A STUDIO EXPLORATION OF RUBBER DUST WASTE FROM TYRES AS A SURFACE FOR DRAWING

MAKWA PETER KAMULI

21/U/GMAID/14311/PE

A DISSERTATION SUBMITTED TO THE DIRECTORATE OF RESEARCH AND GRADUATE TRAINING IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OF MASTER OF ART AND INDUSTRIAL DESIGN OF KYAMBOGO UNIVERSITY

OCTOBER, 2024

DECLARATION

I, **MAKWA Peter Kamuli** hereby declare that this dissertation is my original work and has never been submitted to any other institution for the award of a Masters degree.

Signed:..... Date:.....

MAKWA Peter Kamuli

(21/U/GMAID/14311/PE),

APPROVAL

We as University supervisors do hereby confirm that this dissertation was done by the candidate under our supervision.

Signed:..... Date:.....

Kekimuri Joan (PhD)

(Principal Supervisor)

Signed:..... Date:.....

Mr. Ssegujja Joseph

(2nd Supervisor)

DEDICATION

This dissertation is dedicated to my children Kamuli Florence and Kamuli Elijah Boaz

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I thank the Almighty God who has enabled me to accomplish this work. In a special way I thank my supervisors Dr. Joan Kekimuri and Mr. Joseph Ssegujja who spared their precious time to give me the necessary guidance and supervision towards achieving this work.

I extend my sincere appreciation towards my parents for the financial and moral support. I also appreciate my friends Ebayu Caleb, Namukasa Christiner and Wamala Erias with whom we worked tirelessly for the same cause.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF ABBREVIATIONS

SDG: Sustainable Development Goals

ELTs: End of Life Tyres

NEMA: National Environmental Management Authority

GDP: Gross Domestic Product

GIZ: Deustche Gesellschsaft fur Internationale Zusammenarbeit

BAID: Bachelor of Art and Industrial Design

ABSTRACT

The increase in population and urbanization of cities in Uganda has led to accumulation of Solid waste which consists of plastics, textile, glass, medical waste, metal and tyres among others. Recycling methods involving incineration of such waste are highly condemned by NEMA due to health risks that may arise from air and water pollution. A recent report on waste management around Greater Kampala Metropolitan Area (GKMA) in May 2023 by GIZ, a Germany development agency indicates that 50% of solid waste around Kampala is uncollected or poorly disposed in unknown dump sites. Recycling methods involving art and craft practices such as material exploration may contribute towards combating poor waste disposal. This study investigated the possibilities of creating drawing surfaces out of rubber dust waste from tyres as an intervention into its poor disposal. The study was guided by three objectives; To establish the various sources leading to formation of rubber dust waste from tyres; To examine the extent to which artists have explored recycled surfaces for drawing and To produce drawing surfaces using rubber dust waste from tyres. The study adopted an exploratory research design guided by the theory of production with waste and recycling by Klaus Conrad (1997) using in-depth interviews, observation, literature review, photography and studio exploration methods to collect qualitative data. Fifteen respondents involving five casual workers from footwear cottages and ten year III students pursuing Bachelor of Art and Industrial Design were selected using purposive sampling technique to participate in this study. The findings revealed a variety of sources responsible for the production of rubber dust waste from tyres including road abrasion, tyre treading, and tyre manufacturing processes. This study was able to reveal that rubber dust waste from tyres can be manipulated to create drawing surfaces bearing different attributes such as thickness, colour, flexibility and texture as would be determined by the artist. The study recommended that artists should engage in recycling practices as an intervention into poor waste disposal and possibilities of exploring rubber dust as a drawing material to widen the scope of its reuse.

CHAPTER ONE

INTRODUCTION

1.0 Overview

This study set out to explore rubber dust waste from tyres as a surface for drawing. The desire to safeguard our immediate environment through recycling waste into usable products motivated the researcher to conduct this study. This chapter therefore presents the background of the study, statement of the problem, purpose of the study, objectives of the study, research questions, content scope, Geographical Scope, Time Scope, significance of the study, Limitations and definition of terms.

1.1 Background of the study

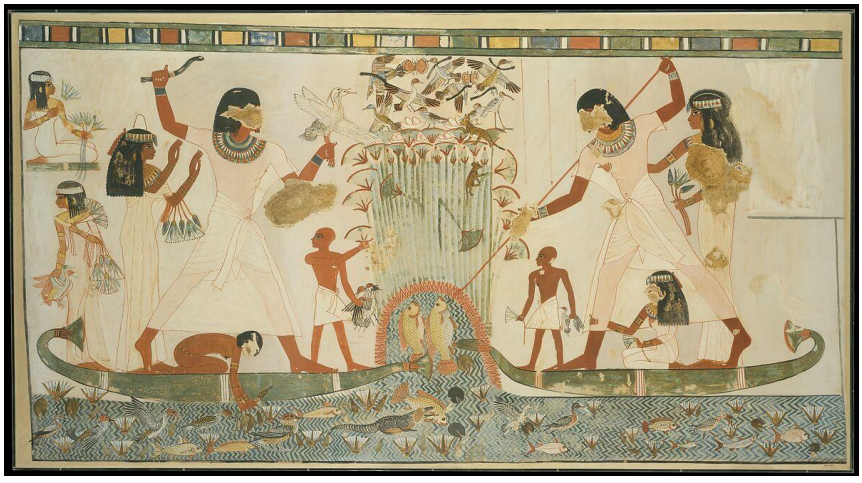
Mayanja (2015) defines drawing as a form of visual expression in which an artist puts a mark on two dimensional surfaces using drawing instruments including but not limited to charcoal, graphite pencils, brushes, paint, ink, crayons, markers and oil pastels among others. Drawing is one of the oldest media of expression according to Otet (2018) which facilitates relations between imagination, perceptions and the depths of the hand and mind. He further explains that drawing possesses the potential to express emotions, feelings and ability to give form to concepts.

In the renaissance period, drawing was considered a necessary support of other forms of expressive media such as sculpture, tapestry and painting among others but was not considered as an autonomous expressive media. Indeed Vasari (1998, p. 85) quoted in (Otet 2018) defined drawing as a starting point of an art work essential to its conception and production but not an art work as such. Basing on his argument, drawing was the inevitable step in a creation of an art work as it served as the foundation or plan for that particular work.

Drawing is as old as human civilization. This is evident with the discoveries of cave drawings in ancient Egypt, Europe and China. Alu (2011) asserts that the discovery of Chauvet and Lascaux caves in France about 30,000 BCE and 17,000 BCE respectively serve an important role in the history of drawing. He adds that drawings found on the walls of these caves depicted real life experiences and figures ranging from plants, animals and human figures. In Egypt for example, when a Pharaoh or rich person died, human figures and animals were carefully arranged along straight lines drawn in plastered walls of tombs to tell a story, usually an event or activities in the life of the deceased. (Alu, 2011). View Figure 1.1 below;

Figure 1.1

Menna and his family fishing



Source: *https://www.metmuseum.org/art/collection/search/548437*

The figure above depicts Menna and his family fishing. Menna was the overseer of all the fields belonging to Amenhotep III the ninth pharaoh of the eighteenth Dynasty of Egypt between 1385 -1355 BC (Fletcher, 2000).

According to Rabie (2018), the size of human figure drawings was relative to the importance of the person, that is to say the pharaoh was usually drawn larger than the wife. The servants, entertainers and outsiders were the smallest of all human figures drawn as can be observed in the figure above.

In China, delicate and detailed line drawings were executed using dilute black ink in cave 85 discovered in the mid fourth century (Wong, 2013). Red line drawings were also added to provide extra detail and to emphasize the lines of important figures as seen in figures 1.2 and 1.3 below;

Figure 1.2

Ink on paper with perforations in cave 85

Source: "The Conservation of Cave 85 at the Mogao Grottoes, Dunhuang" by Lori Wong et al., 2013, published by Getty Conservation Institute, p.185. Copyright 2013 by J. Paul Getty Trust.

The image depicts the use of line drawing using ink in early Chinese civilizations

Figure 1.3

Red line drawing of a central dancing figure on the south wall in Cave 85

Source: "The Conservation of Cave 85 at the Mogao Grottoes, Dunhuang" by Lori Wong et al., 2013, published by Getty Conservation Institute, p.185. Copyright 2013 by J. Paul Getty Trust.

The image depicts how a Chinese draughtsman executed drawings using Inorganic Pigments and Organic Colorants a predominant characteristic of Chinese wall drawings in cave 85 according to Wong (2013).

It is evident that the cave and tomb drawings in early civilizations were generally composed of human and animal figures drawn with purpose and not for drawing's sake. As for the case of Egypt and China most drawings were a depiction of gods and commemoration of life events executed in similar materials, techniques and methods including free hand line drawing applied with natural oxides in red, green and black colours.

As civilizations advanced, so did the sophistication of drawing surfaces. Papyrus, a plant-based material, was one of the earliest forms of paper used by ancient Egyptians and Greeks for drawing and writing. The Chinese, meanwhile, developed papermaking techniques using mulberry bark around the 2nd century BCE.

In the 19th century, the industrial revolution brought about mass production of paper, making it more affordable and accessible to artists and the general public alike. This era also witnessed the introduction of mechanical pencils and graphite sticks, offering new drawing tools and possibilities.

According to David (2013), early drawings in Uganda can be traced from the discovery of rock art in Nyero in Kumi district dated in the Stone Age period before 1250AD. He stresses that drawings of Nyero were largely executed with red and white pigment as material and geometric lines as a technique that makes them homogenous. He also sites other rock art discoveries in Dolwe, Mukongoro, Kapiri and Kakoro within the country later after Nyero. According to Mayanja (2015), drawing in Uganda and world over is no longer purposed only for decoration but also intrinsic value, siting an example of the prominent drawings of Nyero Rock that have been graphically illustrated on the new one-thousand-shilling currency note. He adds that Modern art movements such as cubism, abstract, expressionism, fauvism and surrealism where soot was introduced as a medium in painting were characterized by experimentation and use of various media and techniques.

Akintunde (2017) puts it that for several centuries, the environment has provided habitation for humans and numerous organisms but the insatiable needs of humans have driven them to devise strategies for survival and adaptation, some of which (especially technology) have had direct and indirect consequences on the immediate environment resulting in its degradation.

One of the main challenges of modern society is the rising rate of solid waste generated by man's activities which has poised a major environmental concern (Osayi, 2014). The solid waste referred to as trash or garbage in the United States and rubbish in Britain is a category of waste which comprises of items discarded daily by the public. It consists of house hold waste, construction and demolition debris, industrial/ commercial waste, used electronic equipment, used oil and used tyres among others.

Rubber dust is a bi-product of recycling used tyres which are a global challenge as an estimated 3.2 million tons of used tyres were collected worldwide in 2019 according to the European Association of Tyres and Rubber Producers (Bravo1 & Brito1, 2012), which fundamentally increased by an estimate of 1.3 billion collected worldwide annually (Osayi, 2014). In a recent study, Abraham et al. (2011) found that about 242 million tyres are discarded every year in the United States and these, according to them pose a significant problem of waste disposal in the country. According to Mpanyana (2009), an estimate of 160,000 tons of scrap tyres are generated in South Africa each year with a recycle rate of less than 20 % and about 28 million illegally discarded or burnt to extract steel wire sold as scrap metal whereas in developed countries such as in the United States of America, 98% of an estimated 290 million waste tyres collected annually is fully recycled into fuel, civil engineering and rubber applications among others.

According to Karekho (2022), discarded tyres in Uganda are part of the wider plastic disposal waste challenge that the country is facing. She further adds that used tyres can be observed indiscriminately discarded with in the environment and stock piles in slum areas and outskirts of Kampala and other cities.

Few recycling firms such as Ruma Industries in Luwero and Super Waste Recycling Company Limited in Wakiso recycle used tyres by burning to extract oil used by other factories to burn metal scrap, an activity condemned by NEMA. Rofiqul et al. (2010) contends that waste tyres

arise from the operation and dismantling of end-of-life vehicles and are bulky and cannot be compressed due to their nature which eventually necessitates a lot of land for stock piling.

Okurut (2021) warns that the informal incineration of waste tyres produces toxic fumes that are usually persistent organic pollutants and contribute to the greenhouse gas emissions as well as sludge from melting processes that contaminate soil and water. In avoidance of burning tyres hence forth, Ugandan artists and craftsmen such as Eric Rugomoka and Karen Kyazze have turned the used tyres into functional crafts such as shoes and furniture respectively. Some production processes these craftsmen use for example; the action of smoothing craft shoes and sandals made from used tyres create dust as a by-product which has been referred to as 'rubber dust waste' in this study. This dust is seen indiscriminately discarded into drainage channels. Upon raining, the dust is washed away and carried towards swamps which can be poisonous to aquatic and human life.

The range of drawing surfaces today continues to expand. Traditional materials like paper and canvas persist, while digital tablets and interactive displays redefine how artists create and interact with their work as a result of technological advancement. The history of drawing surfaces reflects not only artistic evolution but also the dynamic relationship between artists and the materials they use to bring their visions to life.

1.2 Statement of the problem

The increasing GDP of Uganda to a rate of 5.3% in 2023 according to World Bank Statistics is a reflection of increased Production and consumption; factors which are responsible for generation of bio and non-biodegradable waste such as plastics, polythene and used tyres among others. Craftsmen operating footwear cottages around Banda slum recycle tyres to make footwear using sanding machines to smoothen their crafts. The sanding process accumulates significant amounts of rubber dust waste which is disposed in nearby drainage channels and

may poison nearby water bodies. The researcher therefore explored this dust to make drawing surfaces as an intervention into poor disposal of rubber dust waste.

1.3 Purpose of the study

The purpose of this study was to explore rubber dust waste from tyres as a drawing surface.

1.4 Objectives of the study

The study was guided by the following objectives:

i) To establish the various sources leading to formation of rubber dust waste from tyres.

ii) To examine the extent to which artists have explored recycled surfaces for drawing.

iii) To produce drawing surfaces using rubber dust waste from tyres.

1.5 Studio guiding questions

The study was guided by the following research questions:

i) What are the various sources leading to the formation of rubber dust waste from tyres?

ii) To what extent have artists explored recycled surfaces for drawing?

iii) How best can rubber dust waste from tyres be explored to create drawing surfaces?

1.6 Scope of the study

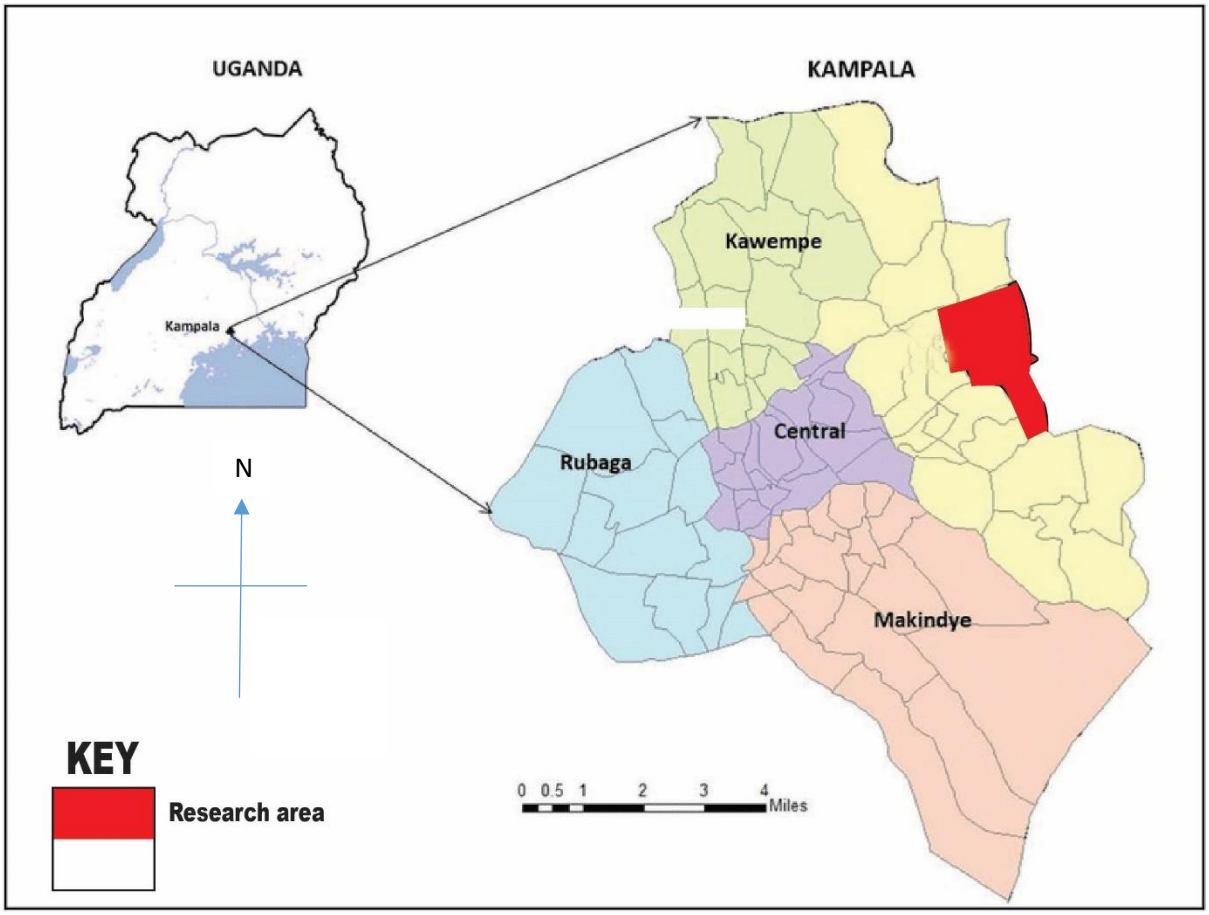
The scope of the study entailed the geographical, content and time scope.

1.6.1 Geographical Scope

The researcher carried out this study with in Kyambogo University and the surrounding Banda slum Located in Nakawa Division, Kampala district in Uganda. Kyambogo University and Banda slum are located approximately 8 kilometers East of Kampala Capital City Centre. The school of Art and Industrial design in Kyambogo University was well equipped with studios having a conducive environment for the researcher to explore with rubber dust waste from tyres.

Figure 1.4

Map of Uganda showing the research area; Kyambogo University and Banda Slum



Source: Journal of community health: https://www.researchgate.net/figure/Map-of-Kampala-showing-the-five-divisions-where-the-study-was-conducted_fig1_348693332

1.6.2 Content scope

The content scope of this study was guided by the research objectives: The first objective was to establish the various sources leading to the formation of rubber dust waste from tyres. Through literature review, the researcher identified and discussed the various methods through which rubber dust waste from tyres is produced.

The second objective was to examine the extent to which artists have explored recycled surfaces for drawing; the researcher discussed various drawing techniques on different recycled surfaces which was achieved by conducting field surveys, and reviewing related literature.

The third objective was to produce drawing surfaces using rubber dust waste from tyres. This objective was achieved through studio exploration which involved various processes leading to the production of drawing surfaces.

1.6.3 Time Scope

Although this study focused on studio exploration of rubber dust waste from tyres as a drawing surface, it reflected on data dating back to pre-historic era to date. This was intended so because the study relates ancient drawing methods, techniques, styles and materials with modern ones to determine the nature of drawings and surfaces to be produced during studio exploration.

1.7 Significance of the Study

Researchers and scholars may use the findings and recommendations of this study as a foundation to conduct further studies directed towards identifying recyclable materials for creating drawing surfaces.

Students may benefit from the study through getting knowledge on material exploration and experimental drawing techniques. This may improve on their knowledge base, creativity and save on material costs for drawing surfaces.

Finally, the study may draw insight to stake holders concerned with environmental protection to advocate for more recycling practices through art and design in order mitigate the problem of poor waste disposal.

1.8 Limitations

The information documented about rubber dust waste is too scientific which limited the content in literature review.

Rubber dust if inhaled can cause sneezing and cough. The researcher therefore had to acquire protective gears such as a nose mask and gloves to prevent respiratory illnesses.

The sustainability of surface processing using rubber dust waste from tyres could not be established given the limited time of the study and therefore was suggested as an area for further research.

1.9 Definition of operational terms

Used tyres: Are tyres which have been used on motor vehicles and replaced but still have an economic life and can be retreaded and used again.

End-of-life tyre: Refers to tyres that have ceased to perform their original function having exhausted all its re-use options.

Recycling: Reusing of materials considered to be waste to create a usable product.

Road Abrasion: The unavoidable loss of rubber material during rolling and sliding contact of tyres with the road surface.

Monochrome: Describes where one single colour is used within a drawing

Layering: A method of making thin rubber dust surfaces by smearing the binder on a flat surface and rubber dust spread over.

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

This chapter presents the theoretical framework and reviews literature related to the study. Visual as well as written literature is presented and discussed in view of the topic

2.1 Theoretical framework

The study was guided by the theory of production with waste and recycling by Conrad (1997). According to Conrad, the management of solid waste is becoming an essential issue due to the rising GDP and population growth in majority of the world's nations. He further emphasizes that recycling naturally occurring materials is one way to address this issue. Conrad argues that recycling is the process of repurposing solid (or liquid) waste as a resource at the incorrect point and consistency in the production process. While the researcher agrees with Conrad, the argument that recycling naturally occurring materials is not enough contribution to managing solid waste. Today it is evident that the problem of inorganic waste including plastics, metal, used oil, among others surpasses that of naturally occurring materials.

Conrad continues to stress that waste abatement is the sole responsibility of waste producers. The producer must substantiate the installation and operation of the necessary treatment technology and pollution prevention measures. This implies that a product will follow its manufacturer from cradle to grave. It should be versatile, technically durable, and simple to discard. According to the researcher, Conrad stated the ideal situation of how the manufacturing process should flow in regard to waste management. However, in Uganda, it is evident that the greater percentage of manufacturers poorly dispose their waste in water bodies or even burn wastes that that may pollute the environment.

This theory also advocates for producers of waste to recycle their waste as a way of reducing on disposal which degrades environment. This is supported by Jolie (2021) where in a recent

study on waste management in Benin she cites this theory affirming that waste materials from which items are made can be reprocessed into new products. However, neither Conrad nor Jolie suggests that users of the manufactured products and or other agencies and interested individuals concerned with maintaining a green environment need to equally take responsibility of recycling wastes. The researcher therefore argues that Conrad should have considered collaborative efforts between the producers and users of products to abate the challenge of waste disposal. The researcher is also in agreement that taxing depletable resources and subsidizing on recycling activities is one way of promoting recycling wastes into re usable products. Therefore this study was based on the constructs of this theory in relation to exploring rubber dust waste from tyres as a surface for drawing.

2.2 The sources of rubber dust waste from tyres

The production and disposal of tyres gives rise to a significant generation of rubber dust. This fine particulate matter is composed mainly of microscopic fragments resulting from various sources including but not limited to; tyre tread wear, road abrasion, tyre manufacturing processes and craft making. Understanding the various sources contributing to rubber dust is essential for devising effective strategies to mitigate its environmental impact and alternative uses of the same hence the researcher's intention to explore this dust to create a drawing surface

2.2.1 Tyre Tread Wear:

Tyre tread wear is widely recognized as one of the primary contributors to rubber dust generation (Choi S. S. et al., 2019). As vehicles travel on roads, friction between tyres and asphalt leads to gradual erosion of their surface material known as tyre tread wear particles (Ruben et al., 2020). These worn-off particles primarily consist of natural or synthetic rubber compounds blended with additives like carbon black, silica, and reinforcing agents (Choi et al., 2019). Environmental factors such as weather conditions can further enhance this process by accelerating tyre degradation due to temperature fluctuations or exposure to sunlight.

2.2.2 Road Abrasion:

Road surfaces are major sources of generating significant amounts of rubber dust through abrasive interactions with tyres (Fikarova & Niznanek, 2020). The combination effect caused by variations in pavement texture characteristics along with traffic load plays an important role in determining particle emissions during vehicle operation (Taheri-Qazvini, 2017). It has been observed that rougher road surfaces contribute more significantly than smoother ones towards increased emission levels due to higher contact stresses experienced by tyres during their interaction with irregularities present on these pavements.

2.2.3 Tyre Manufacturing Processes:

In addition to usage-related factors, certain stages involved in tyre manufacturing also generate substantial quantities of rubber dust (Fikarova & Niznanek, 2020). During the production and shaping of tyres, fine rubber particles are released into the atmosphere. The manufacturing processes typically involve cutting, grinding, molding, and curing operations that contribute to airborne emissions (Taheri-Qazvini, 2017). These activities release particulate matter directly from raw materials or result in abrasive wear of machinery components.

2.2.4 Craft making:

An unintended consequence associated with craft making using tyres is the generation of rubber dust (Bodor 2021). The researcher supports this statement because in a pilot study, it was discovered that some methods of tyre recycling generate significant amounts of rubber dust. The making of craft shoes and bags among others from tyre recycling involves the process of sanding to smoothen rough surfaces which the researcher finds it as the most productive method of rubber dust waste from tyres.

2.3 The extent to which artists have explored recycled surfaces for drawing

Drawing is an expressive form of art that can be practiced on various surfaces. In recent years, there has been a growing interest in utilizing recycled materials as drawing surfaces due to the environmental benefits and unique textures they offer. This section examines the extent to

2.3.1 Paper Upcycling:

Paper upcycling involves reusing discarded or unwanted paper products as drawing surfaces. To prepare such surfaces, one can use techniques like papier-mâché, where layers of shredded paper are glued together using non-toxic adhesives to create a thick surface suitable for drawing with pencils, charcoal, or pastels (Stevenson & Jones, 2018). Another approach involves transforming old newspapers into durable sheets by soaking them in water mixed with cornstarch before drying and pressing them under weights until flat enough to draw upon (Greenberg & Ferguson, 2020). These methods not only reduce waste but also add textural elements that enhance the drawings' overall aesthetic appeal. In view of the above artists in Uganda such as Ochom Adonias have used the technique of drawing over used news papers as seen in the figure below;

Figure 2.1

A drawing by Ochom Adonias on old news paper

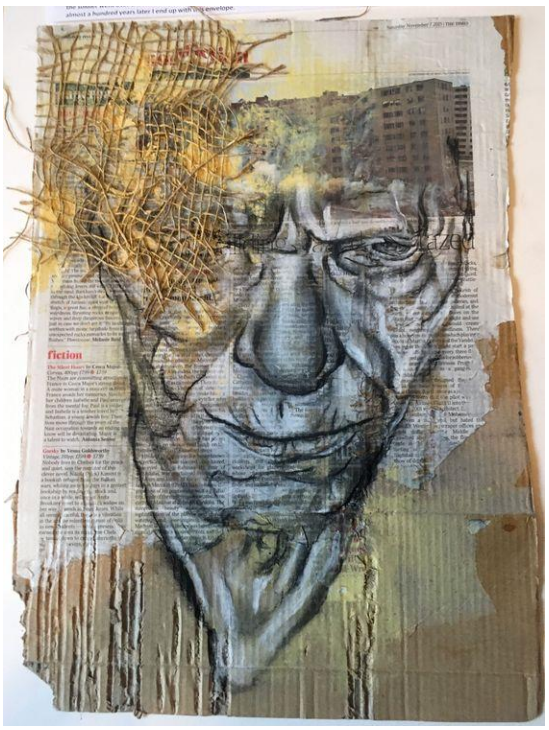
Source: https://africanah.org/submissions/

2.3.2 Cardboard Exploration:

Cardboard is plentifully available from packaging materials and offers a versatile surface for artistic expression when reused creatively. One technique is to cut out cardboard shapes of desired dimensions and layer them together using eco-friendly glues or tapes to build three-dimensional canvases suitable for more experimental forms of drawings (Smithson et al., 2019). Cardboards allow the artist to experiment with chalk, charcoal, pen, pencil and wash among others. This can be evidenced in the figure below;

Figure 2.2

Drawing technique used on cardboard



Source: https://www.pinterest.com/pin/3659243437905855/

2.3.3. Wood Repurposing:

Wooden objects such as discarded pallets or furniture pieces present opportunities not only for recycling but also for unique drawings. Sanding the surfaces to remove any existing varnish or paint can create a smooth base for drawing with ink pens, wood burning tools, or even carving

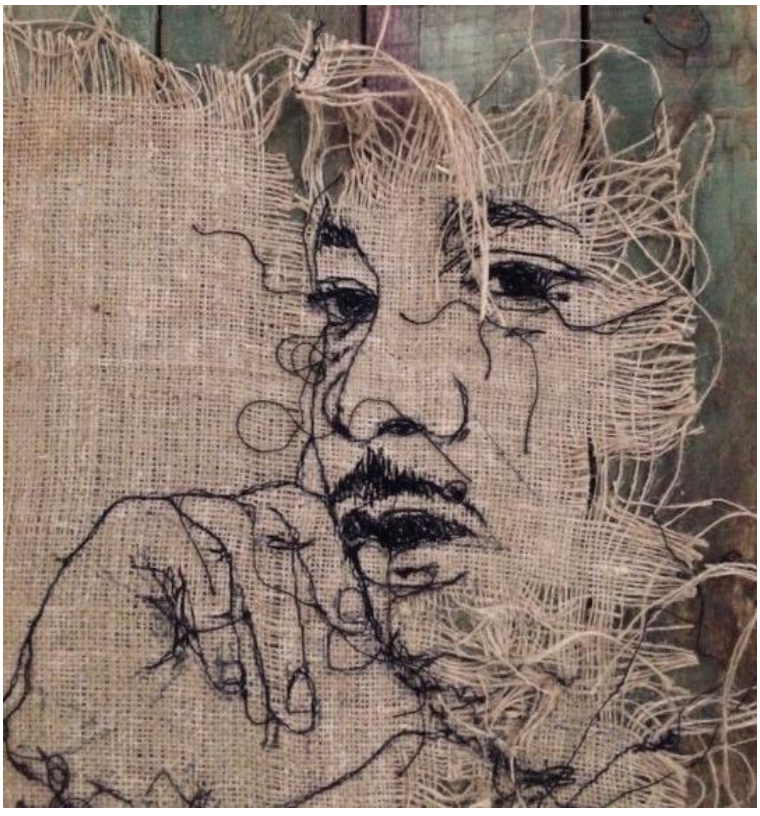
techniques (Krishnan & Khandekar, 2021). This technique offers an organic canvas that adds character and movement through the natural grain patterns of the wood.

2.3.4 Drawing with thread

Cryer (2023) views drawing with thread as a continuous process of decision making. Deciding what is required for example, to conjure up a facial feature exactly where the needle enters and exits the fabric, the type of thread, the length of each stitch, the number of stitches needed to suggest a smile or capture an emotional nuance require artistic skill of creativity and time. This is evident in his work as seen in the figure below:

Figure 2.3

Drawing technique using thread on recycled fabric



Source: https://www.andreacryer.co.uk/colour-portraits

2.3.5 Drawing on used printing plates

Drawing on printing plates involves a process of embossing the soft aluminum sheets of metal used in commercial printing. The artist presses the sheet using specialized tools to create the desired image from the underside thereby embossing the sheet and a pen is tactfully used to draw over the embossed image in order to create shadows and highlights as seen from figures 2.4 and 2.5 below;

Figure 2.4

Drawing on printing plates

Figure 2.5

Drawing on printing plates

Source: Researcher's pictures taken from work of an undergraduate student of Kyambogo University.

2.4 How rubber dust waste from tyres can be explored to create drawing surfaces?

Orchards (2010) quoted in Mugabi (2021) writes that Some artists draw almost exclusively in one favorite material, while others experiment widely and are eager to try each new materials and techniques that come their way. He adds that the choice of a material influences the resulting art work and that different media tend to produce different effects.

The versatility of rubber dust allows for a wide range of applications in craft making (Thompson 2018). Rubber dust can be incorporated into the production of decorative items such as coasters, keychains and sculptures among others. The flexibility and malleability of rubber dust make it an ideal material for various craft projects, providing endless possibilities for creative expression.

It is evident in contemporary drawings in Uganda and world over that artists are no longer limited to drawing on conventional surfaces such as paper and canvas. Through research and innovation artists are developing new drawing media and surfaces through studio explorations.

In summary, drawing on recycled surfaces provides artists with innovative possibilities while simultaneously promoting sustainable practices. Techniques like paper upcycling allow artists to breathe new life into discarded materials by creating visually appealing textures (Thompson 2018). Cardboard exploration encourages experimentation in three-dimensional forms and captivating corrugated textures. Wood repurposing not only reduces waste but also incorporates nature's inherent beauty into artistic creations and the use of recyclable materials such as rubber dust waste from tyres hence forth may contribute positively towards innovating a new drawing surface. According to the researcher therefore, arists have to a greater extent explored recycled surfaces for drawing basing on the available information although no available information was found in regards to drawing on surfaces created from rubber dust waste except for the researcher’s own studio explorations.

CHAPTER THREE

METHODOLOGY

3.0 Introduction

This chapter presents the overall strategy as to how the study was conducted. It presents selected methods and tools which the researcher used in the study. It consists of the research design, study area, population, sample size, sampling techniques, methods and tools of data collection, procedures of studio experimentation, reliability and validity of research instruments and ethical considerations.

3.1 Research design

An exploratory research design was used in this study. According to Thomas, (2020) an exploratory research design is used for a research problem where the researcher has no past information or only a few studies for reference. This is supported by Swaraj, (2019) who argues that exploratory research is conducted to develop initial ideas and insights to provide direction for further research. Indeed, information on the re-use of rubber dust waste from tyres especially through the channel of art and design was limited. The researcher therefore used this research design to collect qualitative data.

3.2 Study Population

The study targeted casual workers of the only two footwear cottages operating in Banda slum and year III Bachelor of Art and Industrial Design (BAID) students of Kyambogo University. Population is a set of all the units which possess variable characteristics under study and for which findings of research can be generalized (Shukla, 2020) whereas Prabhat, (2015) describes Population as the parent group from which a sample is selected. Casual workers of footwear cottages operating in Banda slum were selected as part of the population because they had information regarding rubber dust waste whereas year III BAID students of Kyambogo

University were selected as part of the study population because it formed the parent group from which participants to test the surfaces were selected.

3.3 Sample size

The researcher selected a total of fifteen respondents; Five casual workers from footwear cottages recycling tyres around Banda and ten year III BAID students of Kyambogo University. Five casual workers of the footwear cottages were selected to form part of the sample size because it formed half of the total number of casual workers in both cottages which the researcher considered as sufficient enough to provide the required data whereas on the other hand, ten year III BAID students were selected to form part of the sample size because it was a manageable number for the researcher to provide drawing surfaces. As Thomas (2020, p.669) indicates that exploratory research involves a smaller sample size, hence the total of fifteen participants.

3.4 Sampling technique

The researcher used purposive sampling to select respondents. Taherdoost (2016) describes purposive sampling technique as "the kind in which particular persons or events are selected deliberately in order to provide important information that cannot be obtained from other choices" whereas according to Creswell (2011), purposive sampling entails locating and choosing individuals or groups of individuals who have specialized knowledge of or experience with a topic under study. The researcher therefore purposely selected casual workers because they had direct information pertaining rubber dust waste while year III BAID students were mandated to explore different materials in drawing which rubber dust exploration would not only benefit the researcher but also the students.

3.5 Methods and tools of data collection

This study employed five methods to collect qualitative data; in-depth interviews, observation, document review, photography and studio exploration.

Muhammad (2016, p. 4) recommends three commonly used methods of collecting qualitative data; In-depth Interviews, Observation and Document review however, in addition to the afore mentioned methods the researcher also used Photography and Studio exploration to collect relevant data for the study.

3.5.1 In-depth interviews

The researcher prepared interview guides bearing semi- structured and closed ended questions for the casual workers and students. Taherdoost (2022, p.4) explains that this in method, an interviewer is at will to ask additional questions for clarifications even when the interview is based on structured questions. The researcher and the participants scheduled appropriate dates and time on which the interviews were conducted to avoid interference with their programs.

3.5.2 Direct observation

The researcher prepared an observation schedule to collect additional information that was deemed relevant to the study during data collection. Kumar, (2022) describes observation method as one in which a person observes subjects and records information about characteristics of a phenomenon. The researcher recorded extra information about the general working conditions of the two footwear cottages in Banda following the attributes that were enlisted in the observation schedule.

3.5.3 Document review

The researcher reviewed literature from published information on scholarly internet sites including Google Scholar, Academia and Science Direct, textbooks, newspapers, reports and journals among others. Bowen (2009) describes document review as systematic procedure for

reviewing or evaluating both printed and electronic documents. This method facilitated collection of relevant data for all of the research questions of the study.

3.5.4 Photography

The researcher used a smartphone camera to capture still images during situation analysis and studio exploration. Basalamah, et.al (2013) argues that photography is a crucial element in the organization of an event, particularly as documentation. The researcher conforms to Basalamah's statement because photographs served as visual literature and evidence of studio processes for this study. Photographs of studio work in progress were captured by requesting colleagues present during work in progress whereas a selfie camera was used to capture important steps when no one was available to take a photograph.

3.5.5 Studio Exploration

The researcher grounded himself in performing a series of experiments in order to achieve the most desired drawing surface. This method facilitated the generation of data relevant for achieving research question three which sought to produce drawing surfaces using rubber dust waste from tyres. The participants were given the freedom to explore the surfaces using their own desired sources of inspiration and materials and whereas the researcher tested the surfaces by manipulating drawing compositions derived from his source of inspiration; the leopard tortoise as presented in sections 3.5.5.1 and 3.5.5.2 respectively.

3.5.5.1 Source of inspiration

In a recent visit to the reptile village located in Entebbe district in Uganda, the researcher picked interest in one of the reptiles scientifically known as stigmochelys pardalis and ordinarily as the leopard tortoise . This reptile bears unique patterns on its yellowish shell with black spots which gives it that look like a leopard skin. The movement of lines on the shell and textures on its legs interested the researcher and found them as unique features that would make interesting

drawing compositions. Chan et al., (2014) stresses that design ideas come from a source of inspiration. Besides the unique physical features, the reptile is classified as a rear species of tortoises found in arid areas of Northern Uganda according to the tour guide at Reptile village. The information provided on this reptile and its physical features inspired the researcher to develop drawing compositions in different themes talking about its uniqueness.

Fig 3.1

The researcher carrying the Leopard Tortoise

Source: Researcher

Photo of the researcher taken by the tour guide at Reptile Village, Entebbe district, Uganda. The tortoise weighs approximately eight kilograms and is estimated to be 40 to 50 years old.

3.5.5.2 Drawing compositions derived from the source of inspiration

Fig 3.2

Front view sketch of the leopard tortoise

Fig 3.3

Front view sketch of the leopard tortoise

Fig 3.4

Side view of the leopard tortoise

Fig 3.5

A study of the head of a leopard tortoise

Source: Researcher.

Fig 3.6

A realistic drawing of the front view of a leopard tortoise

Source: Researcher

The researcher used oil pastels on a black manilla paper. Lighter values were used over a dark surface to create the drawing, a technique known as reverse drawing.

Fig 3.7

A composition depicting the leopard tortoise and her family

Source: Researcher

The researcher used charcoal dust and charcoal pencil to draw on a white paper which is previously treated with wash technique of blue and yellow water colours. The wash technique gives the impression of colour with in a composition where the actual drawing is done in monochrome. The drawing measures 50cm x 42cm.

Fig 3.8

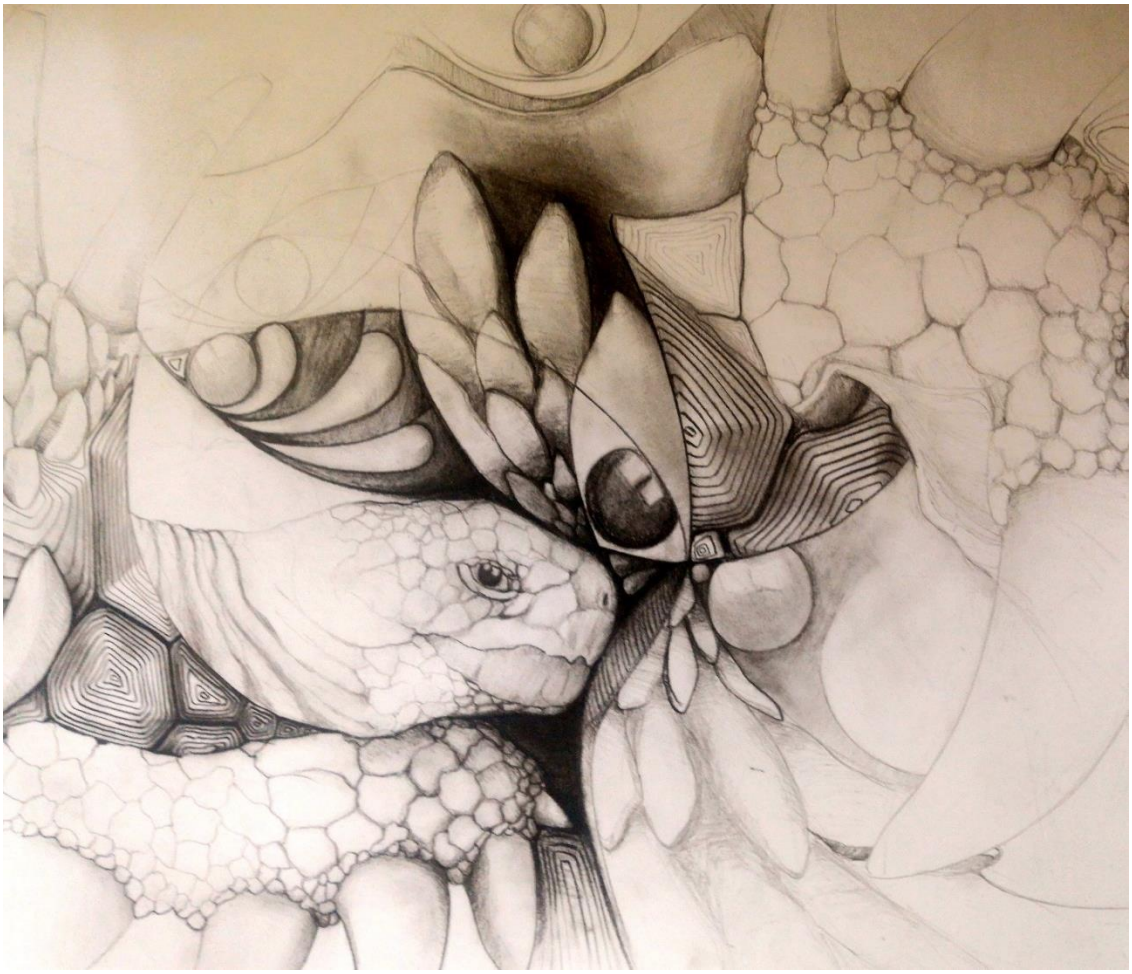
A composition depicting the agony that smuggling brings onto the life of the leopard tortoise

Source: Researcher

The researcher used charcoal pencils on white paper to create this drawing. This drawing was inspired by the news of 152 leopard tortoises seized by Uganda Revenue Authority officials in Mbale District, Eastern Uganda on May 17th 2016 according to New Vision. The tortoises were being illegally smuggled to Asia each tortoise costing Uganda Shillings 16.7 Million. The skeleton hands in the drawing depict the cruelty and harshness of human activity of smuggling to the reptile. The drawing measures 50cm x 42cm.

Fig 3.9

A composition depicting scales and lines from body parts of the leopard tortoise

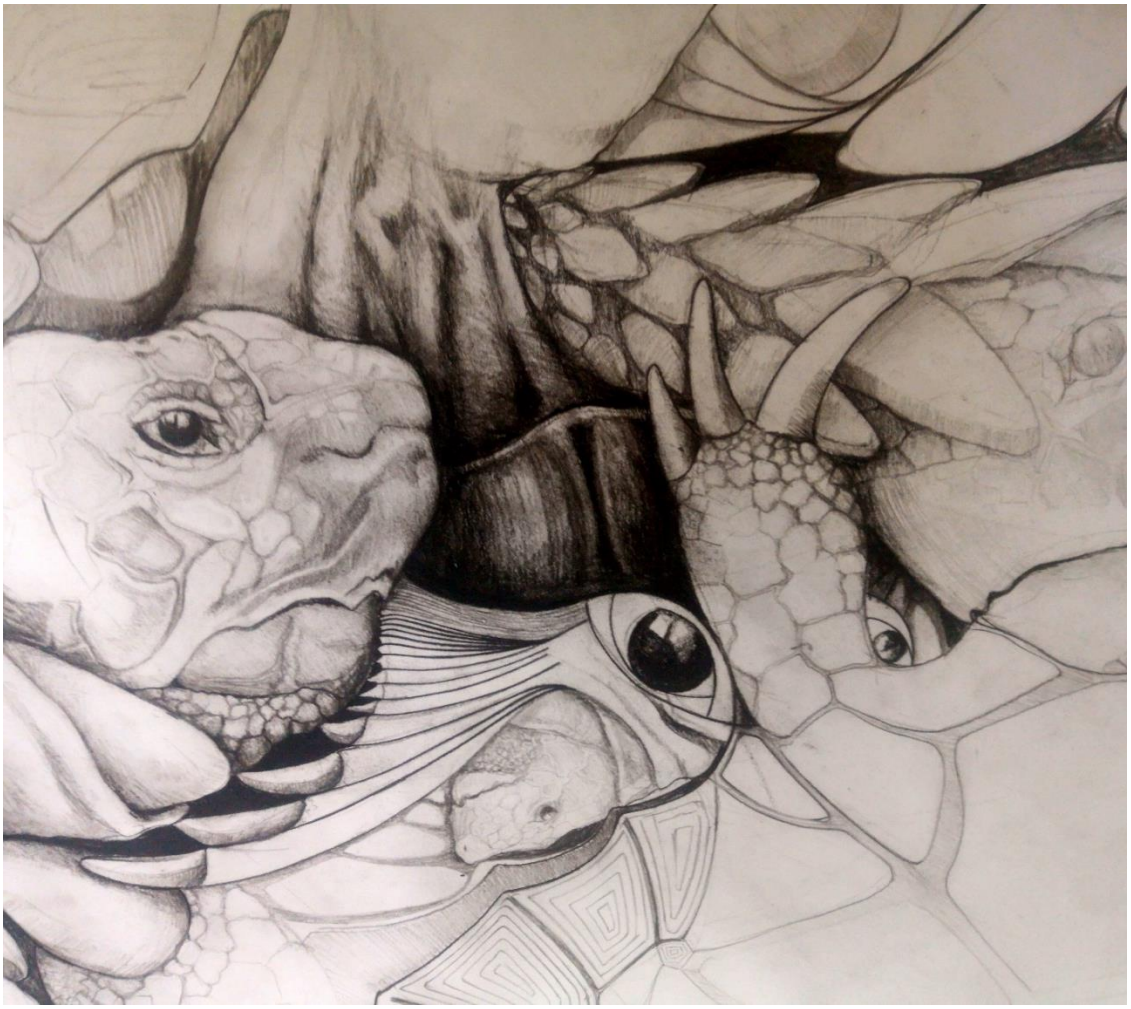


Source: Researcher

The researcher used charcoal pencils on white paper to create this drawing. This was inspired by the scales on the feet, and lnes of the shell. The eye is a signature feature that the researcher chose to appears in all his compositions. The drawing measures 50cm x 42cm.

Fig 3.10

A composition depicting a state of worry on the face of the leopard tortoise



Source: Researcher

The researcher used charcoal pencils on white paper to create this drawing. The drawing depicts a state of worry on what next move the human may do to affect its normal life. The look on its face tells that the tortoise senses some form of danger in the near future. The drawing measures 50cm x 42cm.

Fig 3.11

A composition depicting pollution of the habitat of the leopard tortoise

Source: Researcher

The researcher used charcoal dust and an electric rubber on white paper to create this drawing. Charcoal dust is applied on the surface of the paper and the electric rubber creates sharp lines as it spins thereby creating a negative drawing technique. The drawing also depicts how man pollutes the swamps and drainage channels with plastics thereby affecting the habitat of this reptile. The drawing measures 50cm x 35cm.

Fig 3.12

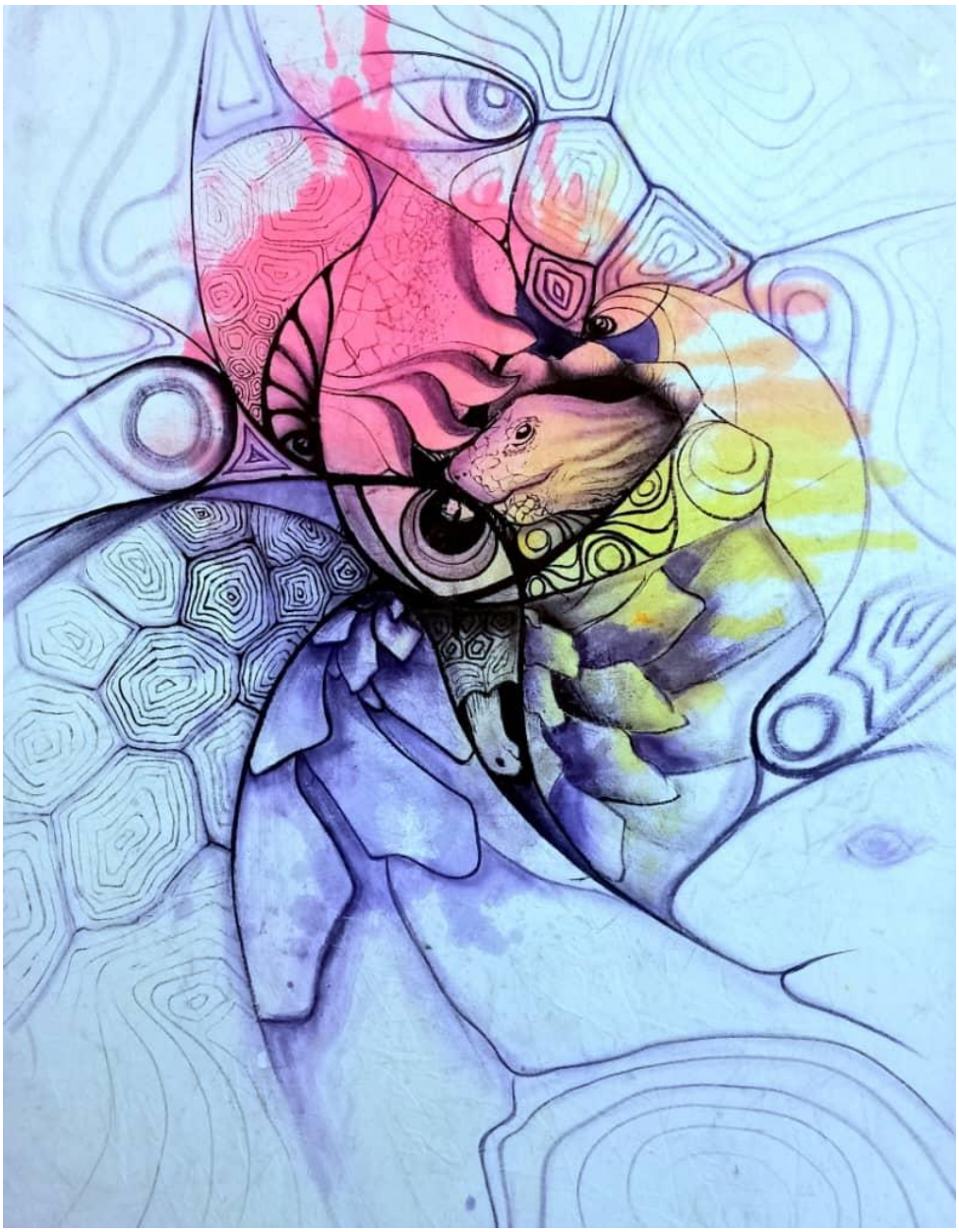
A composition showing patterns derived from the features of the leopard tortoise

Source: Researcher

The researcher used charcoal pencil on white paper treated with an orange wash to create this drawing. The drawing is a derrivation of patterns that can be developed from the leopard tortoise as a source of inspiration. The drawing measures 42cm x 30cm.

Fig 3.13

A composition showing patterns derived from the features of the leopard tortoise



Source: Researcher

The researcher used stainer and a pointed brush on a canvas treated with wash technique using purple, red and yellow water colours. The drawing measures 100cm x 50cm.

Fig 3.14

A composition showing reproduction of the leopard tortoise

Source: Researcher

The researcher first applied applied a faint yellow wash on a white paper then treated the paper with soot from a candle and used an electric spinning rubber to create the drawing. The drawing is a depiction of how leopard tortoises reproduce by way of laying eggs and hatching. The drawing measures 60cm x 40cm.

Fig 3.15

A composition showing the congestion of the leopard tortoise during the illegal smuggling

Source: Researcher

The researcher used charcoal pencil on white paper treated with yellow and greenish wash to create this drawing. The drawing measures 60cm x 40cm.

Fig 3.16

A composition showing the innocence of the leopard tortoise

Source: Researcher

The researcher used blue stainer and a brush on a canvas treated with light blue and yellowish wash to create this drawing. The drawing measures 100cm x 50cm.

Fig 3.17

A composition showing the impact of industrialization of wetlands on the habitat of the leopard tortoise

Source: Researcher

The researcher used charcoal pencil to draw over a white paper treated with blue and purple wash. The composition depicts how construction of buildings in wetlands may affect the tortoises. The drawing measures 50cm x 40cm.

3.6 Reliability and validity

To ensure reliability and validity in this study, the researcher carried out Pilot testing of the instruments by distributing copies to five masters students to pretest whether they could

understand questions being asked before commencing the data collection process. The questions that were not clearly understood by colleagues were re framed to the the easiest way possible to ensure that correct data was collected.

According to Hamed (2016), Reliability is the extent to which an instrument can measure stable and consistent results of a phenomenon while validity of an instrument is achieved when it is able to measure what was intended to be measured. Indeed, the researcher conforms to Hamed's explanation as the instruments correctly collected the data that was intended to.

3.7 Ethical consideration

The researcher obtained an introductory letter and consent letter from the directorate of research and graduate training which was presented to research participants to seek their approval before involvement in the study. These provided them with confidence to make informed decisions upon their willingness to participate or withdraw from the study. The researcher requested for permission to take photographs where it was pertinent to the study before using the camera. The authorities were duly informed that the photographs were for academic purposes only. The interview guides were also designed in such a way that they exclude the names of the participants for purposes of confidentiality and freedom of expression to ensure that participants provide accurate information.

Participants were duly informed that the data collected was for academic purposes only and that no response was to be shared or published in any public article of any kind.

The researcher ensured that participants were given the freedom to choose the media to use on the surfaces provided and also the freedom to draw at their own desired time and return the drawings to the researcher upon completion within an agreed time. Translation of questions to local language was done by the researcher during interview sessions for participants who did not understand English especially at the footwear cottages.

CHAPTER FOUR

PRESENTATION, ANALYSIS AND INTERPRETATION OF RESEARCH FINDINGS

4.0 Introduction

This chapter presents analyses and interprets the findings of the study. This was done following the research objectives; To establish the various sources leading to formation of rubber dust waste from tyres, To examine the extent to which artists have explored recycled surfaces for drawing and To produce drawing surfaces using rubber dust waste from tyres.

4.1 The Sources leading to formation of rubber dust waste from tyres.

The sources including road abrasion, tyre tread wear and manufacturing processes were discovered by reviewing literature related to rubber dust waste from tyres. When asked about any other source of rubber dust waste, two respondents from footwear cottages replied that;

"I dont know".

While three of the respondents stressed that there was probably no other source where this dust could come from. This may have been for the reason that workers of footwear cottages were directly involved in only one source which was the sanding process. Therefore all responded replied to the question of knowing any other source of formation of rubber dust.

The respondents of footwear cottages when asked whether they experienced any occupational hazards arising from the sanding process mentioned "Cough and sneezing" as the only hazard. The researcher however suspected that the workers may face long-term respiratory illnesses as a result of exposure to the carbon composed rubber dust. Although when asked if they had any measures to counter the hazard, only one said;

"We have nose masks we use during sanding"

However, this was not realistic because there was no nose mask available in the workshop as observed by the researcher, while the rest of the respondents replied;

"We just operate like that but haven't faced serious consequences except cough and flu".

This pauses a risk to the health of the casual workers towards contracting respiratory infections which may be faced in the long run. The researcher observed that the rubber dust generated was poorly disposed siting traces of rubber dust dumped in nearby trenches. When asked on the method of disposal, all the five responded that;

"We pack it in sacks and a truck from city council comes and collects them"

Whereas this may have been a reality, the traces of rubber dust in the trenches was evidence that it was poorly disposed. This evidence therefore was identified by the researcher as the gap that needed to be bridged through exploring rubber dust waste as a drawing surface. This would reduce on the burden of disposing the dust indiscriminately in trenches while at the same time promoting proper re-use and also creating cheap surfaces for students of Art and Design.

4.2 The extent to which artists have explored recycled surfaces for drawing.

Various surfaces were discovered through observation, interviews and reviewing related literature. Respondents of year III BAID students were asked if they had explored recycled surfaces for drawing, materials and techniques used on the surfaces and they mentioned; "Recycled paper , drawing on old boards, drawing on used newspapers". Through observation, the researcher identified an artist who had explored printing plates using embossing and inking to highlight the embossed images. Wood repurposing and drawing with thread were identified through literature review. When asked about the materials they explored on the recycled surface, each respondent from BADI III mentioned at least two drawing techniques and

materials including water colour drawing, oil pastel, charcoal pencil drawing and bleaching techniques. According to the researcher therefore, efforts to explore recycled surfaces for drawing has been done to a greater extent. However there was no evidence of artists exploring rubber dust waste as a drawing surface. When asked which challenges they faced upon exploring on the drawing surfaces, they mentioned;

> *"The black colour limits the techniques to explore, thickness and weight, inability to choose a drawing techniques, not understanding the material and lack materials to experiment with".*

All the ten BAID III respondents testified that the surfaces created out of rubber dust waste were new to them therefore it was their first time to explore. They were also asked to suggest the possible measures that would be put in place to make the surface suitable for drawing and they all stressed that colorizing and making the surfaces lighter would improve on their usability.

4.3 Production of drawing surfaces using rubber dust waste from tyres.

The findings under this objective are presented following the studio procedures that the researcher undertook to come up with the drawing surfaces.

The studio procedures started with collecting rubber dust from footwear cottages, identification and testing of binders using both synthetic and natural binders, making the mould, making the surfaces and finally drawing on the surfaces with different techniques and materials.

4.3.1 Collection of rubber dust waste from foot wear cottages

Fig 4.1

The researcher collecting rubber dust waste from a footwear cottage in Banda

Source: Researcher

4.3.2 Identification of binders

The researcher identified and experimented with synthetic and natural binders. The synthetic binders identified were tough bond, styrene and wood glue while natural binders were boiled cassava paste, gum extracted from Mauritius thorn and sap extracted from a Ficus thonningi tree.

4.3.2.1 Synthetic binders

i) Tough bond

This is a binder that is a purely manufactured synthetic adhesive used to bond Formica, laminates, PVC floor coverings, fabrics, foam sheets and rubber surfaces among others.

Fig 4.2

Tough bond

Fig 4.3

Tough bond poured onto sieved rubber dust

Source: was adapted from: https://www.google.com/ search?q=tough+bond while Fig. 4.3 is work done by the researcher.

The surface created with this binder was very strong and hard upon drying. These characteristics were desirable for a good surface as it showed that the bound surface would stand intact for a long time. However, using tough bond produced the smallest surface among the rest of the binders purchased at the same cost. This implies that it would be very expensive for mass production in comparison to the rest of the binders.

Fig 4.4

Sample of a surface created by using tough bond

Source: Researcher

This surface presented with a successful outcome however it was very hard with minimum ability to be flexible.

ii) Styrene

This is a water-based adhesive (one of the polymers used in tyre production) that was used in binding the dust to make drawing surfaces.

Fig 4.5

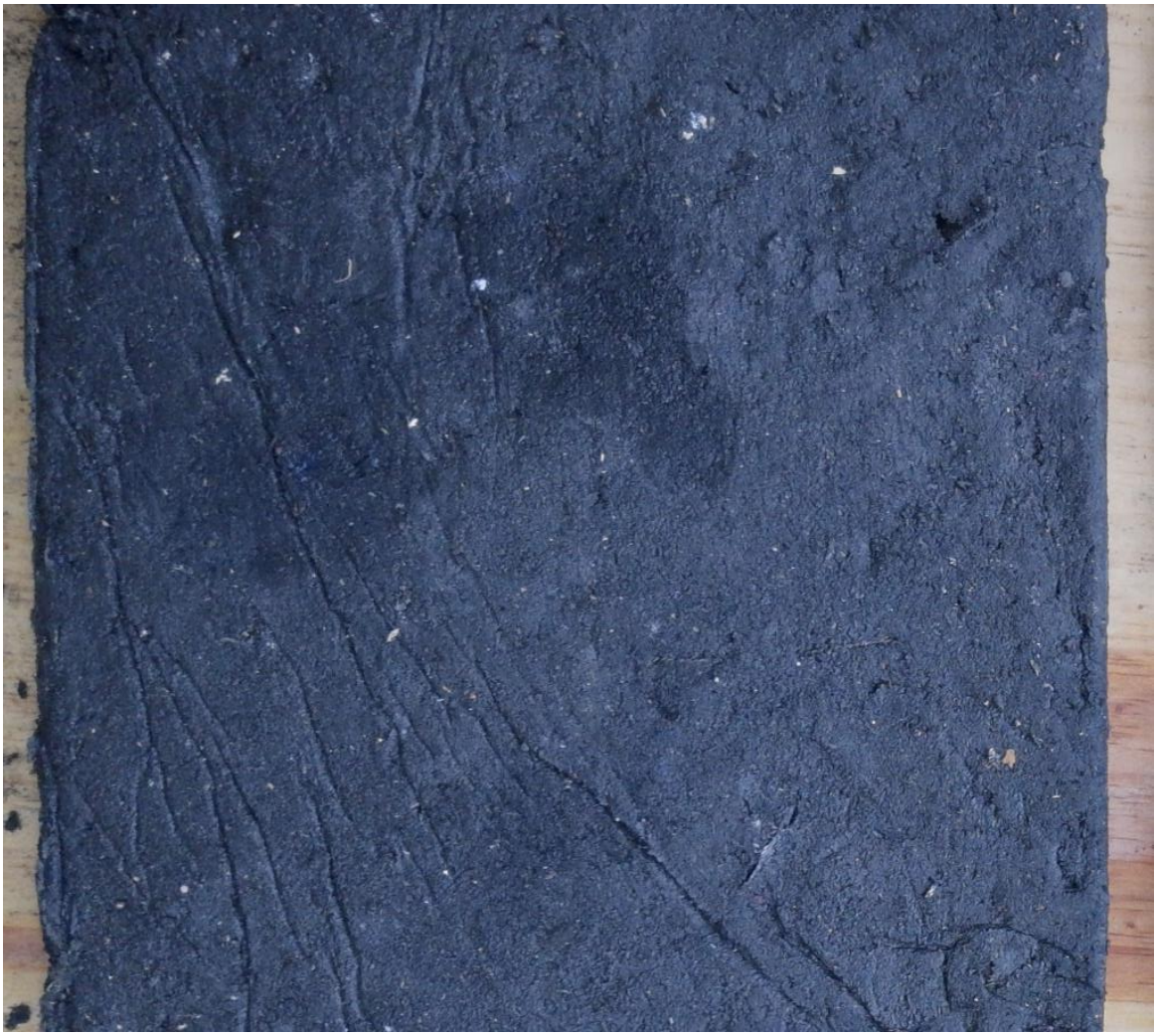
The researcher mixes styrene with rubber dust

Source: Researcher

This binder showed strong binding power and would allow maximum thickness compression up to 3 mm to form the surface. Styrene also allowed the surfaces to fold without breaking beyond 360^0 for those that were compressed to 3 mm thickness. This fold however could not be achieved on 8 mm surfaces as they showed a higher level of fragility in comparison to the 3 mm surfaces. The relevance of this fold was to ease transportation and storage of drawings. This binder was non corrosive to the skin and therefore was appropriate for use.

Fig 4.6

Sample of a surface created by using styrene



Source: Researcher

This surface presented the best characteristics among all the surfaces produced by the other synthetic binders. It was well compacted with signs of flexibility, however it was thick to about 5 mm

iii) Wood glue

This is also a water based adhesive binder that was used in creating the drawing surfaces

Fig 4.7

The researcher mixes wood glue with rubber dust

Source: Researcher

This was found to be fairly strong in binding power and would allow maximum thickness compression up to 3 mm of the mixture to form the surface. This binder however was found to produce a hard surface that would make it more difficult to fold upon drying as compared to styrene. The hardness was found to increase fragility henceforth reducing the fold ability of the surface. This binder was non corrosive to the skin and therefore was appropriate for use with or without gloves.

Fig 4.8

Sample of a surface created by using wood glue

Source: Researcher

4.3.2.2 Natural Binders

i) Boiled cassava paste

Fig 4.9

Boiled cassava paste

Fig 4.10

The researcher mixes rubber dust in cassava paste

Fig 4.11

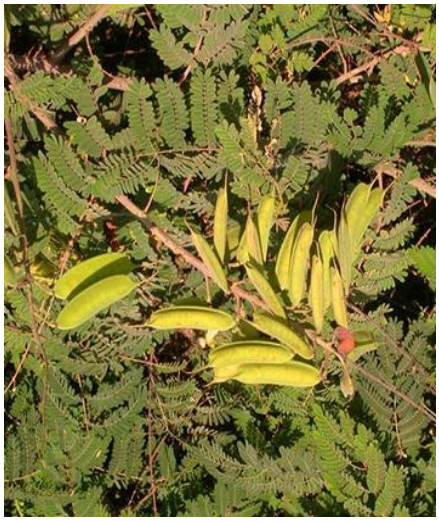
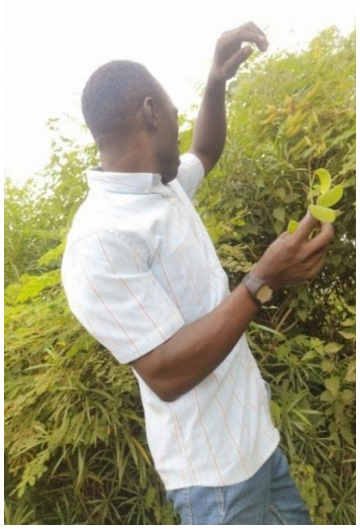
Sample surface made by using boiled cassava paste

Source: Researcher

ii) Gum extracted from Mauritius thorn

Fig 4.12 **Fig 4.13** **Fig 4.14**

Mauritius thorn *Researcher plucking pods* *Researcher extracts gum*


Source: Researcher

Fig 4.12 shows mauritius thorn, commonly planted along boudaries of land in the researcher's village. Fig 4.13 depicts the researcher collecting pods of the mauritius thorn which posess a gum inside and Fig 4.14 shows the researcher extracting the gum from the pods to use as a binder.

The gum presents its self in a flabby state and is elastic when touched. Each pod contains approximately 5 gramms of the gum which is scooped from the pods by using a sharp edged tool such as a knife. The adhesion of the gum reqires to smear it onto a collection surface by applying some force in order to take it off the knife.

Fig 4.15

Sample of a surface created by binding using gum from Mauritius thorn pods

Source: Researcher

The surface created became hard upon drying. This made the surface brittle and could easily brake when an external force schuch as tension or comression is applied to it.

iii) Sap extracted from a ficus thonningi tree

Fig 4.16

Cutting through the bark of the tree

Fig 4.17

Cutting through the bark of the tree

Fig 4.18

The researcher mixing the sap with rubber dust.

Source: Researcher

Fig 4.19

Sample of surfaces created using sap from a tree

Source: Researcher

The surfaces made from sap of the tree remained flabby given the same period of drying as the gum from the pods of the Mauritius thorn. The sap is watery and not sticky during collection however, it becomes sticky as it dries up forming a binder.

In conclusion, all binders tested were able to give a surface each bearing its own characteristics. However, considering all factors including costs, time, quantity and ease of production, styrene was the most appropriate binder the researcher selected to produce the surfaces.

4.4 Production of the surface

The making of the surface took a procedure of 5 steps starting with making the mould, sieving the rubber dust, mixing with the binder, compressing and drying.

4.4.1 Making the mould

Fig 4.20

Design of the mould

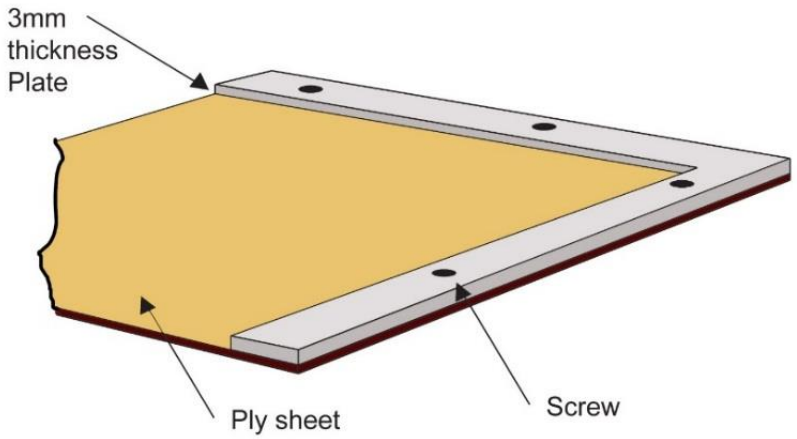


Fig 4.21

The actual mould

Source: Researcher

Fig 4.20 depicts the design of the mould by the researcher using Computer Aided Design (CAD) whereas Fig 4.21 shows the actual mould made by a carpenter. Pictures were taken by the researcher. The mould measures 80cm x 50cm.

4.4.2 Sieving the rubber dust

The rubber dust collected from the footwear cottages had impurities such as sharp needles, leather offcuts, tyre offcuts among others which required to be sieved out before making the surface. This would ensure that a smooth surface is attained in the end and also avoid the risk of harm by sharp objects during production. The researcher therefore used a 0.5mm plastic mesh to sieve the rubber dust.

Fig 4.22

The researcher sieving rubber dust

Source: Researcher

This was the most dangerous stage in the production process as the action of sieving made dust particles to spread the surrounding air. Therefore the researcher had to wear a protective gears which included a face mask, eye glasses and gloves as seen in Fig 4.23 below. This helped to protect the researcher from contracting respiratory and any other risky infections resulting from inhaling the dust.

Fig 4.23

The researcher wearing the protective gears in an enclosed studio

Source: Researcher

4.4.3 Mixing the rubber dust together with the binder

In this step, the researcher mixed the sieved rubber dust together with styrene until a uniform mixture was attained.

Fig 4.24

The researcher mixing styrene with rubber dust

Source: Researcher

Fig 4.25

The researcher mixing styrene with rubber dust

Source: Researcher

4.4.4 Compressing

This involved spreading the mixed rubber dust onto the surface of the mould and then compressing it using a paint roller as seen in figures 4.26 and 4.27 below

Fig 4.26

Spreading the mixture of rubber dust and styrene on the mould

Source: Researcher

The researcher spreads the mixture of rubber dust waste with styrene onto the mould to level the particles before compressing is done as seen in Fig. 4.27 below;

Fig 4.27

Compressing the mixture

Source: Researcher

The paint roller was used to compress the spread particles so that a smooth and even surface could take the shape of the mould. This process also helped in increasing the bond between the binder and the rubber dust particles.

Fig 4.28

The researcher displays dry surfaces

Source: Researcher

At this stage however, all surfaces produced were black, thick, heavy and difficult to fold. Having all surfaces in black would be monotonous and limiting on the drawing techniques and materials to be used. The weight, thickness and difficulty in folding of the surface would inconvenience the user during transportation and limit the number of surfaces created per unit of measure. The researcher therefore performed experiments to counter these features presented in the first surfaces that were produced so as to achieve the most effective and flexible surface. The experiments included declorization and colorization to counter the black colour,

blended approach of rubber dust and recycled paper to counter the weight and layering method to counter thickness and difficulty in folding.

4.5 Decolorization

A bleaching test was done by dropping a handful of rubber dust into a tin containing bleach and left to soak for 24 hours. No colour change was observed as the black remained intact.

Fig 4.29

Bleaching test

Source: Researcher

The researcher proceeded to Uganda Industrial Research Institute to find out whether there were any other reagents or bleaching materials that would reduce or completely remove the

black color from the rubber dust carbon. The chemist however, attested that there were no reagent able to bleach carbon black since it exists naturally as black and suggested colorizing instead. Therefore no tests were performed at the Institute.

4.6 Colorization

Colorization tests were done by mixing the rubber dust with red, blue and white powder paints, red and yellow oxides, saw dust and priming the surface as it is with canvas.

Fig 4.30

Powder paints ready to be mixed with the rubber dust

Source: Researcher

Fig 4.31

Mixture with blue powder paint

Fig 4.32

Sample surface with blue powder paint

Fig 4.33

Mixture with red oxide

Fig 4.34

Sample surface with red oxide

Source: Researcher

Fig 4.35

Mixture with yellow oxide

Fig 4.36

Sample surface with yellow oxide

Fig 4.37

Mixture with saw dust

Fig 4.38

Sample surface with saw dust

Note. Work by the researcher

Note. The surface measures 20cm x 12cm.

Source: Researcher

4.7 Weight control

The researcher performed a weight control test by crushing used papers with help of a blender and mixed with rubber dust in a ratio of 1:1. This test significantly reduced the weight of the surface by approximately half the weight of an equal size and thickness of a surface produced with only rubber dust, besides the resultant surface presented with black and white patterns which also countered the monotony of black colour of the initial surfaces. The resultant surface was also foldable to some extent for easy mobility. The surface however would develop cracks if folded beyond a certain limit.

Fig 4.39

Crushing used papers with a blender

Fig 4.40

crushed papers and rubber dust ready to be mixed

Source: Researcher

Fig 4.41

Sample surface made by mixing rubber dust with crushed paper

Source: Researcher

4.8 Thickness control

The researcher developed a new method of making a thin surface that he termed as layering. In this method, the binder was smeared onto a smooth surface of polythene and sieved rubber dust evenly dropped onto the layer of binder and left to dry. The same procedure was repeated twice however, on the second time, a flat thick panel of wood was placed onto the surface so that compression and bonding would take place. The result was a thin and flexible surface.

Fig 4.42

Smearing styrene on to the polythene surface

Fig 4.43

spreading the rubber dust over the styrene

Fig 4.44

1 millimeter thickness of the resultant surface

Fig 4.45

Foldability of the resultant surface

Source: Researcher

Fig. 4.44 and 4.45 show the flexibility of the surface created by layering. The resultant surface was smooth on the side touching the polythene and rough on the top side. This was because there was no mask of the binder on the top as the side below. However, this was left intentionally to give the effect of texture on one side so that the researcher had a choice to draw onto the smooth or textured side. This surface would not crack even at the maximum floding level. The surface did not only contribute towards reducing thickness but also the weight of the surface.

Sieving the rubber dust left a lot of residue that would be harmful to the environment in case it was disposed. Therefore the researcher sorted out sharp objects from the residue and decided to bind it into a surface to ensure maximum utilization of the rubber dust. The resultant surface however, was thick and rugged as seen in figure 4.46 below;.

Fig 4.46

Surface created by binding the residue after sieving rubber dust

Source: Researcher

Fig 4.47

All sample surfaces packed together

Source: Researcher

4.8 Testing the surface

Having produced the surfaces, All the ten respondents were provided with a surface and given freedom to use any source of inspiration, materials and techniques to draw. However, only half of them managed to explore the surfaces while the other half declined for reasons including; not having the rightful materials to draw on the black surface, not understanding the surface and inability to choose a drawing technique. The rest of the drawing surfaces were tested by the researcher.

4.8.1 Tests by the student respondents

Fig 4.48

Drawing of a girl listening to music

Source: Researcher

The drawing in fig 4.48 depicts a feminine figure wearing headphones. The respondent used oil pastels to draw on to the black surface.

Fig 4.49

Drawing of a crested crane

Source: Researcher

The drawing in fig 4.49 depicts the crested crane. The respondent executed this drawing using soft pastels.

Fig 4.50

A drawing of an Angry Gorilla

Source: Researcher

The drawing in fig 4.50 depicts an angry gorilla. The respondent executed this drawing using oil pastels.

Fig 4.51

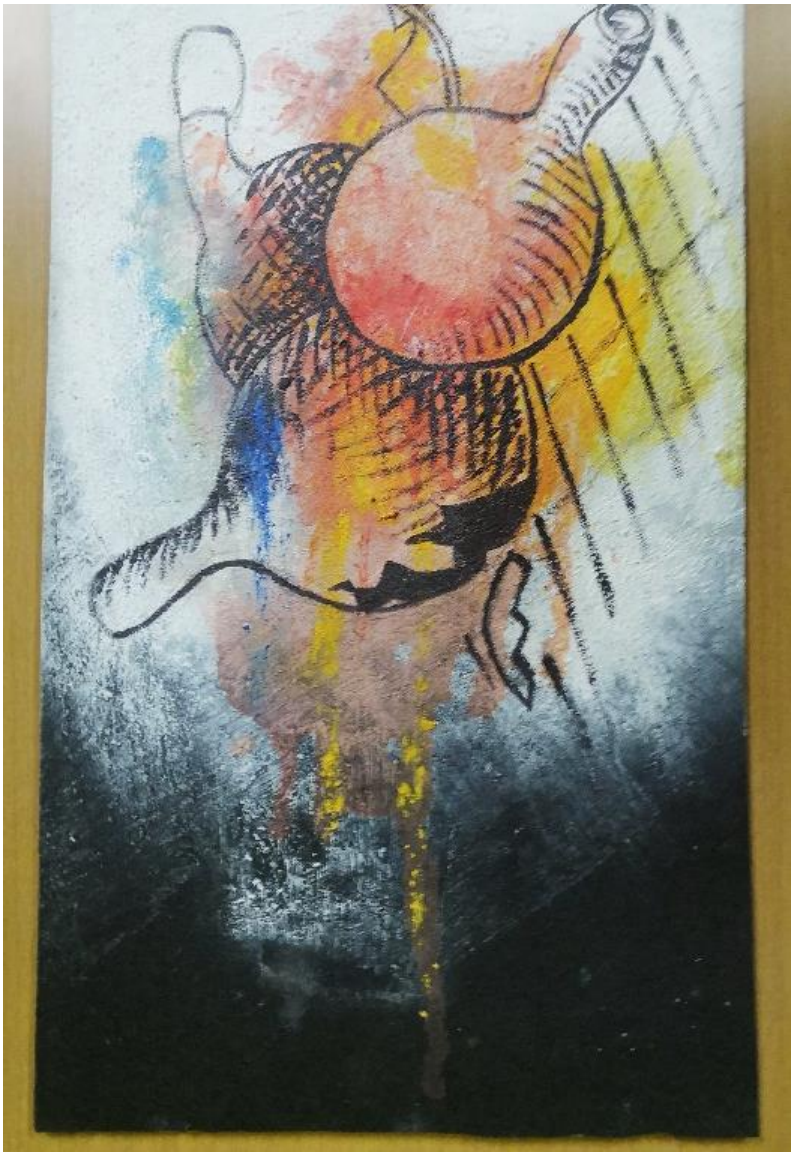
A drawing of a face

Source: Researcher

The drawing in fig 4.51 depicts a human face. The respondent executed this drawing using a white charcoal pencil.

Fig 4.52

A drawing of gourds



Source: Researcher

The respondent executed this drawing using paint and a brush on a surface treated with wash technique.

4.8.2 Tests by the researcher

The researcher tested the surface by drawing directly on to it and also employed technology through Computer Aided Design (CAD) to test the capabilities of the surface

4.8.2.1 Tests by drawing directly onto the surface

The researcher experimented with different drawing materials and techniques on the surfaces using a leopard tortoise as the source of inspiration. These included Soft pastel drawing, Oil astel drawing, charcoal pencil drawing, wax drawing, drawing with brush and mixed media drawing which are presented in the figures below respectively;

Fig 4.53

Soft pastel drawing

Source: Researcher

The researcher executed this drawing using soft pastels

Fig 4.54

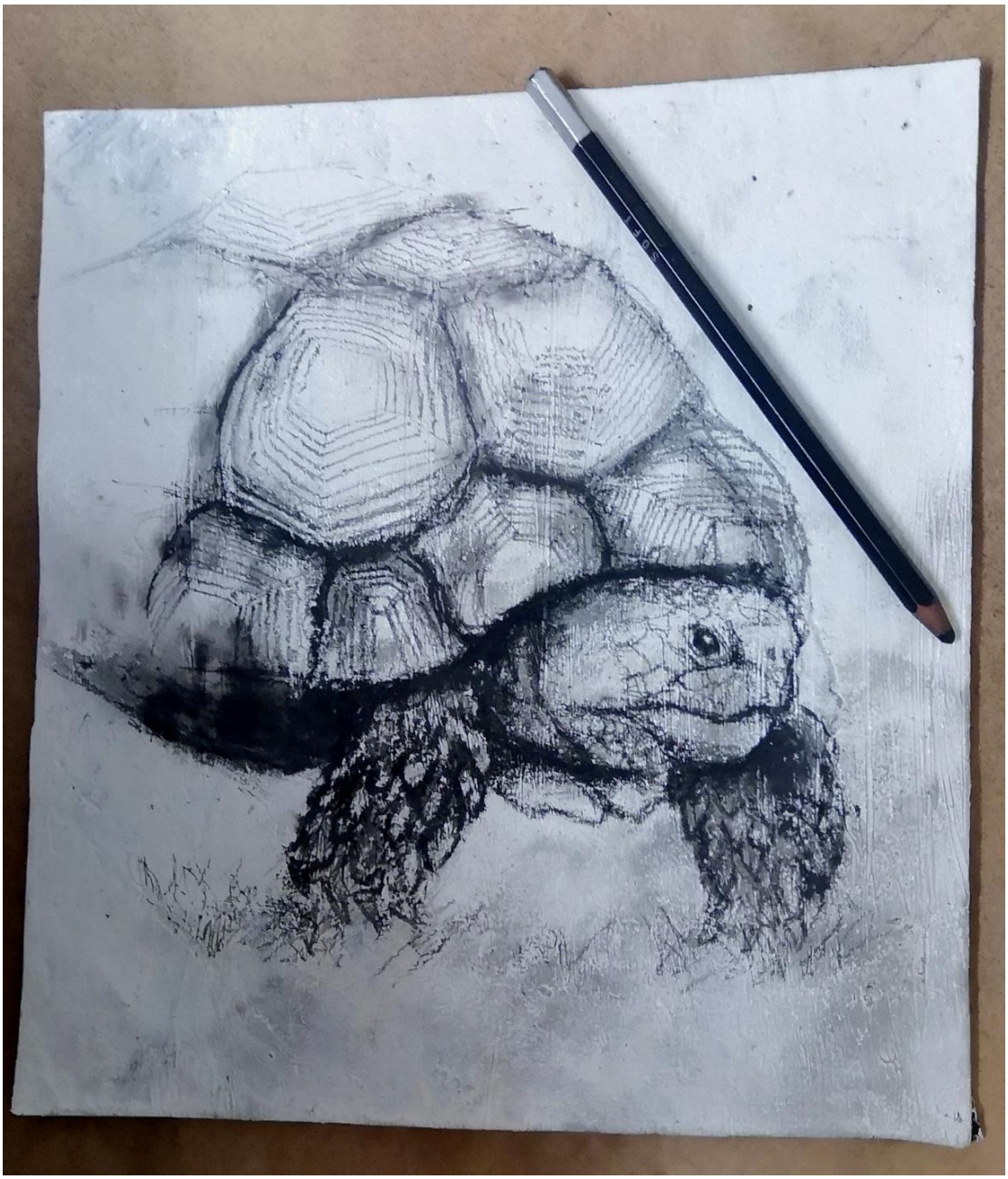
Oil pastel drawing

Source: Researcher

The researcher executed this drawing using oil pastels on a black surface

Fig 4.55

Charcoal pencil drawing



Source: Researcher

The researcher executed this drawing using charcoal pencil and charcoal bars on a primed surface

Fig 4.56

Drawing with wax

Source: Researcher

The researcher executed this drawing by melting candle wax using a heat gun. A piece of candle was held above the surface and heated to melt as the molten wax drips onto the surface. The researcher then shaped the molten wax into a tortoise before the wax solidified.

Fig 4.57

A primed surface

Fig 4.58

Black fountain ink poured on the surface

Fig 4.59

Drawing by bleaching

Source: Researcher

Figures 4.57 to 4.59 depict the process of drawing by bleaching. The researcher cut out the surface into a circular shape, primed with different colours and thereafter a layer of black fountain ink was poured over the colours and bleached using a brush to reveal the underlying colours as seen in Fig. 4.59

Fig 4.60

Drawing with brush

Source: Researcher

The researcher executed this drawing by first priming the surface partially so as to allow interaction with the actual surface material. The drawing was then executed around the primed area using a brush and paint.

Fig 4.61

Mixed media drawing

Source: Researcher

The researcher executed this drawing by stapling electric wires following a sketch of the leopard tortoise. Colours were then applied using soft pastels and paint using a brush. This was done in order to explore drawing capabilities of the rubber dust surface and also create reliefs of features of the tortoise as textures in the composition.

4.8.2.2 Tests by drawing using Computer Aided Design

The researcher used two methods of production under this tes; Laser engraving technology and heat press transfer technology using a film printed from a Direct To Film (DTF) machine.

i) Laser technology

Fig 4.62

A vector drawing to be cut into the surface

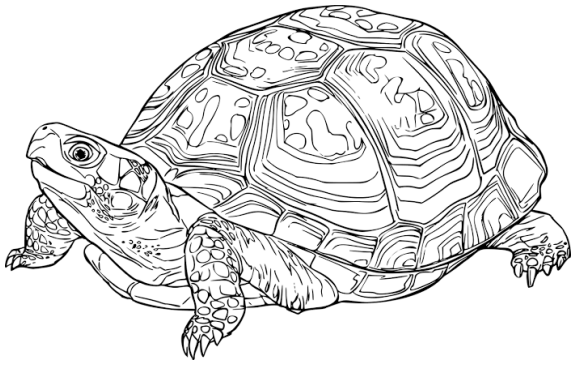


Fig 4.63

The drawing put in a software for cutting

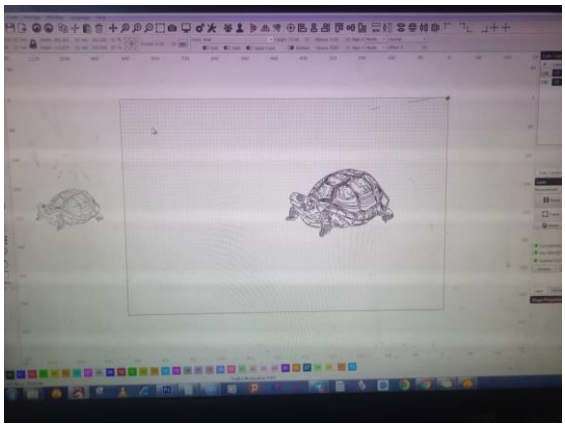
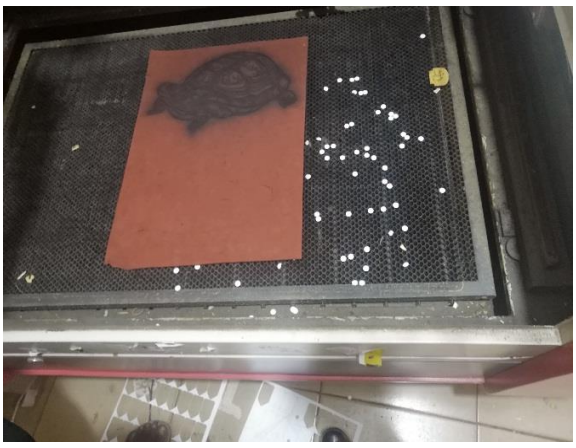


Fig 4.64

A laser machine cuts the vector image

Fig 4.65

After cutting the vector image



Source: Researcher

The drawing is converted into a vector image by using Adobe illistrator. The image is then loaded into the operating software of the lazer machineas seen in fig 4.48 and sent as a

command to the machine to start drawing onto the surface. The machine transfers thevector image onto the surface by way of engraving using lazer technology. The depth into which the lazer engraves the image is controlled in the software. The resultant drawing can be seen in fig 4.61 below;

Fig 4.66

A drawing of the leopard tortoise in motion using Computer Aided Design

Source: Researcher

ii) Heat press technology

Fig 4.67

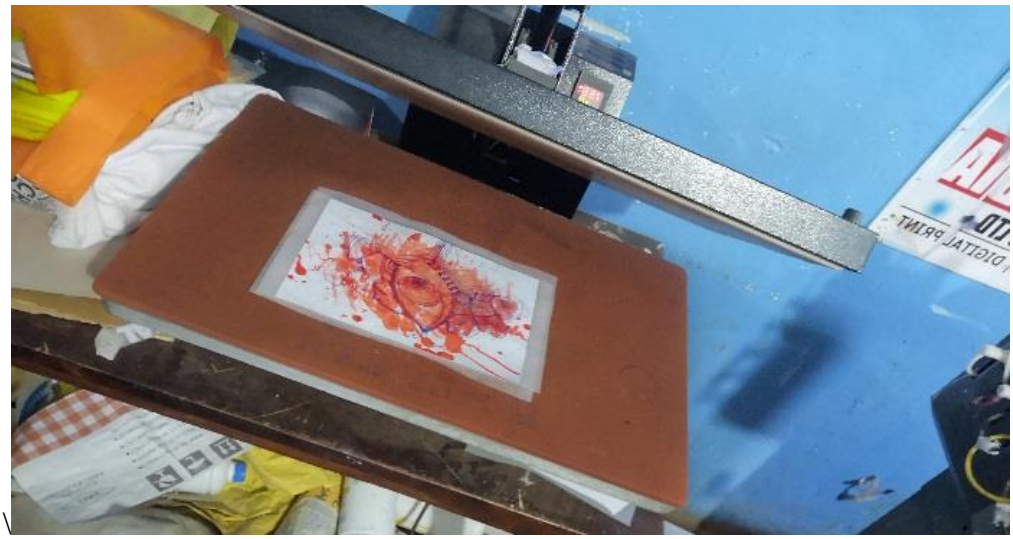
A drawing composition chosen to be printed

Fig 4.68

Direct to Fabric(DTF) printinter

Fig 4.69

The printed composition redy to be heat pressed onto the surface



Source: Researcher

was printed through a DTF as seen in Fig 4.63 and then heat pressed onto the made surface as seen in Fig 4. 64

This method was efficient for mass production because of the ability to duplicate the same drawing. The researcher therefore used this technology to produce prototypes of mouse pads by using heat to transfer the drawing onto the surface as seen in figures 4.65 and 4.66 below;

Fig 4.70

Prototypes of mouse pads

Source: Researcher

Fig 4.71

Usability of the mouse pad

Source: Researcher

CHAPTER FIVE

DISCUSSION, CONCLUSION AND RECOMMENDATIONS

5.0 Introduction

In this chapter, the researcher presents the discussion, conclusion, recommendations drawn from the study and areas for further research. These shall be presented following the study objectives which were; To establish the various sources leading to formation of rubber dust waste from tyres, To examine the extent to which artists have explored recycled surfaces for drawing and To produce drawing surfaces using rubber dust waste from tyres.

5.1 Discussion

This study revealed a variety of sources responsible for the production of rubber dust waste from tyres, including tyre tread wear (Choi et al., 2019), road abrasion, tyre manufacturing processes (Fikarova & Niznanek, 2020) and Craft making (Bodor 2021). Findings showed that considerable amounts of rubber dust could only be collected from manufacturing and craft making processes that involved the re-use of tyres as opposed to road abrasion and tyre tread sources of rubber dust formation.

It was also revealed that casual workers of the two footwear cottages were at risk of contracting serious respiratory infections caused by the dust due to absence of protective gears and poor ventilation of the workshops. The workers also piled the accumulated rubber dust in sacks and some discarded in nearby water trenches since they had no valuable use for it.

The researcher established that recycled drawing surfaces can be made by binding processes or by drawing directly on found surfaces which have been discarded such as used cardboard, wooden pallets and used printing plates.

Furthermore, the researcher observed that the difference in characteristics presented by different recycled drawing surfaces involving material, fragility, texture, fold ability, colour and thickness among others influenced the drawing materials and techniques to be used on the

created surfaces. Drawing techniques such as stapling could only be used on surfaces created out of rubber dust waste due to the ability of the rubber to hold staples and the thickness of the surface which was impossible for printing plates.

The study revealed that rubber dust waste from tyres was a new material to the students. This was because all the ten year III BAID students who participated in testing the drawing surfaces asked the researcher to explain what material it was, how it came about and where it was found besides only five respondents managed to draw on the surfaces. This may have arose from fear of the nature of the surface although the researcher ensured that the surfaces were well bound and safe for use before distributing them to the students to explore.

The production process of drawing surfaces using rubber dust waste from tyres became easier and faster after discovering the layering technique. This technique did not require a lot of energy and time as compared to the earlier methods of making the surfaces using a mould. Surfaces made out of the mould were thick, heavy and more fragile in comparison to those made by layering.

The findings revealed that surfaces made by layering would serve a purpose beyond acting as drawing surfaces but also allowed the researcher to discover the possibility of mass production of functional drawing products such as mouse pads as seen in figures 4.70 and 4.71 above.

The study was able to reveal that artists can make their own drawing surfaces out of recyclable materials at low or zero costs and make experimental drawings using various drawing materials and techniques. This would serve as one way of reducing on material costs and substantially increasing mass production.

It was discovered that synthetic binders were much reliable in terms of acquisition and binding power as opposed to natural binders. As much as natural binders were able to produce tangible surfaces, it was difficult to extract gum from Mauritius thorn and sap from fius thonningi tree. The surface created by cassava paste was seen to develop moulds at room temperature even

after drying over a period of time while those made using gum from Mauritius thorn cracked after storage beyond a month's time. Surfaces created using sap from ficus thonningi tree had less binding power in comparison to all surface created.

The researcher also discovered that there were no reagents of any kind that would bleach the rubber dust from its black colour since it is composed of carbon black, silica and binding agents (Choi et al., 2019). Therefore changing the colour of the surfaces would only be achieved through colorization methods.

5.2 Conclusion

As much as road abrasion and tyre treading produce rubber dust, these processes produce minimal amounts and therefore cannot be reliable sources for collection. This is because the dust produced in the two processes is swept into the air by wind or even washed way by rain besides it would be difficult collect dust from the roads with the intention for recycling. This leaves tyre manufacturing and recycling processes as reliable sources for artists to collect the material. Natural binders are unreliable in regard to the binding power of rubber dust to produce drawing surfaces.

The capabilities of rubber dust waste from tyres in regard to production of drawing surfaces cannot be underrated. The use of rubber dust waste produces excellent drawing surfaces with attributes that can be predetermined by the artist including texture, weight, thickness and colour.

5.3 Recommendations

The study recommends that artists should explore the possibilities of using rubber dust waste from as a material for drawing as a way widening the scope of its functionality.

The study recommends that artists seeking to explore rubber dust waste should acquire protective gears recommended by medical personnel as a health warning to prevent risks of contracting respiratory sicknesses that may arise from the use of this waste since it is airborne.

The study also recommends that artists should make their own drawing surfaces using rubber dust waste as one way of reducing on costs of drawing surfaces while at the same time promoting safe re-use.

5.4 Areas for further research

Further research should be conducted on suitable methods or materials for colorizing rubber dust to make it easily usable for drawing since the researcher only explored with oxides and primer.

Further research should be conducted into the extraction of natural binders to quantities that can be used to bind drawing surfaces to minimize production costs incurred on Styrene which is a synthetic binder.

Further research should be conducted on the sustainability of the surfaces made from rubber dust waste.

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APPENDIX 1: WORKPLAN

	Proposal development	Proposal defense	Data collection data, analysis, report writing	Production of final studio work	Report compilation and submission	Report defense and graduation
OCT 2022 TO FEB 2023						
JULY						
AUGUST 2023 TO NOV. 2023						
DEC. 2024 TO MARCH 2024						
APRIL. 2024 TO JULY 2024						
AUGUST. 2024 TO DEC. 2024						

APPENDIX II: BUDGET

PARTICULARS	**ESTIMATED COST**
Transport to the field to collect findings	100,000
Feeding costs during data collection	250,000
Rental cost during data collection	300,000
Printing source documents, binding proposal and report	200,000
Tools, materials and moulds for production of drawing surfaces and drawing materials from waste tyres	1000,000
Grand total	**1,750,000**

APPENDIX III: INTERVIEW GUIDE FOR CASUAL WORKERS

Qn. 1: What type of tyres do you recycle?

a) New tyres
b) Used tyres
c) End of Life Tyres
d) Any other?.....

Qn 2: Which crafts do you make out of the recycled tyres

a) Craft shoes
b) Craft bags
c) Belts
d) Any other crafts?

……..

Qn 3: What are the suitable binders used at this firm to bind the rubbers

…….

Qn 4: How safe are they to human health?

……..

……..

Qn 4: The recycling method used at your firm leads to production of rubber dust from waste tyres

a) Yes
b) No

Qn 5: If yes, do you have any valuable use the rubber dust?

……

Qn 6: Are there any occupational hazards that result from the production of the rubber dust:

a) By the machine operator (Yes/No)

b) By fellow employees in the working area where the dust is created (Yes/)

Qn 7: If yes in any of the above, are there any measures taken to counter the hazzard?

……

……..

Qn 8: Are there other sources of rubber dust you know of except the method used in your firm?

a) Yes

b) No

Qn 9 If yes, which source?

……

……

Qn 10. How is the rubber dust generated discarded?

……

……

End

Thank you for your participation

APPENDIX IV: OBSERVATION SHEDULE

NAME OF RESEARCH AREA..…….

DATE VISITED:……....

ITEM	**YES**	**NO**	**GRADE (POOR, FAIR, GOOD)**	**COMMENTS**
Presence of working gears				
Ventilation measures				
Availability of a seperate space for feeding				
Dumping method of rubber dust/ waste bins for rubber dust				
Any visible health risk arising from rubber dust				
Any visible form of drawings on recycled surface				

APPENDIX V: INTERVIEW GUIDE FOR STUDENTS

Respondent Index No.

Qn 1: Have you drawn on recycled surfaces before?

Yes ☐ No ☐

Qn 2: If you answered yes in the question above?

i) Ddescribe the nature of the surface in terms of materials, colour, texture among others.

……

.....

ii) Which techniques of drawing did you use on that drawing surface?

…….

Qn 3 Which techniques of drawing are you comfortable with experimenting on this drawing surface?

……

……

Qn 4: Which drawing materials can work on this drawing surface?

……

Qn 5: Does this surface suit drawing exercises?

Yes ☐ No ☐ Not certain ☐

Qn 6: Did you experience any difficulties using the surface?

Yes ☐ No ☐ Not certain ☐

Qn 7: If yes in the question above,

i) Describe the nature of the difficulty

……..

……..

ii) What can be improved to make the surface better for drawing

……

End. Thank you for your participation

APPENDIX VI: INTRODUCTORY LETTER FROM THE DIRECTORATE OF RESEARCH AND GRADUATE TRAINING

KYAMBOGO UNIVERSITY

P. O. Box 1 Kyambogo, Phone: 041-285001/2 Fax: 041-220464

www.kyambogo.ac.ug

SCHOOL OF ART AND INDUSTRIAL DESIGN

DEPARTMENT OF INDUSTRIAL AND COMMERCIAL ART

MASTERS OF ART AND INDUSTRIAL DESIGN

25/08/2023

.....

.....

Dear Sir/Madam,

TO WHOM IT MAY CONCERN

This letter introduces **MAKWA PETER KAMULI** a final student of Masters in Art and Industrial Design (MAID) Programme at Kyambogo University. Registered under number **21/U/GMAID/14311/PE**

In partial fulfillment for the award of a MAID Programme at Kyambogo University, he is expected to conduct a research study in a specialized area as approved by the school graduate board.

The purpose of this letter therefore, is to request you to allow him to conduct Research at/ in .....and accord him the necessary support for the study.

Looking forward to your kind cooperation.

KYAMBOGO UNIVERSITY
25 AUG 2023
DEPARTMENT OF INDUSTRIAL & ART & DESIGN

Yours Sincerely,

Prof. Kwesiga Philip

Head of Department, Industrial and Commercial Art

APPENDIX VII: LETTER OF CONSENT

Dear Respondent,

My name is Makwa Peter Kamuli pursuing a Masters degree of Art and Industrial Design at Kyambogo University. I would like to carry out research about rubber dust waste from tyres.

This interview should take less than one hour and I will be doing the reording in order to capture every detailof the deliberations as I also take some notes during the session. I encourage you to be more audible when speakingvso that I do not miss your comments and suggestions during the discussions.

Every response will be kept confidential and used for the purpose of this study. Your interview responses will be analysed to ensure that any informationincluded in the report does not identify you as a respondent.

Is there a question about what I have explained?

Are you willing to participate in this interview?

I…….Accept to take part in this research and oblige to givethe necessary feedback to the researcher.

Signature:……

Date:……