# LEVEL OF AWARENESS AND ATTITUDE TOWARDS THE USE OF POLYSTYRENE AS A DAMP PROOF MATERIAL IN BUILDING CONSTRUCTION IN MINNA, METROPOLIS OF NIGER

**BY**

**JAN Yishinmasu Yohanna**

**2018/3/74397TI**

**DEPARTMENT OF INDUSTRIAL AND TECHNOLOGY EDUCATION,**

**FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA, NIGER STATE.**

**APRIL, 2023**

# LEVEL OF AWARENESS AND ATTITUDE TOWARDS THE USE OF POLYSTYRENE AS A DAMP PROOF MATERIAL IN BUILDING CONSTRUCTION IN MINNA, METROPOLIS OF NIGER

**BY**

**JAN Yishinmasu Yohanna**

**2018/3/74397TI**

**A RESEARCH PROJECT SUBMITTED TO THE DEPARTMENT OF INDUSTRIAL AND TECHNOLOGY EDUCATION, SCHOOL OF TECHNOLOGY EDUCATION, FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA, NIGER STATE, IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF BACHELOR OF TECHNOLOGY (B. TECH) DEGREE IN INDUSTRIAL AND TECHNOLOGY EDUCATION.**

**APRIL, 2023**

## DECLARATION

I, **Jan Yishinmasu Yohanna**, with matriculation number **2018/3/74397TI**, an undergraduate student of the department of Industrial and Technology Education, certify that the work embodied in this project is original and has not been submitted in part or full for any other diploma or degree of this or any other University.

**Jan Yishinmasu Yohanna**,
.....
**2018/3/74397TI**, **Signature/Date**

## CERTIFICATION

This project has been read and approved as meeting the requirement for the award of B. Tech degree in Industrial and Technology Education, School of Technology Education, Federal University of Technology, Minna.

Mr. Ekhalia B. J. _____

_____

Project Supervisor Signature and Date

Dr. T. M. Saba

_____

Head of Department Signature and Date

_____

External Examiner Signature and Date

## DEDICATION

With profound joy and gratitude in my heart, I dedicate this project to God Almighty for His Unshakable and Unbreakable Faithfulness. His Divine and constant guidance in my life has made this project a reality today. Thank God.

## ACKNOWLEDGEMENTS

My sincere gratitude goes to God almighty for his help and guidance that finally I was able to complete this project as one of my requirement to complete my study. I would like to extend my deepest gratitude to my grand creator, and all the individuals who in one way or the other contributed to the success of this research. My sincere appreciation also goes to my project supervisor Mr. Ekhalia B. J. I would also like to extend my words of appreciation to project coordinator Dr. A.M. Hassan, my HOD Dr. T.M. Saba and all staff of ITE department. My joy and happiness will be incomplete without specially thanking my parents in respect of Mr & Mrs Zayum Yohanna Daniel and my elder brother Jan Yipupbalsu Zayum, Nagari Martha Danladi for their support and prayers all these years. Special thanks to my mentor Mr. Zacks Joshua and Mr. Victor Bende I also wants to extend my appreciation to my helpful Friends in home and in school.

## ABSTRACT

*This study examined the level of awareness and attitude towards the use of polystyrene as a damp proof material in building construction in Minna metropolis of Niger. Three research questions were developed to guide the study and one null hypotheses were tested at 0.05 level of significance. The study employed a survey research design. The study used a four-point scale questionnaire, which contains a total of 23-items, as instrument. The total population of the study is 80 respondents comprising 20 building contractors and 60 building contractors. The result showed Poly-concrete (Lightweight Concrete Using Polystyrene Beads As Aggregate), Environmental friendliness, Thermal And Sound Insulation. The study recommended among other things, Standard Organizational of Nigeria (SON) should enforce standard in EPS products and also broaden its scope to partnering with Universities and Research Institutions for optimal results towards consumer safety*.

## TABLE OF CONTENTS

**Contents**

**Pages**

**APPENDIXES**

**36**

**Tables** **LIST OF TABLES** **Pages**

# CHAPTER ONE

# INTRODUCTION

## 1.1 Background of the Study

Building is a reflection of the cultural, economic and social evolution of a society. It is an expression of a people's ability to meet their needs of shelter (Duyne Barenstein, 2015). The significance of shelter to man cannot be over emphasized as it is next in importance to air, water and food (Raimi *et al.,* 2019). The primary function of a building is to provide shelter from the weather, fire outbreak, warmth, and comfort to the users. In recent years, conventional materials such as sandcrete block, concrete blocks and burnt bricks have been used to provide housing for shelter and other basic needs. The use of some of these materials have not met the goals of sustainability in building construction due to their high cost of purchase, difficulty in obtaining material due to its limited availability, poor performance and high level of maintenance (Wang *et al.,* 2016). The use of building materials is very vital in all phases of life as no field of building and engineering is conceivable without their use and there is always a new technology to replace an outgoing technology due to mans' technological advancement. The use of building materials have changed from one material to another over the period of time due to technological advancement. These issues have led to the invention of alternative building materials among which are improved plastic material called Expanded Polystyrene (EPS) which offered new options to access a material that is economical and produces structural as well as aesthetics efficiency (Momoh and Folorunso, 2018). Polystyrene is a thermoplastic material obtained by the polymerization of styrene and is used in Packaging electronics, food items and building houses. Polystyrene is a light synthetic material which cannot be used in building houses unless it has been expanded to form a block (Bicer and Kar, 2017). The product of polymerization of styrene is called Polystyrene which is then expanded to produce a

block-shaped panel. Over the years, a lot of materials have being used in building construction ranging from stones, mud, timber, bamboo, glass, block, brick, grass, metal, cement, concrete and polystyrene among others.

EPS is a chemically stable compound and possesses some Characteristics that makes it suitable as a construction material and for packaging of consumer Products (Schyns and Shaver, 2021). The material is not susceptible to decay due to its non-biodegradable nature when exposed to the landfill (Degenstein, 2018). Expanded Polystyrene (EPS) is a multipurpose plastic material made available for a multiplicity of applications. EPS has experienced wide range of applications owing to its lightweight, rigidity & thermal and acoustic insulating properties. Initially, EPS was mainly used for insulation foam for closed cavity walls, roofs and floor insulation. But ultimately, the application has extended vastly in the building and construction industry such that EPS is now used in road construction, bridges, floatation and drainages. Polystyrene used for building construction are of various types and sizes Windapo *et al*. (2021) explains the 3D panels to consist of an: EPS core with a thickness ranging from 40-100mm sandwiched between two plane-parallel welded wire mesh sheets and inclined diagonal wire in between that go through the EPS core and that are welded to the cover mesh.

King *et al.* (2021) explains EPS as one of the Insulating Concrete Forms (ICF). ICF systems are comprised of lightweight modular units manufactured of insulating materials such as polystyrene and are designed primarily for placement as foundation and exterior concrete walls. EPS buildings demonstrate high thermal insulation capacity, light weight, faster time, higher strength, greater structural stability and cost effectiveness. The study emphasizes that EPS possesses overriding advantages over the sandcrete block and masonry in urban housing. ESP can also be use as damp proof materials to stop rising of moisture which could result in dampness.

Dampness is defined as the presence of hygroscopic and gravitational water in the struct ural elements. It endangers the structural safety as well as gives rise to the unhygienic conditions along with that it supports the pathogenic and fungal colonies. Basically, moistures travelling through the walls, roofs and floors are stuck there and gives rise to dampness. Therefore, damp prevention is very much essential and it should be done through provision of damp proof course or through proper structural design. ESP is a very good damp proof course to restrict the rising of water in the building structure. Many building contractors lack awareness of the use of ESP as a damp proof course in Minna metropolis of Niger state, because it is rarely been used in construction.

Awareness in general means, knowledgeable being conscious; cognizant, informed alert. Awareness is the state or ability to perceive, to feel, or to be conscious of events, objects, or sensory patterns. Awareness is Knowing that something exists, or understanding of a situation or subject at the present time based on information or experience. Acquaintance, consciousness, knowledge (Van Manen, 2017). ESP usage as damp proof course required the awareness of building professional in Minna metropolis of Niger state.

Expanded Polystyrene as an alternative building material is a multipurpose plastic material made available for a multiplicity of applications due to its light weight, buoyancy and it being a good insulator of heat and sound has proclaimed its overwhelming properties and the compatibility of its use in the construction industry yet it is evident that its application in the construction of buildings in Nigeria building industry has not been fully integrated due to inadequate awareness and attitude of its usefulness and skeptical overview of its performance (Moshood *et al.,* 2020).

Vawa and Manga (2021), despite the proven huge benefits derivable from EPS e.g., environmental friendliness, great versatility, structural stability, recyclability, economic viability, faster erection time and cost effectiveness, its usage for construction of buildings is very low in Nigeria. The study therefore seeks to identify the level of awareness and attitude towards the use of polystyrene as a damp proof material in building construction in Minna metropolis of Niger state.

## 1.2 Statement of the Problem

As technology plays an ever more prevalent role in our society, it is critical that it remain accessible and understandable to all. According to Vawa and Manga (2021), despite the proven huge benefits derivable from EPS for example, environmental friendliness, great versatility, structural stability, recyclability, economic viability, faster erection time and cost effectiveness, its usage for construction of buildings is still very low in Nigeria.

Yevu *et al.* (2022) stated that the low usage of EPS in construction and solicitation for acceptance of the EPS construction concept by stakeholders, the focus is on the slow adoption pace of EPS for construction in Nigeria.

Through the incessant struggle of man to meet his shelter needs and considering scare resources, a need to provide a cause for succour to the skyrocketing cost was created; hence, there is a reason to assess cost of embedding polystyrene in building components over canonical methods of constructing different building components. Provision for man's basic needs of survival at a cheaper, faster and easier way of providing shelter is expedient. Hence the question of awareness, understanding and other factors associated with EPS has to be studied and analysed carefully to achieve a common and beneficial goal. It is against the stated problem the study seeks to identify the level of awareness

and attitude towards the use of polystyrene as a damp proof material in building construction in Minna metropolis of Niger state.

## 1.3 Purpose of the Study

The purpose of the study is to identify the level of awareness and attitude towards the use of polystyrene as a damp proof material in building construction in Minna metropolis of Niger state. Specifically, the study will determine:

1 The level of awareness on the use of polystyrene as a damp proof material in building construction in Minna metropolis of Niger state.

2 The factors influencing the use of polystyrene as a damp proof material in building construction in Minna metropolis of Niger state.

3 The perception of stakeholders on the production and usage of EPS.

## 1.4 Significance of the Study

The findings of the study will be of benefit to the builders, building contractors and the building professional bodies.

The findings of this study will be of benefit to the builders as it will serve as eye opener for them on the use polystyrene as a damp proof. It will also create an awareness for them on the application of polystyrene in building.

The building contractors will benefit from study as it will enable them to improve on building construction and also be able to improve their knowledge on the use of polystyrene in modern building construction.

The findings of this study will be of benefit building professional as it will enable them to make building policies to guide builders on the new approaches to building constructions.

## 1.5 Scope of the Study

The study seeks to identify the level of awareness and attitude towards the use of polystyrene as a damp proof material in building construction in Minna metropolis of Niger state. The study will cover the level of awareness on the use of polystyrene as a damp proof material in building construction in Minna metropolis of Niger state, the factors influencing the use of polystyrene as a damp proof material in building construction in Minna metropolis of Niger state, the perception of stakeholders on the production and usage of EPS. However, due to constraint of time level of utilization will not be included in the study.

## 1.6 Research Question

1. What are the level of awareness on the use of polystyrene as a damp proof material in building construction in Minna metropolis of Niger state?
2. What are the factors influencing the use of polystyrene as a damp proof material in building construction in Minna metropolis of Niger state?
3. What are the perception of stakeholders on the production and usage of EPS?

## 1.7 Hypotheses

**$H_{01}$** There is no significant difference between the mean responses of Builders and building contractors on the level of awareness on the use of polystyrene as a damp proof material in building construction in Minna metropolis of Niger state.

# CHAPTER TWO

# REVIEW OF RELATED LITERATURE

The review of related literature to this study is organized under the following subheadings:

## 2.2 Conceptual Framework

2.1.1 Polystyrene production from crude oil

2.1.2 Expanded Polystyrene (EPS)

2.1.3 Properties of Expanded Polystyrene

2.1.4 Life cycle analysis of EPS

2.1.5 Sustainable Building Construction Using Expanded Polystyrene

## 2.4 Related Empirical Studies

## 2.5 Summary of Review of Related Literature

### 2.2.1 Polystyrene production from crude oil

Styrene is the building block (monomer) of polystyrene and is obtained from crude oil (van Schijndel *et al.*, 2020). The effect of this discovery does not affect the initial discovery process but it creates an easier option for production of the monomer before the polymer. A range of processes such as distillation, steam cracking and dehydrogenation are required to transform the crude oil into styrene.

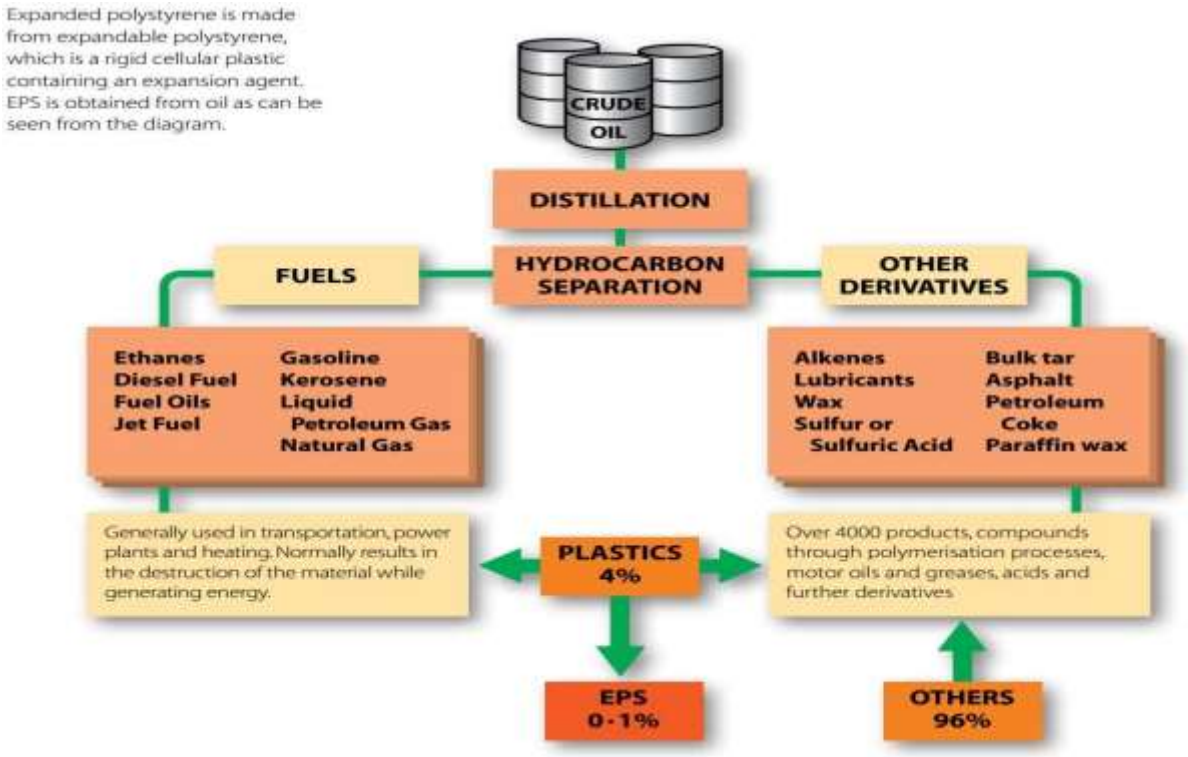


*Figure 1: EPS production from crude oil.*
**Source:** Expanded Polystyrene (Eps) And the Environment (2015)

The production route from crude oil refining produces naphtha which contains a mixture of low molecular weight, saturated hydrocarbons of various compositions. This is converted into a smaller group of unsaturated hydrocarbons by cracking (a process in which the naphtha is heated to a high temperature in the absence of air).

The resulting mixture is then separated into its constituent's components by distillation producing principally ethylene, propylene and a number of other products, which find

uses elsewhere in the petrochemical plant either as feedstock or fuels. Natural gas is also converted into ethylene and other products by cracking. Ethylene and benzene are reacted to form ethyl-benzene which is dehydrogenated into styrene. At the end, polystyrene is produced by polymerizing styrene (Artetxe *et al.,* 2015). This is an exothermic reaction that can be initiated with organic peroxide or by heat.

### 2.1.2 Expanded Polystyrene (EPS)

Polystyrene is a thermoplastic material obtained by the polymerization of styrene which produces spherical beads about the size of sugar granules and is used in packaging electronics, food items and building houses (Okeke *et al.,* 2022). The polymer, polystyrene, used in the manufacture of expandable polystyrene has been produced for more than 60 years and is used for a wide range of plastics and plastic products. Expanded polystyrene is made from expandable polystyrene, which is a rigid cellular plastic containing an expansion agent. The production of EPS is a three-stage process. During the process, a low boiling point hydrocarbon, usually pentane gas is added to the material to assist expansion during subsequent processing which is finally expended so that the finished products contains no residual gas.

In the first stage, polystyrene beads are expanded to a range of 40 - 50 times their original volume by heating to about 100˚C with steam in an enclosed vessel called a pre-expander; during this process, the beads are stirred continuously and the final density of EPS is determined ranging between 14 kg/m$^3$ - 30 kg/m$^3$ (Afolabi *et al.*, 2019). After pre-expansion, the expanded beads are cooled and dried in a fluidized bed drier, before being pneumatically conveyed to storage silos for maturing.

In the course of maturing, which is the second stage of processing, the expanded beads containing up to 90% air are stabilized typically over a period of 24 hours. Following

pre-expansion, the beads have a partial vacuum which must be equalized before final processing by allowing air to diffuse into the beads until equilibrium is reached. This is how the beads achieve greater mechanical elasticity and improve expansion capacity very important in the following transformation stage.

In the third stage of processing, known as the Molding stage, beads are conveyed into a mold, then are heated again by the introduction of steam. Under the influence of steam, the bead s softens and starts to expand again. However, as they are contained in a mold they cannot expand freely and therefore create an internal pressure within the mold. Under this pressure the softened beads fuse together when the correct temperature is reached within the mold. Following fusion, the mold is cooled usually under the influence of a vacuum to remove moisture.

The molded product is ejected from the mold at the completion of the cycle. During processing, the pentane gas is expended, so that the finished products contains no residual gas. In this way molded shapes or large blocks are obtained which can be later sectioned into required shapes like boards, panels, cylinders etc.

Bestowing to (Netsch *et al.,* 2022), EPS is formed by a union of so many beads of polystyrene produced during a modeling process with a supply of heat which comes in form of steam until the following characteristics are obtained: Normal density of 15kg/m$^3$, Thermal conductivity of 0.037w/mk,

Steam resistance of 0.15mmHgm$^2$ dia/gcm and Compressive stress at 10% of strain is 50kpa. EPS (Expanded Polystyrene) is an excellent material for packaging and for construction as it is light, yet rigid foam with good thermal insulation and high impact resistance.

EPS is used in many aspects of construction including large structures such as roads, bridges, railway lines, public buildings or even small family residences.

The characteristics of EPS makes it ideal for use as an insulator, an element for decorating or imaginative touches, and a lightweight filling material in roads to facilitate land drainage etc. For polystyrene beads to be used they should be left to take up air for more than four hours; this is due to their inelastic nature and inability to recover from deformation.

### 2.1.3 Properties of Expanded Polystyrene

Expanded polystyrene is among the most important plastic materials, with more than 30 years of application in various functions. This is because expanded polystyrene has a unique combination of characteristics such as its lightweight, good thermal insulation, strong absorption of shock, high compressive strength and good moisture resistance. Expanded polystyrene is used in the construction industry due to the following benefits.

**Relative lightweight:** A single panel with a size of 1.2 by 3m for building a wall can be carried by a single operator. Compared with the traditional prefabricated structure, the panels are light weight with their variable weight approximately between 4 and 15 $Kg/m^2$. This feature enables an easy handling of the panels in all phases, from the production to the final erection of the building (Ngugi *et al.,* 2017).

**Improved strength compared to ordinary masonry wall:** Walls made using expanded polystyrene panels are composite structures. The bond between the galvanized wire mesh reinforcement and shotcrete (or concrete for floor slab panels) makes the wall to be more capable of resisting applied flexural loads as if they were an integral section. The wire mesh is also connected across the panel assisting on transfer

longitudinal shear. In addition, expanded polystyrene panels have a high strength to weight ratio.

**It offers good thermal insulation and fire resistance:** Expanded polystyrene panels have been used in the construction industry to mostly solve problems concerning the thermal insulation. Additives can be added to expanded polystyrene to give it "self-extinguishing" characteristics and ability to withstand heat or fire for a long period before combustion. The amount of aggregates in concrete or mortar determine the duration of time to resist fire, the more the aggregates, the greater the ability to resist fire. Shotcrete has more aggregates than mortar since the former has quarry chippings in addition to cement and sand.

**It does not react with water:** Expanded polystyrene does not react with water neither is water absorbed along the walls of the closed cells in the polystyrene foam as compared to masonry stone which can absorb water and become bulky over time in a wet environment. This can lead to damp conditions in buildings causing paint and plaster to peel off from the walls.

**It is sound proof:** The loss of sound transmission of a wall is related to the unit mass of the surface to its stiffness, and its intrinsic damping. An insulation to sound is created in shotcrete walls made using expanded polystyrene. The insulating ability of walls that are hollow or filled with a material with similar behavior to that of air is usually greater than that of a one layered structure whose weight and thickness is twice the former hollow or filled wall.

**Earthquake and storm resistant:** When hurricanes howl, flying debris is the greatest danger to property and people. Concrete walls such as expanded polystyrene walls covered with shotcrete do not generate flying debris during hurricanes and tornadoes.

Buildings made of concrete are much more storm-resistant than buildings made of wood and steel. Most homes in North America and Asia, which are stormprone areas, are now making concrete walls and are using alternative materials to wood and steel such as expanded polystyrene (Ahmed, 2020).

### 2.1.4 Life cycle analysis of EPS

A life cycle analysis is a technique intended to quantify the total impact of a product during its production, distribution, use and recycling, treatment or disposal. As individuals, and as organizations, all our daily actions have an impact on the environment. We use energy and resources, generate emissions into the atmosphere, pollute water and produce waste. One of the tasks of a responsible business is to calculate its impact on the environment and to find ways to reduce it.

However, some businesses use concern about the environment as a marketing tool and make claims that their products or materials are 'environmentally-friendly' or have a low carbon footprint. Responsible organizations will either conduct a thorough life-cycle analysis of a product, or calculate its carbon footprint using Carbon Trust methodology, (making their research public) before making statements of this kind.

Reliable life cycle analyses will measure:

- Energy consumption
- Air pollution
- Water pollution
- Global warming potential
- Volume of solid waste

### 2.1.5 Sustainable Building Construction Using Expanded Polystyrene

Sustainability of buildings is an important issue for the construction industry and are characterized by the lower construction costs for energy consumption and operations, environmentally friendly, able to save natural resources, comfortable and healthy for their users (Lin *et al.,* 2016). Safe and affordable housing provides personal, social, and economic benefits, and contributes to the health and safety of individual inhabitants (Jackson *et al.,* 2018). Energy is one of the most important factors in economic growth and social development in all countries and as urbanization is rapidly growing, the construction of residential area is perpetrating intensely and at the same time the world is also facing the energy resource shortage, hence the need to modify the housing design and construction technologies to reduce the cost, gas emission, and to provide more indoor comfort with least energy needs and reduces the effect of diminishing energy resources which is a threat to the present and future of mankind (Shahsavari & Akbari, 2018).

According to Ahmed and Tsavdaridis, (2018), the building industry uses great quantities of raw materials which involve high energy consumption and that choosing materials with high content in embodied energy entails an initial high level of energy consumption in the building production stage but also determines future energy consumption in order to fulfil heating, ventilation and air conditioning demands. Furthermore, Mirrahimi *et al.* (2016) also stated that in the energy efficient building design, the use of energy efficient building materials is very important since the construction materials can positively support the constructions in which they are used by reflecting their environmental features with their all other features into the construction. Based on this, it is important to consider alternative option such as expanded polystyrene or other types of combustible materials for insulation. This is

confirmed by Abu-Jdayil *et al.,* (2019), where he stated in his study that a great satisfaction was derived by both client and residents of EPS constructed building for its high-ranking performances for recyclability, reliability, versatility and moisture resistance. They also stated that there is a great future for the applications of EPS in the Nigerian building industry. Also Momoh and Folorunso (2018) said that the use of pre-reinforced Expanded polystyrene sheets will reduce the overall construction cost as it reduces the duration of construction drastically hence the labour cost is reduced consequently which also can be assembled where the bearing capacity of soil is low as the dead weight of the superstructure is very less compared to that of conventional reinforced concrete structure.

Because the expanded polystyrene (EPS) light weight concrete has the characteristics of lightweight, energy absorption, and heat preservation, it is used in many specific construction industries like high rise buildings, floating marine platforms, and large-sized and long-span concrete Gyawali and Maeda (2019), which is why it should be considered for use in Minna metropolis as an alternative building materials to the available alternatives which has demonstrated threat to the sustainability of the immediate surrounding.

## 2.2 Related Empirical Studies

Ede (2014) carried out a study on Use of Advanced Plastic Materials in Nigeria: Performance Assessment of Expanded Polystyrene Building Technology System. The provision of affordable residential houses for the masses in the developing nations has been a mirage over the years and the future does not portend good as the cost of adopting conventional concrete material technologies is escalating while so many environmental issues like climate change are being raised in the recent times. To

circumvent this poor housing provision trend, some innovative construction materials and technologies are being introduced to facilitate unique modular designs, reduction of labour, decline in the depletion of exhaustible materials, savings of time and fund. One of such materials is the expanded polystyrene. The introduction of advanced plastic materials and in particular the expanded polystyrene building technologies in the Nigerian construction industry will be a very useful and brilliant initiative that will aid the reduction of cost of construction and facilitate access to affordable houses for the masses. This research aims at studying the applications of this innovative plastic material in the Nigerian building industry with special regard to the performance perception by the clients and the end users. A building estate where expanded polystyrene building technology has been predominantly used in Abuja is considered as a case study. Questionnaires were distributed among clients and residents of the building estate and statistical tools were used to analyse the data collected. Great satisfaction verified among the clients and residents and the high ranking performance confirmed for recyclability, reliability, versatility and moisture resistance of EPS building products all herald a great future for the applications of this advanced building products in the Nigerian building industry.

Oriafoh (2015) carried out a study to assess the perception of stakeholders on the use of EPS for building construction in Nigeria towards identification of all major challenges relating to the problem. This is meant to promote the diversification of its use and acceptability across Nigeria and enhance sustainable development. The study used a qualitative approach by using a structured questionnaire for stakeholders in relation to EPS with a sample size of 40 respondents. Respondents included: manufacturers of EPS, individual users of EPS for construction, and end users of EPS. Findings indicated that the cause of slow adoption pace of EPS for building construction in Nigeria mainly

stems from the general awareness of the public, the petrochemical sector and the power sector of the Nigeria. The failure of the petrochemical sector to produce styrene, a by-product of petroleum to aid the sequential production chain to achieve EPS as the final product for construction in Nigeria results in a resort by manufacturers to import expandable polystyrene granules from Asia and Europe. This is a capital intensive venture owing to shipment freight coupled with its accruing cost and unreliable power supply from the national grid. This paper has clarified the direction for further research on the use of EPS in Nigeria that seeks for a lesser overall cost of projects, lesser time for completion of various milestones in projects. This will be beneficial to Quantity Surveyors whose primary aim is to maximize satisfaction and minimize cost. From a bigger picture, it will benefit the construction industry with its easier, time saving, efficiency, durability, environmental friendliness and better structural properties.

Momoh (2018) conducted a study on Identifying Factors Hindering the Adoption of Expanded Polystyrene for Building Construction in Akure, Nigeria. conventional building materials thereby leading to the invention of alternative building materials. This paper looks at the barriers to the adoption of expanded polystyrene (EPS) for building construction in Akure, Nigeria. The methodology adopted elicited information through structured questionnaire which assessed the socio-economic characteristics of the respondents, their level of awareness of EPS and its application in building construction, the rate at which they specify EPS for designs and construction and the hindrances to its adoption for building construction. A total of 60 questionnaires were administered on the architects in practice and in the academia environment but 45 were retrieved. This was the bases to which the conclusion of this research was made. The outcome of the research shows that lack of awareness is a key hindrance to the adoption

of EPS for construction as most architects in Akure do not know much about expanded polystyrene, thereby, cannot fully decipher its qualities and/or suitability for construction. As such, most questions pertaining the durability, cost implication or client's preference could not be answered by the architects since their knowledge on the subject matter is minimal. However, those who knows about EPS confirms its flexibility, quick construction time and its environmental friendliness but stated that EPS is not readily available like other conventional materials. As such, their specification always goes towards the available materials.

Maryam (2020) improving the adoption and awareness of expanded polystyrene as building material in the construction industry. Housing provision has become a global issue as the need for affordable housing kept increasing in Nigeria. This has emerged due to various economic, socio-cultural, and environmental factors which have increased pressure on conventional building materials, thereby leading to the invention of alternative building materials. This paper investigated the adoption of expanded polystyrene (EPS) for building construction. Expanded polystyrene is a thermoplastic material obtained from the polymerisation of styrene and used as packaging material. The methodology adopted elicited information through a structured questionnaire which assessed the socio-economic characteristics of the respondents, their level of awareness of EPS as a building material. Strategies in reducing the cost of construction of EPS buildings, advantages of using polystyrene, factors hindering its adoption for building and the remedies to factors impede the adoption of EPS for building construction were also elicited. Structured questionnaires were used for the data collection and subsequently analysed. The study revealed that EPS demonstrates fast construction time, flexibility, reduced heat transfer; high strength and stability and environmental friendliness. The outcome of this research shows that perceived high cost and lack of

awareness were the key hindrances to the adoption of EPS for construction and if strategies such as cutting production costs, reducing supply expenses, lower financial expenditure etc. can be adopted the material will be highly suitable in construction.

## 2.3 Summary of Review of Related Literature

The literature review is discussed under the following subheading: Polystyrene production from crude oil, Expanded Polystyrene (EPS), Properties of Expanded Polystyrene, Life cycle analysis of EPS, Sustainable Building Construction Using Expanded Polystyrene. It was deduced from the study that expanded polystyrene (EPS) light weight concrete has the characteristics of lightweight, energy absorption, and heat preservation, it is used in many specific construction industries like high rise buildings, floating marine platforms, and large-sized and long-span concrete, which is why it should be considered for use in Minna metropolis as an alternative building materials to the available alternatives which has demonstrated threat to the sustainability of the immediate surrounding.

# CHAPTER THREE

# 3.0 METHODOLOGY

## 3.1 Research Design

The study will adopt the descriptive survey research design used to identify the level of awareness and attitude towards the use of polystyrene as a damp proof material in building construction in Minna metropolis of Niger state. Survey design is aimed at collecting data on and describing in a systematic manner, the characteristics features or facts about a given population. The design is suitable for the study because it solicits information from Builders and Building contractors.

## 3.2 Area of the study

The study will be carried out in the following areas in Minna metropolis of Niger state

## 3.3 Population for the Study

The population for the study consists of 80 respondents comprising 20 building contractors and 60 building contractors.

## 3.4 Sample and Sampling Technique

There will not be sampling because of the manageable size of the population.

## 3.5 Instrument for Data Collection

The researcher designed a structured questionnaire titled: level of awareness and attitude towards the use of polystyrene as a damp proof material in building construction in Minna metropolis of Niger state as an instrument that will be used in collecting data for the study. The questionnaire is made up of four sections (A, B, C, and D ). Section 'A' contains items on personal information of the respondents. Section

'B' seeks the level of awareness on the use of polystyrene as a damp proof material in building construction in Minna metropolis of Niger state. Section 'C' find out factors influencing the use of polystyrene as a damp proof material in building construction in Minna metropolis of Niger state. While Section 'D' find out perception of stakeholders on the production and usage of EPS. The questionnaire items were based on four points scale types. Items for section 'B, C, and D contain four responses category each. The response categories for section B, C, and D are strongly Agree (SA), Agree (A), and Disagree (D) and strongly disagree (SD). These response categories will be assign numerical values of 4, 3, 2 and 1 respectively. Respondents were requiring checking (√) against the response category that best satisfies their opinion.

### 3.6 Validation of instrument

The instrument will be validated by three lecturers from the department of Industrial and Technology Education, Federal University of Technology, Minna. Contributions on the appropriateness of the instrument will be considered in the final draft of the research instrument.

### 3.7 Reliability of instrument

In order to determine the reliability of the research instrument, a pilot test will be conducted using fifteen building contractor and builders in Suleja. During the test, the questionnaires will be distributing by the researcher. The questionnaire will have filled by the respondents and then returned to the researcher. The data collected will be analyzed using Crombach Alpha.

### 3.8 Administration of instrument

The instrument that will be used for the data collection will be administered to the respondents by the researcher and three research assistants in the study area.

### 3.9 Method of data analysis

Data collected will be analyzed using mean and standard deviation for the research questions while t-test was used to test the hypothesis at the 0.05 level of significant. A four (4) point rating scale was to analyze the data as shown below.

| | | | |
|---|---|---|---|
| Strongly Agree | (SA) | = | 4points (3.5 – 4.0) |
| Agree | (A) | = | 3points (2.5 - 3.49) |
| Disagree | (D) | = | 2points (1.5 – 2.49) |
| Strongly Disagree | (SD) | = | 1point (1.0 – 1.49) |

Therefore, the mean value of the 4-point scale is:

$$\bar{X} = \frac{4+3+2+1}{4} = \frac{10}{4} = 2.5$$

### 3.10 Decision Rule

The cutoff point of the mean score of 2.50 was chosen as the agreed or disagreed point. This will be interpreted relatively according to the rating point scale adopt for this study. Therefore, an item with response below 2.49 and below will be regard or consider as disagreed while an item with response at 2.5 and above was regard or considered as agreed.

# CHAPTER FOUR

# PRESENTATION AND ANALYSIS OF DATA

## 4.1 Research Question 1

What are the level of awareness on the use of polystyrene as a damp proof material in building construction in Minna metropolis of Niger state?

**Table 4.1: Mean responses of the Builders and building contractors on the level of awareness on the use of polystyrene as a damp proof material in building construction in Minna metropolis of Niger state.**

**$N_1$=20 $N_2$=60**

| S/N | ITEMS | $\bar{X}$ | SD | Remark |
|---|---|---|---|---|
| 1 | Poly-concrete (Lightweight Concrete Using Polystyrene Beads as Aggregate). | 3.84 | .510 | Agreed |
| 2 | Insulating Concrete Forms (ICF) Using Polystyrene. | 3.73 | .554 | Agreed |
| 3 | The Use of EPS in Place of Concrete Fascia. | 3.70 | .505 | Agreed |
| 4 | EPS Wall Panels. | 3.63 | .586 | Agreed |
| 5 | Embedding EPS Blocks as a Concrete Suspended Slabs. | 3.20 | .939 | Agreed |
| 6 | EPS Panels as aCeiling Finishes and Insulators in Place of Fiber Glass. | 3.48 | .762 | Agreed |

**N=80**

$\bar{X}$**=** mean of the respondents

**$N_1$** = Builder

**$N_2$**= Building contractors

**SD** = standard deviation of the respondents

Table 1 showed that both the Builders and building contractors agreed on all items from 1 to 6. This is because none of the mean response was below 2.50 which was the beach mark of agreed on the 4-points response options. The standard deviation score ranged

between 0.505 and 0.939. This showed that the responses of the Builders and building contractors on the items were not divergent.

### 4.2 Research Question 2

What are the factors influencing the use of polystyrene as a damp proof material in building construction in Minna metropolis of Niger state?

**Table 4.2: mean response of the Builders and building contractors towards the factors influencing the use of polystyrene as a damp proof material in building construction in Minna metropolis of Niger state?**

**$N_1$=20 $N_2$=60**

| S/N | ITEMS | $\bar{X}$ | SD | Remark |
|---|---|---|---|---|
| 1 | Environmental friendliness | 3.63 | .490 | Agreed |
| 2 | Versatility | 3.72 | .454 | Agreed |
| 3 | Structural stability | 3.53 | .506 | Agreed |
| 4 | Recyclability | 3.70 | .463 | Agreed |
| 5 | Economic viability | 3.53 | .554 | Agreed |
| 6 | Erection time | 3.76 | .431 | Agreed |
| 7 | Cost effectiveness | 3.48 | .716 | Agreed |
| 8 | Life span | 3.76 | .431 | Agreed |

**N=80**

$\bar{X}$**=** mean of the respondents

$N_1$ = Builder

$N_2$= Building contractors

**SD** = standard deviation of the respondents

Table 4.2 showed that both the Builders and building contractors agreed on all items. This was because none of the mean response was below 2.50 which was the bench mark of agreed on the 4-point response options. The standard deviation score ranged between

0.431 and 0.716. This showed that the responses of the Builders and building contractors on the items were not divergent.

### 4.3 Research Question 3

What are the perception of stakeholders on the production and usage of EPS?

**Table 4.3: Mean responses of the Builders and building contractors on the perception of stakeholders on the production and usage of EPS?**

**$N_1$=20 $N_2$=60**

| S/N | ITEMS | $\bar{X}$ | SD | Remark |
|---|---|---|---|---|
| 1 | Low Maintenance Cost | 3.74 | .443 | Agreed |
| 2 | Fast Erection/Installation | 3.58 | .594 | Agreed |
| 3 | High Strength | 3.68 | .513 | Agreed |
| 4 | Improved Technology | 3.63 | .586 | Agreed |
| 5 | Thermal And Sound Insulation | 3.74 | .443 | Agreed |
| 6 | Save Cost | 3.68 | .526 | Agreed |
| 7 | Low Energy Costs | 3.52 | .735 | Agreed |
| 8 | Quality of Product | 3.63 | .490 | Agreed |
| 9 | Reduce Weight | 3.74 | .443 | Agreed |

**N=80**

$\bar{X}$**=** mean of the respondents

**$N_1$** = Builder

**$N_2$**= Building contractors

**SD** = standard deviation of the respondents

Table 4.3 showed that both the Builders and building contractors agreed on all items from 1 to 9. This was because none of the mean response was below 2.50 which was the bench mark of agreed on the 4-point response options. The standard deviation score

ranged between 0.443 and 0.735. This showed that the responses of the Builders and building contractors on the items were not divergent.

### 4.4 Hypothesis 1

There is no significant difference between the mean responses of Builders and building contractors on the level of awareness on the use of polystyrene as a damp proof material in building construction in Minna metropolis of Niger state

**Table 4.4 T-test on level of awareness on the use of polystyrene as a damp proof material in building construction in Minna metropolis of Niger state**

**$N_1$=20 $N_2$=60**

| Respondents | N | X | SD | Df | Tcal | P-value | Remark |
|---|---|---|---|---|---|---|---|
| **Builders** | 50 | 3.52 | 0.50 | 63 | 0.549 | 0.06 | NS |
| **Building contractors** | 15 | 3.67 | 0.62 | | | | |

**N=80**

$\bar{X}_1$= mean of Builders

$\bar{X}_2$ = mean of Building contractors

$N_1$ = Builders

$N_2$= Building contractors

$SD_1$ = standard deviation of Builders

$SD_2$ = standard deviation of Building contractor

**NS**=Not Significant

Table 4.4 showed that there was no significant difference in the responses of Builders and building contractors on all the items as challenges faced by women in carrying out the building construction skills in building industries; therefore, the null hypothesis of no significant difference was upheld at 0.05 level of significance.

### 4.5 Findings of the study

The following are the main findings of the study; they are prepared based on the research questions and hypothesis tested.

What are the level of awareness on the use of polystyrene as a damp proof material in building construction in Minna metropolis of Niger state?

- Poly-concrete (Lightweight Concrete Using Polystyrene Beads as Aggregate).
- Insulating Concrete Forms (ICF) Using Polystyrene.
- The Use of EPS in Place of Concrete Fascia.
- EPS Wall Panels.
- Embedding EPS Blocks as a Concrete Suspended Slabs.
- EPS Panels as a Ceiling Finishes and Insulators in Place of Fiber Glass.

What are the factors influencing the use of polystyrene as a damp proof material in building construction in Minna metropolis of Niger state?

- Environmental friendliness
- Versatility
- Structural stability
- Recyclability
- Economic viability
- Erection time
- Cost effectiveness
- Life span

What are the perception of stakeholders on the production and usage of EPS?

- Low Maintenance Cost
- Fast Erection/Installation
- High Strength

- Improved Technology
- Thermal and Sound Insulation
- Save Cost
- Low Energy Costs
- Quality of Product
- Reduce Weight

**4.6 Discussion of findings.**

The result from table 4.1 shows the findings on the level of awareness on the use of polystyrene as a damp proof material in building construction in Minna metropolis of Niger state. The findings of the study revealed that Poly-concrete (Lightweight Concrete Using Polystyrene Beads As Aggregate), Insulating Concrete Forms (ICF) Using Polystyrene, The Use Of EPS In Place Of Concrete Fascia, EPS Wall Panels, Embedding EPS Blocks as a Concrete Suspended Slabs, EPS Panels As a Ceiling Finishes And Insulators In Place of Fiber Glass. The findings of the study are in line with Vawa and Manga (2021) who noted that the other factors that can enhance its usage in Nigeria, enlighten the general public about the benefits that can be derived from EPS panels, and furthermore train individuals on how to handle and install EPS panels on sites.

The result of the hypothesis on level of awareness on the use of polystyrene as a damp proof material in building construction in Minna metropolis of Niger state shows that there was no significant difference in the responses of Builders and building contractors on the level of awareness on the use of polystyrene as a damp proof material in building construction in Minna metropolis of Niger state.

Table 4.2 shows the result of the findings on the factors influencing the use of polystyrene as a damp proof material in building construction in Minna metropolis of Niger state. The findings of the study revealed Environmental friendliness, Versatility, Structural stability, Recyclability, Economic viability, Erection time, Cost effectiveness, Life span. The findings of the study are in line with Ngugi *et al.* (2017) who noted that the usage of EPS as a building material largely merits the erection time of the panels, the life span of the material, the structural stability, the versatility of EPS panels and its economic viability as a building material

The result from table 4.3 reveal the findings on the perception of stakeholders on the production and usage of EPS. The findings of the study revealed that Low Maintenance Cost, Fast Erection/Installation, High Strength, Improved Technology, Thermal and Sound Insulation, Save Cost, Low Energy Costs, Quality of Product, Reduce Weight. The findings of the study are in line with Hashmi *et al.* (2017). the perception of stakeholders on the usage of EPS as a building material, a good number of the respondents have appreciable knowledge about both the manufacture and use of EPS in building construction

# CHAPTER FIVE

# SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

## 5.1 Summary of the Study

The main focus of this research study was to find out the level of awareness and attitude towards the use of polystyrene as a damp proof material in building construction in Minna metropolis of Niger.

Chapter 1 of the study discussed the background of the study, the statement of problem, purpose, significance, scope and the research questions were all stated and discussed for the conduct of this research.

The review of related literature looked into Polystyrene production from crude oil, Expanded Polystyrene (EPS), Properties of Expanded Polystyrene, Life cycle analysis of EPS, Sustainable Building Construction Using Expanded Polystyrene. Various views of different authors concerning the topic were harmonized in a comprehensive literature review and empirical studies.

A survey approach was used to developed instrument for the study; the respondents identified as the population of the study were the Builders and building contractors. The entire respondents were used. A number of 80 questionnaires were administered. The instrument used was analysed using frequency count, and mean scores. The research questions were discussed base on the findings from the responses and results of the instrument used.

Implication of the study and conclusions were also drawn from the findings discussed. Recommendations and suggestions for further study were formulated and stated according to the findings of the study.

## 5.2 Implication of the Study

The findings of the study had implications for government, Building construction industries. It is expected that an awareness on the use of polystyrene be created, retrospectively causing a lesser overall cost of projects, lesser time for completion of various milestones in projects. This will be beneficial to Quantity Surveyors as their aim is to maximize satisfaction and minimize cost. From a bigger picture, it benefits the construction industry at large with its easier, time saving and better structural properties

## 5.3 Conclusion

Based on the findings of the study, the following conclusions were drawn: The result is that the manufacturing stakeholders have no choice but to resort to importation of the granules for EPS production for domestic use. Also implicated in the cumbersome production of EPS is the unreliable public grid, the unending crises in the oil sector which account for the strikes and shortage of petroleum products combined with unfriendly environment, for example, deplorable transportation infrastructure and growing insecurity. Other factors are low knowledge base of the public about the workings (source, production, installation, and variant uses) of EPS is a critical impeding factor in the adoption pace. Data analyzed from this study indicates that all benefits expected from the use of an EPS constructed building were mostly derived.

## 5.4 Recommendations

Based on the findings of the study, the following recommendations were made:

1. Government should embarked on increasing awareness of EPS to the general public and encourage universities to include EPS study on their teaching and research curriculum.
2. Government should enforce purposeful reforms aimed at revitalizing the petrochemical industry that will among other objectives, henceforth make it

account for styrene, for the domestic market. This will ultimately reduce if not totally stop importation of styrene to achieve resource conservation.

3. Standard Organizational of Nigeria (SON) should enforce standard in EPS products and also broaden its scope to partnering with Universities and Research Institutions for optimal results towards consumer safety

## 5.5 Suggestion for Further Study

The following are suggested for further studies:

1. Level of awareness and attitude towards the use of polystyrene as a damp proof material in building construction in other location.
2. Strategies for increasing the level of utilization of polystyrene as a damp proof material in building construction.

## REFERENCE


Abu-Jdayil, B., Mourad, A. H., Hittini, W., Hassan, M., & Hameedi, S. (2019). Traditional, state-of-the-art and renewable thermal building insulation materials: An overview. *Construction and Building Materials*, *214*, 709-735.

Afolabi, L. O., Mutalib, N. A. A., & Ariff, Z. M. (2019). Fabrication and characterization of two-phase syntactic foam using vacuum assisted mould filling technique. *Journal of Materials Research and Technology*, *8*(5), 3843-3851.

Ahmed, I. (2020). To 'Float'or 'Not': Cases of Amphibious Housing and Their Impacts on Vulnerable Communities of Jamaica. *External Interventions for Disaster Risk Reduction: Impacts on Local Communities*, 273-296.

Ahmed, I. M., & Tsavdaridis, K. D. (2018). Life cycle assessment (LCA) and cost (LCC) studies of lightweight composite flooring systems. *Journal of Building Engineering*, *20*, 624-633.

Artetxe, M., Lopez, G., Amutio, M., Barbarias, I., Arregi, A., Aguado, R., ... & Olazar, M. (2015). Styrene recovery from polystyrene by flash pyrolysis in a conical spouted bed reactor. *Waste management*, *45*, 126-133.

Bicer, A., & Kar, F. (2017). Thermal and mechanical properties of gypsum plaster mixed with expanded polystyrene and tragacanth. *Thermal Science and Engineering Progress*, *1*, 59-65.

Degenstein, L. (2018). Biodegradable vs. non-biodegradable textiles: Environmental impacts under standard landfill conditions. *Journal of the Home Economics Institute of Australia*, *25*(1), 18-23.

Duyne Barenstein, J. E. (2015). Continuity and change in housing and settlement patterns in post-earthquake Gujarat, India. *International Journal of Disaster Resilience in the Built Environment*, *6*(2), 140-155.

Gyawali, T. R., & Maeda, M. K. (2019). Mixing of dredging sludge with EPS beads and cement paste in continuous M–Y mixer. *Asian Journal of Civil Engineering*, *20*(8), 1129-1136.

Hashmi, F. K., Hassali, M. A., Khalid, A., Saleem, F., Aljadhey, H., & Bashaar, M. (2017). A qualitative study exploring perceptions and attitudes of community pharmacists about extended pharmacy services in Lahore, Pakistan. *BMC health services research*, *17*(1), 1-9.

Jackson, K. T., Burgess, S., Toms, F., & Cuthbertson, E. L. (2018). Community engagement: Using feedback loops to empower residents and influence systemic change in culturally diverse communities. *Global Journal of Community Psychology Practice*, *9*(2), 1-21.

King, H., Nikolaidou, E., Coley, D., & Walsh, D. (2021). The future of archive film stores in the global south. *Energy and Buildings*, *241*, 110952.

Lin, B., Liu, Y., Wang, Z., Pei, Z., & Davies, M. (2016). Measured energy use and indoor environment quality in green office buildings in China. *Energy and Buildings*, *129*, 9-18.

Mirrahimi, S., Mohamed, M. F., Haw, L. C., Ibrahim, N. L. N., Yusoff, W. F. M., & Aflaki, A. (2016). The effect of building envelope on the thermal comfort and energy saving for high-rise buildings in hot–humid climate. *Renewable and Sustainable Energy Reviews*, *53*, 1508-1519.

Momoh, V., & Folorunso, C. O. (2018). Identifying Factors Hindering the Adoption of Expanded Polystyrene for Building Construction in Akure, Nigeria. *Journal of Materials Science and Chemical Engineering*, *6*(10), 1.

Momoh, V., & Folorunso, C. O. (2018). Identifying Factors Hindering the Adoption of Expanded Polystyrene for Building Construction in Akure, Nigeria. *Journal of Materials Science and Chemical Engineering*, *6*(10), 1.

Moshood, T. D., Nawanir, G., Sorooshian, S., Mahmud, F., & Adeleke, A. Q. (2020). Barriers and benefits of ICT adoption in the Nigerian construction industry. A comprehensive literature review. *Applied System Innovation*, *3*(4), 46.

Netsch, N., Simons, M., Feil, A., Leibold, H., Richter, F., Slama, J., ... & Stapf, D. (2022). Recycling of polystyrene-based external thermal insulation composite systems–Application of combined mechanical and chemical recycling. *Waste management*, *150*, 141-150.

Ngugi, H. N., Kaluli, J. W., & Abiero-Gariy, Z. (2017). Use of expanded polystyrene technology and materials recycling for building construction in Kenya. *American journal of engineering and technology management*, *2*(5), 64-71.

Ngugi, H. N., Kaluli, J. W., & Abiero-Gariy, Z. (2017). Use of expanded polystyrene technology and materials recycling for building construction in Kenya. *American journal of engineering and technology management*, *2*(5), 64-71.

Okeke, E. S., Olagbaju, O. A., Okoye, C. O., Addey, C. I., Chukwudozie, K. I., Okoro, J. O., ... & Abesa, S. (2022). Microplastic burden in Africa: a review of occurrence, impacts, and sustainability potential of bioplastics. *Chemical Engineering Journal Advances*, 100402.

Raimi, M. O., Bilewu, O. O., Adio, Z., & Halimat, A. (2019). Women contributions to sustainable environments in Nigeria. *Raimi Morufu Olalekan, Bilewu Olaolu Oyinlola, Adio Zulkarnaini Olalekan, Abdulrahman Halimat (2019) Women Contributions to Sustainable Environments in Nigeria. Journal of Scientific Research in Allied Sciences*, *5*(4), 35-51.

Schyns, Z. O., & Shaver, M. P. (2021). Mechanical recycling of packaging plastics: A review. *Macromolecular rapid communications*, *42*(3), 2000415.

Shahsavari, A., & Akbari, M. (2018). Potential of solar energy in developing countries for reducing energy-related emissions. *Renewable and Sustainable Energy Reviews*, *90*, 275-291.

Van Manen, M. (2017). Phenomenology in its original sense. *Qualitative health research*, *27*(6), 810-825.

van Schijndel, J., Molendijk, D., van Beurden, K., Canalle, L. A., Noël, T., & Meuldijk, J. (2020). Preparation of bio-based styrene alternatives and their free radical polymerization. *European Polymer Journal*, *125*, 109534.

Vawa, J. Y., & Manga, P. M. (2021). Assessment of expanded Styrofoam and polyurethane as a sustainable building materials; Mubi general hospital Adamawa state, Nigeria. *J. Art Arch. Stud*, *10*(1), 14-23.

Vawa, J. Y., & Manga, P. M. (2021). Assessment of expanded Styrofoam and polyurethane as a sustainable building materials; Mubi general hospital Adamawa state, Nigeria. *J. Art Arch. Stud*, *10*(1), 14-23.

Wang, Q., Yan, J., & Fan, Z. (2016). Carbon materials for high volumetric performance supercapacitors: design, progress, challenges and opportunities. *Energy & Environmental Science*, *9*(3), 729-762.

Windapo, A., Omopariola, E. D., Olugboyega, O., & Moghayedi, A. (2021). Use and performance of conventional and sustainable building technologies in low-income housing. *Sustainable Cities and Society*, *65*, 102606.

Yevu, S. K., Yu, A. T. W., Nani, G., Darko, A., & Tetteh, M. O. (2022). Electronic Procurement Systems Adoption in Construction Procurement: A Global Survey on the Barriers and Strategies from the Developed and Developing Economies. *Journal of Construction Engineering and Management*, *148*(1), 04021186.

## Appendix A

## QUESTIONNAIRE

## FEDERAL UNIVERSITY OF TECHNOLOGY MINNA, NIGER STATE

## SCHOOL OF SCIENCE AND TECHNOLOGY EDUCATION

## DEPARTMENT OF INDUSTRIAL AND TECHNOLOGY EDUCATION

A QUESTIONNAIRE ON ASSESSMENT OF THE LEVEL OF AWARENESS AND ATTITUDE TOWARDS THE USE OF POLYSTYRENE AS A DAMP PROOF MATERIAL IN BUILDING CONSTRUCTION IN MINNA METROPOLIS OF NIGER STATE.

INTRODUCTION: Please kindly complete this questionnaire by ticking the column that best present your perception about the topic. The questionnaire is for research purpose and your view will be confidentially and strictly treated in response to the purpose of the research work.

### SECTION A

**PERSONAL DATA**

Builders: ☐

Building contractors: ☐

Note: A four (4) point scale is used to indicate your opinion, tick the options which best describe your agreement as shown below:

| | | | |
|---|---|---|---|
| Strongly Agree | (SA) | = | 4points |
| Agree | (A) | = | 3points |
| Disagree | (D) | = | 2points |
| Strongly Disagree | (SD) | = | 1points |

Section B: What are the level of awareness on the use of polystyrene as a damp proof material in building construction in Minna metropolis of Niger state?

| S/N | Items | Scales | | | |
|---|---|---|---|---|---|
| | | SA | A | D | SD |
| 1 | Poly-concrete (Lightweight Concrete Using Polystyrene Beads as Aggregate). | | | | |
| 2 | Insulating Concrete Forms (ICF) Using Polystyrene. | | | | |
| 3 | The Use of EPS in Place of Concrete Fascia. | | | | |
| 4 | EPS Wall Panels. | | | | |
| 5 | Embedding EPS Blocks as a Concrete Suspended Slabs. | | | | |
| 6 | EPS Panels as a Ceiling Finishes and Insulators in Place of Fiber Glass. | | | | |

Section C: What are the factors influencing the use of polystyrene as a damp proof material in building construction in Minna metropolis of Niger state?

| S/N | Items | Scales | | | |
|---|---|---|---|---|---|
| | | SA | A | D | SD |
| 1 | Environmental friendliness | | | | |
| 2 | Versatility | | | | |
| 3 | Structural stability | | | | |
| 4 | Recyclability | | | | |
| 5 | Economic viability | | | | |
| 6 | Erection time | | | | |
| 7 | Cost effectiveness | | | | |

| | | | | | |
|---|---|---|---|---|---|
| 8 | Life span | | | | |

Section D: What are the perception of stakeholders on the production and usage of EPS?

| S/N | Skill Items | Scale | | | |
|---|---|---|---|---|---|
| | | SA | A | D | SD |
| 1 | Low Maintenance Cost | | | | |
| 2 | Fast Erection/Installation | | | | |
| 3 | High Strength | | | | |
| 4 | Improved Technology | | | | |
| 5 | Thermal And Sound Insulation | | | | |
| 6 | Save Cost | | | | |
| 7 | Low Energy Costs | | | | |
| 8 | Quality of Product | | | | |
| 9 | Reduce Weight | | | | |