.

Findings from the studio work on finishing the table top with leather offcuts using the mosaic technique led to interesting revelations. It was observed that the contact glue used did not adhere properly to the resin-fibre footwear buffing dust composite. Initially leather offcuts stuck well to the composite, but after keeping it in an airtight environment for about two hours, the leather offcuts started to come off. This was the case for about 70% of the pasted leather offcuts. Silicon sealant was then used to rearrange the leather offcuts in the mosaic pattern preferred. Findings from the studio work showed that leather offcuts adhered with silicon glue stayed in place even after the table top was subjected to an airtight environment.

4.6.4 *Discussion – Objective 5*

Modelling used the secondary recycling method suggested by Grigore (2017) where the physical properties of footwear buffing dust was changed from powdery to solid to restore its lifecycle. For casting, the binder used reacted with the footwear buffing dust causing a physical and chemical change to the material; thus, suggesting the use of chemical recycling (Grigore, 2017). Bonded glue worked well as a suitable binder when using footwear buffing dust for modelling. This result mirrors findings in previous experiments conducted by Sakoalia et al. (2019) although their study focused on a different material (i.e., groundnut shell). Findings from the study showed limitations about the malleability properties of footwear buffing dust in contrast to clay which lends itself easily to shaping (Jin, 2017). Nevertheless, the white glue- footwear buffing dust mixture was workable and easier to manipulate over a long period time before drying. Footwear buffing dust was also limited in terms of adhesion properties as it worked well only on clay; Styrofoam was too smooth to support good adhesion with the white glue- footwear buffing dust mixture. Results also indicated that footwear buffing dust was unable to effectively depict intricate designs in the artwork in comparison to clay. Thus, it could be argued that footwear buffing dust can be used for modelling with limitations.

Regarding casting, results from the study suggested resin as the most effective binder in line with proposition by Timmermans (2018). Resin in combination with footwear buffing dust worked like plaster exhibiting features of fluidity, quick setting time and resistance to shrinkage upon solidifying. However, findings show that, given the same quantity of footwear buffing dust and Plaster of Paris, more resin is needed to obtain the right fluidity in a resin- footwear buffing dust mixture that can pick intricate designs in a mould. This could have negative implications on cost as resin is an expensive binder (Timmermans, 2018). Nevertheless, findings also showed that less footwear buffing dust, in comparison to Plaster of Paris, is need to complete a given sculpture artwork.

The quantity of footwear buffing dust used stood at seven 250mls bottles while that for Plaster of Paris was eleven 250mls bottles. Besides, footwear buffing dust used was free offering cost advantages in line with arguments made by Mensah et al. (2013) on the rationale for exploring new materials in sculpting. According to results presented in objective 1 of this study, it has also been established that availability challenges highlighted by Mensah et al. (2013) may not be an issue for footwear buffing dust. It is also important to mention that footwear buffing dust showed an advantage over Plaster of Paris in terms of portability.

CHAPTER FIVE

SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

5.1 Overview

This chapter outlines the major findings, conclusions, and recommendations of the study. It highlights the contributions of the study to knowledge and the implications of key findings and conclusions for theory. The chapter also makes suggestions for future research.

5.2 Key Findings

The overall aim of the study was to investigate the extent to which solid waste generated in the local footwear manufacturing industry in selected metropolises in Ghana can be used for recycled art. The research focused on leather offcuts and footwear buffing dust in the Kumasi and Tamale Metropolises. Key findings unravelled in this expedition are presented based on objectives below.

5.2.1 *Objective 1*

Objective 1 of the study investigated the factors that influence the generation of leather offcuts and footwear buffing dust by local footwear producers and footwear buffing operators in Kumasi and Tamale. Results from this inquiry indicated the following:

1. Footwear pattern, quality of leather offcuts and size of the leather sheet constitute the main drivers of leather offcuts generation rate among local footwear producers in Kumasi and Tamale. Footwear buffing dust generation depends on the thickness of the outsole and the work setting.

5.2.2 *Objective 2*

Objective 2 of the study examined the visual appearance of leather offcuts to determine their characteristic features. Findings from this research showed the following:

2. Leather offcuts generated in Kumasi had less defects than leather offcuts in Tamale. Leather offcuts in Kumasi were considerably larger in size than leather offcuts in Tamale. Leather offcuts in Kumasi offered more colour variety than leather offcuts in Tamale. Leather offcuts obtained in Kumasi offered more varieties in terms of surface quality finishing. Footwear buffing dust particles offer variety in terms of texture and colour.

5.2.3 *Objective 3*

Objective 3 of the research investigated practices on the usage and disposal of leather offcuts and footwear buffing dust among respondents. Findings revealed the following:

3. Local footwear producers in Tamale reused leather offcuts more than in Kumasi. However, reuse of leather offcuts was occasional for local footwear producers in both metropolises. Lower usage levels were due to local footwear producers' perception that leather offcuts had physical characteristics that made them not useful for footwear related activities. None of the footwear buffing operators used the footwear buffing dust generated. Footwear buffing dust was not used because footwear buffing operators perceived having limited knowledge of reuse strategies.
4. Disposal of leather offcuts and footwear buffing dust is done by dumping on landfills by third party collectors for a fee. However, local footwear producers and footwear buffing operators in the study are willing to separate and donate leather

offcuts and footwear buffing dust at no or low cost. Door-to-door collection is most preferred.

5.2.4 *Objective 4*

Objective 4 of the research explored the extent to which leather offcuts can be utilized for two-dimensional art techniques to prevent waste. Findings revealed the following:

5. All leather offcuts can be employed for mosaic art; however, only leather offcuts that offer colour contrast and good quality are suitable for the marquetry technique. This is due to the differences in the size of patterns used.
6. Cutting is inevitable in using leather offcuts for two-dimensional artwork. Nevertheless, mosaic facilitates complete usage of leather offcuts while marquetry generates minimal residual offcuts.
7. The characteristics of leather offcuts lead to different texture effects in 2D artwork.

5.2.5 *Objective 5*

Objective 5 of the study experimented with footwear buffing dust as alternative material for sculpturing. Highlighted findings are as follows:

8. Bonded glue worked well as a binder in using footwear buffing dust for modelling. Footwear buffing dust lacks some of the characteristic features of materials that are suitable for modelling. Key features such as malleability and adhesion strength are inadequately present with some degree of workability.
9. Resin worked well as a binder in using for casting. Footwear buffing dust possesses all the characteristic features of materials considered suitable for casting. The

feature of portability is an additional benefit of footwear buffing dust in comparison to traditional materials.

10. White glue footwear buffing dust composite is not water resistance when unfinished. Finishing with lacquer improves its water resistance properties of the material.
11. Resin footwear buffing dust composite is not water resistance with or without finishing.

5.3 Conclusions Drawn from the Study

Based on the above-mentioned findings, the researcher makes the following conclusions from the study:

1. Leather offcuts and footwear buffing dust generation depend on production related factors. Therefore, leather offcuts and footwear buffing dust is likely to be available for recycled art so long as production continues.
2. Leather offcuts and footwear buffing dust in Kumasi have characteristic features that offer several options for recycled art in comparison to leather offcuts in Tamale. Nevertheless, local footwear producers and footwear buffing operators in Kumasi have limited time to sort them from Municipal Solid Waste.
3. There is limited usage of leather offcuts and footwear buffing dust among local footwear producers and footwear buffing operators in Kumasi and Tamale. Local footwear producers reuse leather offcuts mainly in footwear related activities. Local footwear producers and footwear buffing operators' constrained recycling knowledge provided a narrow scope for the usage of leather offcuts and footwear buffing dust.

4. Cost of leather offcuts and footwear buffing dust is likely to be low up until the time that they become successfully commercialised. Therefore, leather offcuts and footwear buffing dust are cost effective materials for recycled artwork.
5. Visual characteristics are important determinants of the usefulness of leather offcuts for marquetry, in comparison to mosaic.
6. Mosaic is a good technique for art waste prevention while marquetry focuses on art waste minimisation.
7. Leather offcuts provide several opportunities for improving uniqueness in a 2D artwork.
8. Bonded glue is an effective binder for using footwear buffing dust in modelling. Footwear buffing dust can be used for modelling, but with limitations.
9. Resin is an effective binder for using footwear buffing dust in casting. Footwear buffing dust is a suitable material for casting.
10. Modelled work from white-glue footwear buffing dust composite is suitable for indoor use.
11. Cast work from resin footwear buffing dust composite is suitable for indoor and outdoor use.

5.4 Implications of the Study for Theory and Practice

This study has given a systems perspective on solid waste management in the footwear manufacturing industry specifically from generation to utilisation. Up until this study, data on solid waste management in the footwear manufacturing industry in the Ghanaian context was limited. The work indicates that leather offcuts and Footwear buffing dust are suitable for recycled art due to their characteristics. Nevertheless, current stakeholders are unaware of the utilisation strategies they need to employ to make them useful. By experimenting with leather offcuts and footwear buffing dust, the study brings to light options for recycling leather offcuts and footwear buffing dust in sculpture and two-dimensional artwork.

At the beginning of this study, the researcher assumed that recycled artists would depend on others only for their raw materials i.e., leather offcuts and Footwear Buffing Dust in line with arguments made in the resource dependence theory. However, findings from the study show that recycled artists may also depend on artist in other disciplines for their skills to implement creative ideas. This is because, findings from the art experimentation show that moving out of the footwear manufacturing industry into other art areas is crucial in discovering creative recycling options. Thus, recycled artists who wish to use leather offcuts and Footwear buffing dust creatively must be versatile and skilled in multiple art disciplines or be good at collaborating with other artists. To this end, the research confirms the important role of creativity in converting waste into non-waste as outlined in the rubbish theory. Additionally, the study has discovered a way that this creativity can be fostered.

The problem necessitating the study is the negative environmental and health implications that arise from the improper management of leather offcuts and footwear buffing dust. Using leather offcuts and footwear buffing dust through art addresses the environmental concerns because this waste will no more be disposed of in the open to pollute water bodies, soils and air. Nevertheless, the materials are not free from hazardous chemicals embedded in them when used through arts. Therefore, it is important for the recycled artists to use personal protective equipment like nose masks, goggles, ear plugs and gloves while working. Further, footwear buffing dust in its original state is loose and easily inhaled. However, when used for the artwork as shows in this study, it solidifies decreasing the exposure to inhalation.

5.5 Recommendations for the Study

Considering the findings and conclusions drawn from the study, the researcher recommends the following:

1. Visual art researchers should validate the sustained supply of leather offcuts and Footwear buffing dust for recycled art using observational measurement studies conducted over extended periods.
2. Recycled artists should employ collectors who would go round and gather leather offcuts and Footwear buffing dust, sort and package them based on their characteristics for easy access. Packaging material should also be provided by recycled artists to make collection and storage of leather offcuts and Footwear buffing dust less stressful.
3. Visual art academics should research into new design for waste approaches outside footwear manufacturing. Practitioners should be trained on how they can analyse the characteristics of leather offcuts and footwear buffing dust and create art design concepts that will work well with the characteristics of the wastes.
4. Recycled artist should establish an incentive scheme to local footwear producers and Footwear buffing operators to sustain their willingness to give out leather offcuts and footwear buffing dust. Incentives should relate to the line of business of local footwear producers and footwear buffing operators; this could take the form

of the provision of tools, materials, and personal protective equipment as well as periodic free health checks.

5. Recycled artists should experiment with leather restoration and colour changing techniques that can make most of the leather offcuts suitable for marquetry.
6. Recycled artists should combine 2D techniques in their practice to minimise, if not eliminate residual waste from recycled art.
7. Recycled artists should target their artwork to clients in the middle to high class who will appreciate the uniqueness of the leather mosaic and leather marquetry artworks and would be willing to pay a premium for it. This will require an investigation into the deign needs of this clientele. Recycled artists should evaluate their client's acceptability of the 2D artworks made from leather offcuts. The evaluation should capture how much clients would pay for the artworks to enable a cost price analysis.
8. Art professionals and art student practitioners should use footwear buffing dust to model simple artwork designs and evaluate their client's acceptability of the new material for artworks. The evaluation should capture how much clients would pay for the artworks to enable a cost price analysis. Academics and practitioners in the art field should also experiment more with indoor artefacts and simple designs to understand the material more. Safety protocols in the form of wearing protective clothing like gloves, nose masks, goggles and ear muffs should also be prioritised when handling the materials.
9. Art professionals and art student practitioners should employ footwear buffing dust for their sculpture practice and evaluate their client's acceptability of the new

material for artworks. The evaluation should capture how much clients would pay for the artworks to enable a cost price analysis. Academics and practitioners in the art field should experiment with footwear buffing dust for casting larger artifacts and more intricate design. Safety protocols in the form of wearing protective clothing should also be prioritised when handling the materials.

10. Academics and practitioners in the art field should experiment more with white-glue footwear buffing dust composites to understand its usage capabilities for indoor use.
11. Academics and practitioners in the art field should experiment more with rein footwear buffing dust composites to understand its usage capabilities for outdoor use.

5.6 Limitations and Future Research

The study focused on understanding the generation of leather offcuts and footwear buffing dust from a qualitative perspective. Even though this approach helps to establish the existence of the waste materials, quantifying them to understand magnitude is important and can be investigated in future studies. Additionally, further studies could characterize the thickness of leather offcuts by thickness and tensile strength among other to determine their suitability for different artworks. The bulky nature of the work limited the researcher's ability to undertake several tests to understand the properties of the footwear buffing dust. Although the study has established that footwear buffing dust can be used for sculpting, there is need to conduct more tests on the material composition and properties of the new material to determine its suitability for different functional items. Future work could also explore the development of the leather offcuts for textile designs, graphics, leather marche, and picture making. Leather offcuts and footwear buffing dust could also be combined with other materials for artwork production. Finally, footwear buffing dust could also be explored further for two-dimensional art techniques like collage.

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APPENDICES

APPENDIX 1: INTRODUCTORY LETTER

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Ref: SCA/DME/INT/Vol.1/45 **Date:** 11th June, 2020

THE REGIONAL ENGINEER
REGIONAL MATERIALS LABORATORY
CAPE COAST
CENTRAL REGION

Dear Sir/Madam,

INTRODUCTION LETTER – ALBERT KWAME ARTHUR (9181750004)

Albert Kwame Arthur is a final year student pursuing Ph.D, Arts & Culture at the University of Education, Winneba, Graduate School.

He is currently writing his thesis on the topic "***Generation and Utility of Solid Waste in the Local Footwear Manufacturing Industry in Ghana*** and therefore needs your assistance to enable him acquire the necessary information for his thesis.

We are officially introducing him to your organization/institution to provide him with the necessary information and assistance that he might need.

We count very much on your cooperation and understanding in this regard.

Thank you.

Yours faithfully,

Emmanuel Obed Acquah, Ph.D
Ag. Head of Department

APPENDIX 2: RESPONDENT CONSENT FORM

Dear Sir / Madam,

My name is Albert Kwame Arthur, a doctoral student at the University of Education, Winneba. I am conducting academic research on the topic: **Recycling solid waste in the local footwear production industry through art**. The research aims to address the following objectives:

1. To investigate the factors that influence the generation of solid waste by Local footwear producers (LFPs) and Footwear buffing operators (FBOs) in selected metropolises in Ghana.
2. To analyse the visual characteristic features of solid waste generated by LFPs and FBOs in selected metropolises in Ghana.
3. To examine the strategies employed in the use and disposal of solid waste generated by LFPs and FBOs in selected metropolises in Ghana.
4. To explore the extent to which LOs can be utilised for 2D art techniques to prevent waste.
5. To experiment with FBD as an alternative material sculpting to prevent waste.

I would be grateful if you would participate in the study by granting me your time for an interview that will enable me to address the above research objectives.

I assure you of confidentiality in the study which would be achieved through the anonymisation of findings. You have the right to decide which information to share or not to share and whether you would want the interview to be audio recorded or not.

By signing this consent form, I (the participant), agree to be involved in the study and give my consent for my responses and images to be used in reporting the findings from the study.

Daniel Boamoah ______ March, 2020

Participant's Name **Participant's Signature & Date**

APPENDIX 3: OBSERVATION CHECKLIST

CHARACTERISATION OF SOLID LEATHER WASTE (RESEARCH OBJ. 2)

S/N	Size	Notes	Shape	Notes	Colour	Type	Notes	Quality	Notes

APPENDIX 4: INTERVIEW GUIDE

RESEARCH OBJECTIVES 1 AND 3

The researcher is a student at the University of Education, Winneba, who is conducting research on the management of solid leather waste generated among local artisans in the footwear manufacturing industry. All data collected in this study will be solely for academic purposes and will be analysed anonymously. The researcher appreciates your time and values the information provided

Objective 1: Generation of Solid Leather Waste

1. What factors affect the quantity of solid leather waste generated?

Objective 3: Management of Solid Leather Waste

2. How do you use solid leather waste generated?
   - What specific item(s) do you use them for?
     - What methods and techniques do you use? – for example as it is, joining
   - In what way do you use it?
   - Why do you use the LOs and/or FBD generated?
   - Why do you not use LOs and/or FBD and waste generated?
   - Do you think LOs and/or FBD could be useful for anything? If yes, what things?
   - If you choose to keep the LOs and/or FBD, for how long do you keep it?
3. At what point do you dispose of solid leather waste?

- What factors determine the usefulness of solid leather waste?
- What factors determine the disposal of solid leather waste?

4. How do you finally dispose of?
    - If burning where? How?
    - If landfill where? How do you transport?
    - If collection, who? For free or at a cost? How much?
5. To what extent will you be interested in giving out your solid leather waste to private individuals other than those who currently collect? If willing to give out, under what terms and conditions will you do so?
    - Will you be willing to separate solid leather waste generated from other municipal solid waste (e.g. food residues, plastic packaging materials)?
    - For how long can you keep these wastes?
    - Price
    - Mode of collection – collection by private individual, drop off at specific point
    - Frequency of collection

For Footwear Buffing Operators Only

6. What do you know about the negative impact of footwear buffing dust?
    - What experiences have you, or people you know, had about this?
7. To what extent do you use protective clothing?
    - Which specific protective clothing do you use? Why?
    - Which specific protective clothing do you not use? Why?
    - How often do you use them?

APPENDIX 5: GRADING TEST RESULTS ON FOOTWEAR BUFFING DUST

GHANA HIGHWAY AUTHORITY

REGIONAL MATERIALS LABORATORY, CENTRAL REGION, CAPE COAST

SUMMARY OF LABORATORY TEST RESULT

CLIENT: ALBERT KWAME ARTHUR

PROJECT: STUDENT RESEARCH (RECYCLING OF SOLID WASTES FROM LOCAL FOOTWEAR PRODUCTION IN GHANA THROUGH ART)

TECHNICIAN: JOSEPH AMOAH

DATE: 27/06/2022

SAMPLE IDENTIFICATION	GRADING TEST PERCENTAGE BY WEIGHT PASSING B.S SIEVE														ATTERBERG TEST			COMPACTION TEST		CBR TEST			
																				96 Hrs Soaked			
Soil sample label	75 mm	37.5 mm	20 mm	14 mm	10 mm	6.7 mm	5.0 mm	2.36 mm	1.18 mm	600 µm	425 µm	300 µm	150 µm	75 µm	PI %	PL %	LL %	MDD Mg/m³	OMC %	100%	98%	95%	93%
SAMPLE 1 (ABINCHI)	-	-	-	-	-	-	-	-	-	**4.2**	**9.24**	**74.5**	-	**7.195**	-	-	-	-	-	-	-	-	-
SAMPLE 2 (PATASI)	-	-	-	-	-	-	-	-	-	**9.1**	**14.87**	**58.7**	-	**3.55**	-	-	-	-	-	-	-	-	-
SAMPLE 3 (MOORO)	-	-	-	-	-	-	-	-	-	**9.2**	**20.26**	**52.6**	-	**7.515**	-	-	-	-	-	-	-	-	-

NB: RESULTS DO NOT CONSTITUTE APPROVAL BY GHA

CHECKED BY:
SAMUEL DAKE

REGIONAL MATERIALS ENGINEER
NANCY D. ADANE

REGIONAL MATERIALS ENGINEER
GHANA HIGHWAY AUTHORITY
CAPE COAST

APPENDIX 6: COSTING OF RECYCLED ARTWORKS

2D Mosaic Artwork

Description	Estimated Amount (GHS)
Plywood (support)	15.00
Leather offcut	0.00
Binder	10.00
Tracing paper	10.00
Frame	70.00
Labour	150.00
Total	**255.00**

NB: Work completed over 14 days and working 5 hours per day

2D Marquetry Artwork

Description	Estimated Amount (GHS)
Plywood (support)	15.00
Leather offcut	0.00
Binder	10.00
Tracing paper	10.00
Stencil printing	20.00
Base and Paint	25.00
Frame	70.00
Labour	150.00
Total	**300.00**

NB: Work completed over 14 days and working 6 hours per day

FBD Modelled Foot

Description	Estimated Amount (GHS)
Plywood (support), Styrofoam, nails	0.00
FBD	0.00
Binder	10.00
Lacquer	20.00
Labour	40.00
Total	**70.00**

NB: Work completed over 4 days and working 1 hour per day

FBD Modelled Rabbit

Description	Estimated Amount (GHS)
Plywood (support), Styrofoam, nails	0.00
FBD	0.00
Binder	10.00
Auto based paint	20.00
Labour	40.00
Total	**70.00**

NB: Work completed over 4 days and working 1 hour per day

FBD Cast Sprayed/Painted Table

Description	**Estimated Amount (GHS)**
Resin	96.00
Footwear Buffing Dust	0.00
Iron rods	10.00
Accelerator, Hardener, Fiber	35.00
Design Print Out, Paint and lacquer	53.00
Metal stand	70.00
Total	**255.00**

NB: Work completed over 4 days and working 4 hours per day

FBD Cast Flower Vase

Description	**Estimated Amount (GHS)**
Plaster of Paris	10.00
Footwear Buffing Dust	0.00
Silicon	150.00
Clay	10.00
Resin	96.00
Accelerator, Hardener, Fiber	35.00
Labour	40.00
Total	**255.00**

NB: Work completed over 7 days and working 2 hours per day

Cost of silicon increases the cost of production. However, the Plaster of Paris-Silicon mould can be used to reproduce the artwork as many times as possible. Therefore, cost of production decreases as you produce more.

FBD Cast Mosaic Decorated Table

Description	**Estimated Amount (GHS)**
Resin	96.00
Footwear Buffing Dust	0.00
Leather offcut	0.00
Paint and lacquer	48.00
Accelerator, Hardener, Fiber	35.00
Iron rods	10.00
Metal stand	70.00
Silicon	30.00
Labour	150.00
Total	**255.00**

NB: Work completed over 3 days and working 4 hours per day