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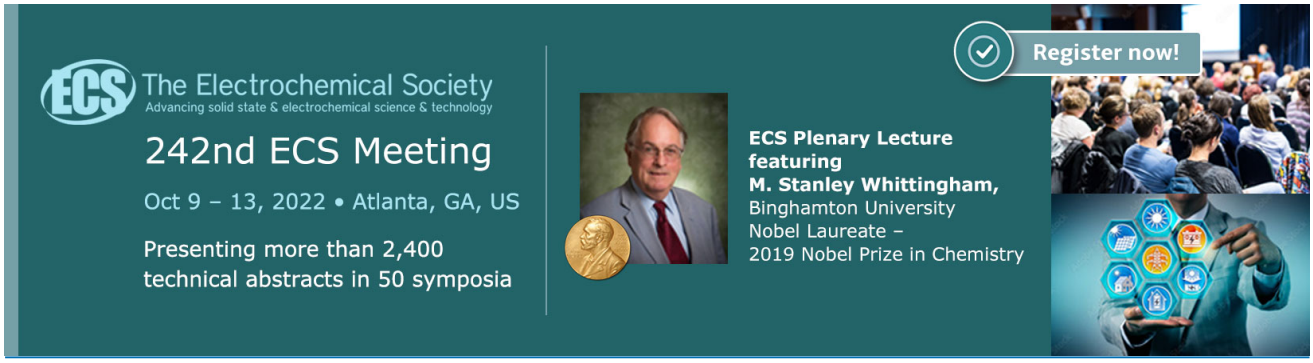

Maintenance of Expanded Polystyrene Building Components in Mount Pleasant Housing Estate, Abuja, Nigeria

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Abstract. This study assessed user's satisfaction as well as maintenance related issues associated with expanded polystyrene elements in a residential housing estate in the Federal Capital Territory. Residents of Mount Pleasant Housing Estate, Abuja constituted the study population. Questionnaires were administered to 310 adult residents of the housing estate out of which 267 were retrieved, constituting 86.1% rate of response and used for analysis. Data were analysed with basic descriptive tools of frequency, percentage and mean score derived from 5-Point Likert scale. Results were presented in tables and then discussed. The study established amongst others that expanded polystyrene materials are used for different components of housing units with partition walls, decorative finishes and window hoods having 79.4%, 68.2% and 64.4% of usage respectively. The study found amongst others that respondents generally agree that EPS elements are costlier in terms of maintenance and require special skill to fix. It was further observed that respondents are of the opinion that EPS elements do not breakdown easily or frequently. Concluding, the respondents ranked their satisfaction level with the aesthetics and moisture resistance above other qualities of EPS components. The study therefore recommended further research to discover how EPS materials can be used to build complete housing unit. Furthermore, developers and builders should as a matter of policy embrace the use of EPS while special awareness creation programme is organized to enlighten the general public on the benefits of EPS to housing development in Nigeria.

Keywords: Expanded Polystyrene, Housing, maintenance, satisfaction, quality.

1. Introduction

Materials used for building construction have changed over the years through advancement in technological. Man, early in history took shelter in caves, rocks and in the trees. Man's later transited to the use of mud, stone and plant materials which were mainly derived from the forest to build houses. As time passed and technology advanced, man began to use improved materials such as burnt bricks, concrete, steel, reinforced concrete, fibre reinforced concrete and plastics as building construction materials. Generally, conventional building materials such as sandcrete blocks, concrete blocks, burnt bricks, quarry stones, planks, wood products and roofing materials have been used primarily for building houses and other basic aspects of shelter over the years [1]. Sandcrete block is the most adopted concrete masonry unit especially in the building residential, industrial and commercial structures [2] and according to [3], sandcrete blocks account for 90% of residential buildings. The construction industry accounts for 40% of aggregates (sand, gravel and stone) used for concrete [4]. Concrete is an essential material used in the construction industry, it is a dominant option as a structural material used in various

types of residential, commercial and industrial buildings. Generally, concrete blocks are used for major structural elements of building such as foundations, floor slabs, load bearing and partitioning walls. Reinforced concrete is equally used for floor slabs, suspended floors, retaining walls and embankments.

Despite the popularity of conventional building materials, there have been growing concern about their affordability and sustainability. According to [5], the application of some of these resources has not met the goals of sustainability. Various problems associated with the materials include limited availability, high cost, poor performance and high cost of maintenance. In an attempt to combat these problems, the use of alternative building materials has been explored. One of such is the expanded polystyrene material (EPS). Expanded polystyrene (EPS) materials according to [6], [7] are economical, structurally and aesthetically efficient. Expanded Polystyrene (EPS) according to [8] term refers to a synthetic insulator that is used as a building material, either in its "sintered" or "extruded" state. As a result of its flexibility and light weight, EPS materials are being used for different parts of buildings such as wall components, slabs, partition, frames, ceiling and building finishes. Despite the various applications, aesthetic efficiency and compatibility as a building material, studies have showed that EPS remains largely unpopular in the construction industry and there is still a lot of uncertainty regarding its performance [1]. This is also compounded by the insufficient feedback on user's satisfaction with the material. This study therefore examined user's experience with maintenance of expanded polystyrene elements in residential units at Mount Pleasant Housing Estate.

2. Literature Review

Extant studies on the use of expanded polystyrene materials in construction industry have focussed on awareness and adoption [1] [8], factors affecting the use of EPS [9], qualities and characteristics of EPS [4] [10] and application of EPS in building and construction [11]. Critical to the adoption of expanded polystyrene in Nigeria construction industry is the awareness among the developers and the general public. The conventional building construction materials which have been in vogue over the last three centuries particularly in Africa remain popular and enjoy widespread acceptance among the poor masses, developers and society elite in Nigeria. The emergence of EPS and commercial usage for building construction began in 1936 [12]. However, up till now in Nigeria, EPS materials are still struggling to gain wide acceptance in the Nigeria construction industry. [8] identified high cost and lack of awareness as the most significant factors hindering the adoption of EPS on industrial scale in the country. Corroborating this, [1] also identified lack of awareness among Architects in Akure as well as the scarcity as major factors affecting its adoption for building construction in the state. The study also alluded to the beneficial attributes such as flexibility and quick construction. [4] expounded on characteristics that make EPS suitable as construction material. The study emphasized its non-biodegradable nature, ability for recycling, chemically stable and environment friendly. Other beneficial qualities identified in the study include excellent sound and thermal insulation, moisture resistance, durability, design versatility, easy installation, functional strength and structural stability [13]. However, studies that dwell on feedback from user's experience with EPS materials and elements appear limited. This study was therefore carried out to contribute to knowledge on EPS by filling the gap and provide essential information on user's satisfaction with EPS components as well as maintenance issues related the use of the material.

3. Materials and Methods

The population for this study are the adult occupants of the 1,620 housing units built with EPS materials in Phase IV of Mount Pleasant Housing Estate, Mbora District, Abuja. The sample size was derived from this population using [14] formula for sample size determination. With the alpha level set at .05, acceptable margin of error of 5%, standard deviation of the scale at .5, and t-value of 1.96, [14] was used to derive the sample size of 384. Since this size exceeds 5% of the population, [14] correction formula was engaged to calculate the final sample size. The sample size was determined using Cochran correction formula, t-value at 1.96 and acceptable margin of error at .05.

Cochran's (1977) correction formula $n_1 = n_0$

$$1 + n_0/\text{Population}$$

Where population size = 1,620
n_0 = required return sample size
n_1 = Adjusted sample size (due to return sample size > 5% of population).

Thus the sample size of 310 was achieved after the adjustment and this was adopted for questionnaire administration. Questionnaires were administered to 310 residents of Mount Pleasant Housing Estate, Mbora District, Abuja through the Residents' Association. A total of 267 were returned which constituted 86.1% rate of response. Data collected were analysed with basic descriptive statistics tools of frequency, percentage, mean score while standard deviation and correlation analysis were also used to make certain deductions about resident's perception and satisfaction with the maintenance of EPS in their housing units. Results were presented in tables, charts and then discussed.

4. Data Analysis

4.1. Respondent's Profile

The characteristics of the respondents were analysed and presented in Table 1. The aspects of the profile covered are gender, age, education, housing type, occupancy status and duration.

Table 1. Characteristics of respondents

Characteristics	Category	Frequency	Percentage
Gender	Male	215	80.5
	Female	52	19.5
	Total	267	100
Age	18 – 35	74	27.7
	36 – 50	163	61.1
	51 – 65	30	11.2
	Above 65	-	-
	Total	267	100
Level of Education	Ordinary Level	-	-
	National Diploma	33	12.4
	First Degree	65	24.3
	Postgraduate Degree	169	63.3
	Total	267	100
Type of House	Bungalow	98	36.7
	Detached	71	26.6
	Semi-detached	43	16.1
	Terrace	55	20.6
	Total	267	100
Occupancy status	Owner	188	70.4
	Renter	79	29.6
	Total	267	100
Duration of occupation	Up to 3years	67	25.1
	4 – 8years	114	42.7
	9 – 12years	86	32.2
	Total	267	100

The Table showed the prevalence of male gender which constituted 80.5% of the respondents and that 72.3% of the respondents above 35years. In addition, the level of education attained showed that 87.6% of the respondents have a minimum of first degree while the rest actually indicated national diploma. By implication, the respondents are literate and learned enough to provide reliable responses

on the subject of this study. Furthermore, the Table revealed amongst others that 63.3% of the respondents live in bungalow and detached houses in the estate while the rest live in semi-detached and terrace houses. The 29.6% of renters in the estate is an indication that there are housing units in the estate that are on lease, actively generating income for the owners. Finally, the Table revealed that the percentage of residents that have stayed up to 12years in the estate is 32.2% while 42.7% have spent between 4 and 8years, living in the estate. The duration of stay is considered sufficient for preliminary feedback by users on issues related to maintenance of their housing units.

4.2. Expanded Polystyrene Housing Elements

In a multiple response question, respondents were requested to identify the components or elements of their housing units that are built with polystyrene. Response were analysed with descriptive tools of frequency and percentage and presented in Table 2.

Table 2. Housing components built with EPS

Building component	Frequency	Percentage
Stair	138	51.9%
Slab	132	49.4%
Fascia	146	54.7%
Partition wall	212	79.4%
External wall	110	41.2%
Frames	112	41.9%
Window hood	172	64.4%
Decorative finishes	182	68.2%
Ceiling	136	50.9%
Roofing	94	35.2%

From the responses, it was observed that the partition wall (79.4%), decorative finishes (68.2%) and window hoods (64.4%) are the major structural elements of houses built with EPS materials. The aspect that got the least use of EPS is the roofing with 35.2% while housing components such as ceiling, slab, fascia and stair got average use as indicated in the rates of response of (50.9%), (49.4%), (54.7%) and (51.9%) respectively.

4.3. User's satisfaction with EPS housing elements

Respondent's level of satisfaction with the identified attributes of EPS components of building was measured on a 5-Point likert scale of Very Satisfactory (5), Satisfied (4), Not Sure (3), Less Satisfied (2) and Dissatisfied (1). The mean score and relative importance indices were calculated and then ranked in order of importance. Result is presented in Table 3.

Table 3: User's satisfaction with qualities of EPS elements

EPS Attributes	Total	Mean	RII	Rank
Aesthetics quality	1098	4.116	0.823	1st
Moisture resistance	999	3.742	0.748	2nd
Heat resistance	887	3.322	0.664	5th
Thermal insulation	854	3.198	0.640	6th
Indoor air quality	981	3.674	0.735	3rd
Sound insulation	943	3.532	0.706	4th

The Table showed that respondents are generally satisfied with the aesthetic quality of EPS elements and this actually ranked first among others. Furthermore, the moisture resistant ability of EPS elements, indoor air quality control and sound insulation also ranked 2nd, 3rd and 4th respectively,

indicating the order of satisfaction with the material. However, the heat resistant and thermal insulation ranked 5th and 6th respectively though this did not necessarily imply dissatisfaction or low level of satisfaction with these attributes of EPS components.

4.4. Maintenance issues associated with EPS elements

Respondents were asked to indicate their level of agreement with statements that express their experience with the use and maintenance of EPS components of their housing units. The response was measured on a 5-Point Likert scale of 5-Strongly agree(SA); 4-Agree(A); 3-Undecided(U); 2-Disagree(D); 1-Strongly Disagree(SD). The mean score of responses was calculated and interpreted using the cut-off points below.

1 - 1.50 = Strongly disagree
1.51- 2.49 = Disagree
2 .50 – 3.49 = Not sure
3.50 – 4.49 = Agree
4.50 – 5.0 = Strongly Agree

Table 4: Maintenance issues with EPS elements

Maintenance issues associated with EPS	Total	Mean Score	RII	Rank
EPS components breakdown easily	511	1.914	0.383	5th
EPS components breakdown more frequently	598	2.240	0.448	4th
EPS elements are costlier to repair	951	3.562	0.712	2nd
EPS materials are difficult to procure	896	3.356	0.671	3rd
Repair of EPS elements require special skill	970	3.633	0.727	1st

In order to have a clear understanding of the position of the respondents on maintenance issues associated with EPS component of their housing units, the cut-off points were engaged to interpret the mean score of the responses and it was observed that respondents generally agreed to the statements that the repair of EPS elements require special skill and technology and that EPS elements are costlier to repair. However, respondents are undecided concerning that EPS materials are difficult to procure while they out rightly disagreed that EPS components break down easily or frequently.

5. Discussion

Expanded polystyrene according to [8] can be used in constructing load bearing walls, non-load bearing walls, slabs, culverts, stairways and other building elements. The results as shown in Table 2 alluded to this fact as it revealed the different housing components that the materials were used for in Mount Pleasant Housing Estate. The result however showed that EPS materials are combined with conventional building materials to construct a complete housing unit regardless of the type. Thus the different rates of response indicated for each of the housing components in the study. Furthermore, the ranking indicated that respondents are at different level of satisfaction with the various attributes of EPS components of their houses. This notwithstanding, respondents were undecided about their perception of satisfaction with heat resistance and thermal insulation properties of EPS elements as reflected by the mean score responses to these two qualities. By implication, the respondents are not sure of how the components built with EPS would fare under extreme heat or fire incidence. Finally, the approval or disapproval of the various statements on issues related to maintenance of EPS elements as presented in Table 4 all point to the fact that EPS is a synthetic building material which is a product of innovation. [15] described EPS as a thermoplastic material obtained by polymerization of styrene, a by-product of crude oil.