ACCELERATED REDUCTION OF PAINT SERVICE LIFE IN SUB-URBAN TROPICAL AREAS IN NIGERIA: MITIGATION STRATEGIES FOR SUSTAINABLE DEVELOPMENT

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Abstract

Physical buildings or structures are believed to be important elements of environment. However, the accelerated reduction of paint service life in unorganized settings most especially in sub-urban tropical regions threatens environmental sustainability with implications for sustainable development. Therefore, mitigation strategies that will minimize or eliminate such occurrence require empirical investigation. This study was conducted in Ilaro Town, a suburban tropical area in Ogun State, Nigeria. Following a scientific process, a sample size of 114 participants was selected whose opinions regarding the study developed mitigation strategies were obtained through survey interviews with well-structured questionnaire as a data collection instrument. Stratified sampling technique was employed to sample representatives from academic Lecturers, Paint professionals in the study area and staff of paint manufacturing companies in Lagos State and Ogun State. The study utilized z-test measure to test hypotheses regarding the significance of the study developed mitigation strategies at 5% level of significance. From the analysis, it was revealed that the use of resistant product; efficient paint application; tree plantation; pigments and resins compatibility; fungicides application; bleaching; crystalline coating and ventilation are significant mitigation strategies to minimize accelerated reduction of paint service life in suburban tropical areas. However, damp control as a strategy was found insignificant. The study affirms that adherence to significant mitigation strategies as revealed by findings will increase paint service life in tropical areas and ensure environmental sustainability with positive implications for sustainable development. The researcher, therefore, calls for required attention to these significant strategies by all stakeholders in the industry.

Keywords: Paint, Service Life, Environmental Sustainability, Strategies, Sustainable Development, Z -Test

Introduction

Paint, being a building material applied on building structures, provides aesthetic and protective for buildings. In terms of aesthetic function, it beautifies housing structure that could sometimes mesmerize people who love art and colour artworks. At the same time, it protects underlying or inner substrate of the building. Meanwhile, the length or period in which paint finish lasts on building structures determines how long painting on building surface continue to provide these functions. This can be intuitively related to service life of paint finish. However, the accelerated reduction of paint service life in unorganized settings most especially in sub-urban tropical regions in developing countries undermines traditional functions of painting. In particular, it threatens environmental sustainability in these counties notably sub-urban tropical areas.

The ultimate implication of such threats to sustainable environment, if control measures or strategies are not provided, is high maintenance costs (Teo, Chew and Harikrishna, 2005) and undue environmental impacts that could endanger sustainable development in less developed countries and tropical regions. This is because environmental sustainability has been recognized as important aspect of sustainability development (San-Jose and Cuadrado, 2010; Steelcase, 2008; Mora, 2007; UNESCO, 2003; Graham, 2003; Curwell and Cooper, 1998). It is in respect of this that a study of this nature is required having being established by Aiyegbajeje and Oguntimehin (2018) that there is evidence of accelerated reduction of paint service life in sub-urban tropical areas in Nigeria. In the co-author research work, factors such as sun persistence, humidity and moisture, growth of mildew and fungi, type of paint, paint application, colour of paint, impact and abrasion were associated as causal elements of accelerated reduction of paint service life.

Meanwhile, theoretical studies on painting and coating have suggested various methods and ways of achieving a long lasting painting finish. For instance, Tator (2015) proposed strategies such as bleaching, fungicides, anti-abrasion pigments and resistance products in painting application. However, gap still exists in the empirical examination such strategies and procedures to ensure their practicability and more importantly efficiency in sub-urban tropical regions. The clarion call is important to minimize environmental impact due to accelerated reduction of paint finish service life and create sustainable painting or coating. Specifically, finding appropriate strategies and methods will help to improve performance and effectiveness of external paint finish in sub-urban tropical regions of developing economies. This study, therefore, is aimed at suggest mitigation strategies against the back drop to promote environmental sustainability that ensure sustainable development in developing countries like Nigeria. For the purpose of accurate data gathering and guarantee of reliable findings, Ilaro town a sub-urban area in Ogun State Nigeria and some paint manufacturing companies in the country were specifically selected for the study.

Review of Literature

Paints are materials that add colour designs to structures like buildings. Generally, paint provides two important functions. Firstly, it beautifies housing structure that could sometimes mesmerize people who love art and colour artworks. Also, it protects underlying or inner substrate of the building. Paints consist of pigments, resins/binders, solvents and additives. Pigments are dry coloring matter generally in the form of an insoluble powder to be mixed with a liquid to produce paint. Binders consist of oils and varnishes that hold the pigment particles together on the surface to form the paint film. Solvents are thinners added to paint or varnish to dilute it, reduce its opacity or viscosity, in order to allow the paint greater workability and for it to spread easily while additives are different substances added to the paint in small quantity to achieve specified properties. Service life of paint refers to a period in which paint materials when applied on objects (buildings in this case) are said to fulfill, equal or exceed required minimum performance standard (Aluko, 2018; ISO 15686-1:2000; Sarja and Vesikari, 1996). When

the period is shorter than expected standard there is tendency for paint finish to diminish and causes problems.

The need to cater for the present generations without affecting the futures led to the concept of sustainable development. According to United Nations General Assembly (1987), sustainable development implies meeting the needs of the present without compromising the ability of future generations to meet their needs. To achieve this, long term stability of environment and economy through appropriate policies are fundamental (Emas, 2015). Meanwhile, exterior parts of building structures have been considered as integral aspect of environment (Tator, 2015); hence, external building walls with paint finish contribute to environment looks. However, frequent maintenance costs associated with accelerated reduction of service life of paint on external walls most especially in tropical environments and in particular in South-West Nigeria has negative implications for sustainable development. This is because the incidence puts too much pressure on limited resources available to plan for future generations.

Extant literature has documented various deterioration defects of external paint finish. For instance, Teo *et al* (2005) is of the opinion that defects such as peeling and flaking, chalking, mildew, crazing, efflorescence, crackliness, uneven discoloration, algae growth, water seepage, and delamination are common problems of external paint finish in Singapore. In Nigeria, defects to external paint finish have been identified as loss of appearance, peeling, crack, flaking, chalking, discolouration, mildew growth, delamination and dirt (Aiyegbajeje and Oguntimehin, 2018). Nevertheless, most of these problems can be classified as uncontrollable or natural influences because they often appear suddenly and their unusual nature can reduce paint service life drastically. Furthermore, these aforementioned problems are caused by certain factors such as sun persistence with its ultra-violet (UV) rays; exposure to sunlight; humidity and moisture, organic growth, type of paint, paint application, paint colour, façade, impact and abrasion (Aiyegbajeje and Oguntimehin, 2018; Aluko, 2015; Tator, 2015)

Empirically, Teo *et al* (2005) had found that crazing, chalking, efflorescence, crackliness, uneven discoloration, algae growth, faking or peeling, water seepage, are delamination the most significant defects on external paint finish in Singapore and that these defects are influenced or caused by weather, materials composition of paint used, degree of workmanship and building characteristics. At home, both Aiyegbajeje and Oguntimehin, (2018) and Aluko (2018) discovered that building characteristics like sun persistence, humidity and moisture, impact and abrasion, age of buildings, façade, layout, wind effect, rain effect, surface after repaint, type of paint, colour of paint and paint application are significant factors that influence extent of defect of external paint finish. As useful as the studies particularly to estimation of service life of external paint finish mitigation strategies that could enhance environmental sustainability and at the same time promote sustainability development in Nigeria was empirically overlooked and hugely unconsidered. Even in international community the study of this nature is scanty or unavailable. It is therefore imperative to carry out such kind of empirical study in environmental studies, the thrust of the current paper.

Research Method

The current study was conducted in one of the tropical areas in Nigeria, named Ilaro Town. The town is a suburb of Ogun State. The rationale for selection was based on the town relative high humidity of rainfall particularly from the end of every first quarter to late October in each year (National Bureau of Statistics, 2010). For wider coverage of perception about the study developed mitigation strategies for increasing external paint finish that support sustainable development interviews through well-structured questionnaires were conducted among group of stratifications. These include scholars, paint professionals in the study area and leading paint manufacturers in the industry. The questionnaires provide information about possible solutions and methods on ways to counter accelerated reduction of external paint finish in the tropical areas most especially in the suburbs. The scholars selected involve lecturers in the School of Environmental Study at the Federal Polytechnic, Ilaro (FPI, the study area) and paint professionals are practicing painters in the study. It is believed that scholars are more versed in theory (paint related courses) and professional painters better in practice.

Further, the idea behind seeking opinion of representatives of paint manufacturing companies was to make use of their practical knowledge and experience in obtaining information and gain a better qualitative understanding about the importance and effectiveness of mitigating strategies against accelerated reduction of external paint finish. Hitherto, information provided on such methods and strategies were scrutinized by leading researchers in environmental studies to ensure contents validity. In other words, sampling frame for the interview surveys consists of the study target respondents which include lecturers, professional painters and paint manufacturers. Meanwhile, the aggregate of all the categorizations (stratifications) forms the total population of the study. According to FPI Bulletin (2018), there are sixty-nine (69) lecturers in the School of Environmental Studies. The study pre-test survey indicates that there are twenty-five (25) professional painters plying their trade in the selected town. The total number of registered paint manufacturers in Nigeria stands at sixty-eight (68) according to Standard Organisation of Nigeria (SON, 2016). However, these companies are concentrated in nine states of the federation (Brandspurng, 2018) which include Ogun State (the state of the

study area), Lagos, Kaduna, Plateau, Enugu, Edo, River and Imo. For easy accessibility, only paint manufacturers in Ogun State and Lagos State are covered by the study. In all, the study population figure is one hundred and sixty-two (162).

Further, a sample size of 114 was obtained from the research population of 162 participants. This was determined scientifically via Krjecie and Morgan (1970) sample formula as applied in Saka and Amusa (2017). Following the application, samples were selected from strata based on the contribution of each stratum to total research population of the study. This procedure has been recommended by Bowley (1926). In the main, forty-nine (49) academic lecturers, forty-eight (48) paint manufacturing companies' staff and seventy (17) paint professionals were selected as sample representatives for the study. On empirical evaluation of the study developed mitigation strategies, z-test at 5% level of significance was employed to test hypotheses for validating such strategies. The use of such method was based on satisfied conditions of unknown population standard deviation and sample size of the study was found higher than thirty.

Presentation, Interpretation and Discussion of Results

Out of the total one hundred and fourteen (114) questionnaires administered, only 98 (48 Lecturers; 35 staff of three selected paint companies; and 15 paint professionals) were returned yielding a retrieval rate of 86%. However, only 94 of the returned questionnaires were found effective due to missing data on key information from 4 questionnaires. In the main, the study considered only those effective 94 questionnaires for further analyses. This yields 82.5% of total distribution. The z-test statistic was performed and results displayed in Table 1. Hypotheses were tested using probability values from z-test analysis. From result in Table 1, it was discovered that the use of resistant product, efficient paint application, tree plantation, pigments and resins compatibility, fungicides application, bleaching, crystalline and ventilation are significant mitigation strategies to minimize accelerated reduction of paint service life in the study area. This is confirmed by the rejection of null hypotheses formulated for the purpose of the significant strategies. However, the acceptance of null hypothesis that the coefficient of damp control is not significantly different from zero indicates that such strategy is an insignificant strategy for minimization of accelerated reduction of paint service life in suburban area like the study area.

Table 1: Z-Test Result for Hypotheses Testing

Variable	N	Mean	Std. Dev.	Z-value	P-value	H_0	Decision
Resistance Product	78	2.551	1.234	9.433	0.000	$H_{01} = 0$	Rejected
Efficient Paint Application	78	3.282	1.268	6.908	0.000	$H_{02} = 0$	Rejected
Tree Plantation	78	3.513	1.327	18.321	0.000	$H_{03} = 0$	Rejected
Damp control	78	3.539	1.148	3.550	0.073	$H_{04} = 0$	Accepted
Pigments and Resins compatibility	78	2.718	1.308	22.543	0.000	$H_{05} = 0$	Rejected
Fungicides Application	78	3.385	1.322	7.298	0.000	$H_{06} = 0$	Rejected
Bleaching	78	4.167	5.940	9.982	0.000	$H_{07} = 0$	Rejected
Crystalline Coating	78	2.680	1.558	4.765	0.000	$H_{08} = 0$	Rejected
Ventilation	78	3.192	1.330	2.985	0.000	$H_{09} = 0$	Rejected

Source: Author' s Computation from STATA 12 Outputs, 2018

Discussion of Findings

The current study developed and evaluated the significance of mitigation strategies that could minimize the accelerated reduction of paint finish service life year on external building walls with a focus on suburban tropical areas in developing countries like Nigeria. This is necessitated on the importance of dwelling and residential buildings to environmental sustainability that promotes sustainable development. The analysis of data collected indicates that the use of resistant product, efficient paint application, tree plantation, pigments and resins compatibility, fungicides application, bleaching, crystalline coating and ventilation are significant mitigation strategies to minimize accelerated reduction of paint service life in suburban tropical areas. On the other side of the coin, damp control was found to be an insignificant mitigation strategy. The implication of the findings is that the application of significant mitigation strategies could help in improving environmental sustainability and ultimately spur sustainable development in tropical regions. However, the reliability of such strategies depends on the evidence of outcome applications.

Conclusion and Recommendations

An environment that meets the need of the present without compromising the needs of the futures is considered an important component of sustainable development. Meanwhile, physical and dwelling buildings or structures are believed to play significant role in environment set up. Therefore, maintaining buildings and structures in the environment is very crucial for sustainable development. The study, through its findings, affirm that the use of resistant product, efficient paint application, tree plantation, pigments and resins compatibility, fungicides application, bleaching, crystalline coating and ventilation are significant mitigation strategies to minimize accelerated reduction of paint service life in suburban tropical areas. The implication is that the adherence to significant mitigation strategies as revealed by findings will increase paint service life in tropical areas and ensure environmental sustainability with positive implications for sustainable development. However, future research will suggest the significance of this

finding in urban tropical regions. The researcher, therefore, recommends that all stakeholders in the industry should pay required attention to the applications of the significant mitigation strategies. In particular, paint professionals should include follow-ups as part of maintenance exercise.

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QUESTIONNAIRE INSTRUMENT

This questionnaire instrument requires your perception about mitigation strategies to minimize accelerated reduction of paint finish service life in sub-urban tropical areas. It is for academic and research purpose, as such your response will be confidentially treated. Thank you in anticipation.

Section A: Demographic Data

Please tick as appropriate

1. Sex: Male ☐ Female ☐
2. Age of Respondent: 21-40years ☐ 41-60years ☐ 61 years and above ☐
3. Occupation Status: Lecturer ☐ Professional Painter ☐ Factory Staff ☐

Section B: Operational Data

Implementation of the following Mitigation Strategies will minimize accelerated reduction of service life of external paint finish in tropical regions. What is your perception about this statement?

SA – Strongly Agree; " A" - Agree; " U" – Undecided; " D" – Disagree; " SD" – Strongly Disagree

S/N	Strategies	SA	A	U	D	SD
4.	Resistance Product (Like anti-abrasion pigments)					
5.	Efficient Paint Application					
6.	Tree Plantation					
7.	Damp Control					
8.	Pigments and Resins Compatibility					
9.	Fungicides Application					
10	Bleaching					
11.	Crystalline Coating					

12.	Ventilation					