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Comparative Properties of Ceramic-Based Roofing Sheets from Local Raw Materials Synthetic Products after Heat Treatment

CHUKWUOCHA, E; *OWATE, I O

Materials Science Group, Department of Physics, University of Port Harcourt, PMB 5323, Port Harcourt., Nigeria

ABSTRACT: Ceramic roofing sheets were fabricated in the laboratory by using ideal raw materials. The fabricating materials are coiled coconut fibre, palm fruit fibre fresh water river sand, polymeric dust, saw dust and cement. The resulting product was compared with factory -produced ceramic-based roofing sheets that are easily available in the Nigeria markets. Both materials were of similar compositions except the mode of introduced polymeric materials. Samples of both materials were characterized in terms of rate of water absorption, density and breaking load. The properties of the materials show that the introduction of the polymeric dust at the fabrication stage and heat-treatment within the polymeric organic solution tremendously improved the quality of the ceramic-based roofing sheets. There was no significant difference on the quality of both samples. However, the total cost of production for the heat-treated finished product was relatively higher than the samples that were directly fabricated with polymeric dust as the dopant. @ JASEM

The provision of housing among other social amenities occupies a strategic position in most development plans for developing Nations such as Nigeria. Presently, Adeloale, 1976, Ofoegbu, 1999, and Opara, 2002 have shown that affordable and low-cost housing systems have been the bane of her strategic plan and policy Thus, there have been both experimental and pilot schemes on the production of low-cost building materials (Adewale, 1974 and 1978). The major problems for most Nigerian rural dwellers are the high cost of roofing materials such as Zinc and Aluminium and the effect of corrosion arising from the Niger delta hostile environment (Adegoke, et al, 1989). The most pathetic situation is the use of thatches and dry leaves as roofing materials. These materials are both dangerous and highly inflammable. Besides, industries that produce asbestos roofing materials are very few within Nigeria due to poor economic and industrial environment of Nigeria (Ekpekpei and Ekiye, 1989) at present there is an improvement in the number of available building materials. The choice of asbestos as a common roofing sheet in Nigeria is partly due to its relative low-cost, thermal insulation and lower water absorption (Barry, 1980 and Berger, 1983). Arising from Niger Delta hostile environment is the prolonged period of heavy rainfall. This influences the environmental impact of most available ceramic-based (asbestos) materials in Nigeria (Clifton, 1980); Equally, an important factor of consideration in using asbestos as roofing sheet is the amount of humidity within the atmosphere. This is because such factors are detrimental increasing chemical reaction, porosity and increasing rate of water absorption within the region have been recorded. (Ivorh, 1986). Consequently there could be increasing rate of water absorption over a period of time, thereby leading to increasing degradation of materials, Owate and Gbarato (1999) have clearly demonstrated the importance of proper mix- ratio composition in concrete building material. Equally important is the environmentally friendliness of such materials. Hence, Avwiri and Tay (1999) showed that within a PH level of about 5, Longspan aluminium and ceramic based roofing sheets were found to be relatively resistant to corrosion in Niger Delta where acid rain was predominant due to industrial activities Garbutt (1991) earlier sounded a note of warning to the fact that new environmental laws could affect the use of some materials as building materials. Consequently, Beardmore (1990) indicated clearly the severity of damage caused by exposure of ceramic brickworks to hostile environmental conditions. The main purpose of this work is to apply the process of heat treatment (with in Polyethylene Liquid) to existing asbestos with view to improving the characteristics of the system (especially its water absorption properly). Secondly, ceramic-based materials (with similar compositions was fabricated using polyethylene (Polymeric dust) as additives. The properties and cost analysis of both systems were compared and reported in the present work.

MATERIALS AND METHOD

Atlas cement (22% wt), River sand (34% wt), coiled coconut fibre (18% wt), palm fruit fibre (14% wt), saw dust (5% wt), polymeric dust (5% wt) and polyethylene were mixed and electrically vibrated for twelve hours (12 hrs). Later some quantity of water was gradually added and then re-vibrated again until a paste was formed. The mortar paste was carefully transferred into the mould box using hand trowel and then the material was allowed to set over a period (28 days). A typical mould used in obtaining the

*Corresponding author

ceramic-based roofing sheet mixed with polymeric dust is shown in Figure 1.

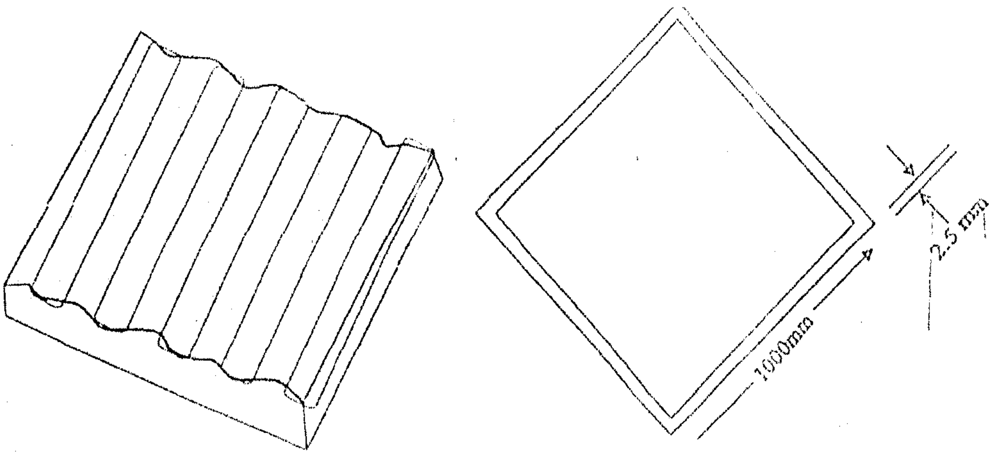

Fig. 1 A sketch of a typical Mould for casting

The cast-products were cured for a further 48 hours by sprinkling of water after every eight hours (8hrs) interval. This was to ensure that comparatively, solid and smooth specimens were obtained. In contrast, commonly obtained Nigerian ceramic roofing sheets of Etanite and super coil brands and standard samples obtained from Wades ceramics, Stoke-on- Kent, England were heat treated in polymeric organic solution with the usual conventional method. The specimens were heat treated between 50-60^{0}C for twelve (12hours) hours after which they were removed washed in soap solution, rinsed with deionized water and dried at 30^{0}C for another six hours (6 hours). The laboratory fabricated production and the heat-treated open-market materials were later characterized for comparative analyses. Parameters that were determined include density, water absorption rate before and after heat-treatment, and mechanical compression Load strengths. Details of the measurement procedures have been provided elsewhere (Anucha, 2002 and Ogbonna 2002).

RESULTS AND DISCUSSION

The characteristics of the laboratory fabricated samples. (A), Etanite (B), Super coil (C) and England-made ceramic-based roofing sheets are presented in Table 1. Sample A made with saw dust, coiled-coconut and palm fruit fibres, river sand, cement and polymeric dust indicated no significant difference with the Heat-treated materials (Samples B and C) that were purchased from the Nigerian market. It was obvious that by heat-treating Etanite and Super coil-roofing sheets in the polymeric liquid had greatly improved the product quality. For example, their water absorption capacities were reduced from 1.590 and 1.7 41% to 0.051 and 0.063 respectively (Table 1).

Table 1 Characteristics of the System.

Specimen	Density (kg/m^3)		Water absorption (%)		Compression Breakdown *Load St. (N/mm^2)*		Cost of Production (N) *1N = £150*
	Before ± 0.021	After ± 0.02	Before ± 0.023	After ± 0.01	Before ± 0.014	After ± 0.03	
A	1.62	-	0.071	-	4.84	-	542.00
B	1.47	1.52	1.590	0.051	4.24	4.72	456.00
C	1.58	1.73	1.741	0.063	4.65	4.94	563.00
D	1.78	1.81	0.032	0.027	5.60	5.04	864.00

Note: A = Laboratory Product B = Eternite Product C = Super coil Product D = Standard Product (England)

This reduction is both significant and important because, a good roofing sheet should not retain much water in order to be able to reduce damp and frost on the walls and the building. Equally important, is the fact that their water absorption capacities were relatively comparable to the standard material obtained from England. (Sample D). The standard sample (D) did not indicate any significant change before and after heat-treatment for all the measured characteristic properties. This implies that the material had been relatively stabilized. The laboratory-fabricated materials were not heat-treated because the aim of the investigation was to compare their characteristics relative to the induction of polymeric material during the processing state of the product and after the manufacturing of the products. It is most probable that the introduction of polymeric material either at the manufacturing stage or by heat-treatment process assisted in reducing up some of the pores thereby controlling the porosity and enhancing the product quality. Consequently, sample C was relatively of better quality than sample B. Also, the compressive breakdown load for all the specimens (A, B and C) showed no significant change but the cost analysis presented in Table 1 implied that the foreign-based roofing sheet was expensive whereas the remaining samples appear to relate their qualities. The basic innovation is the introduction of readily available polymeric dust produced by Eleme Petrochemical Industry Limited. The usual mould-casting technique was applied in the production process.

Economic Importance of the Investigation: The chosen routes of product improvement are economically feasibly and relatively very cheap when compared to the foreign product. Also, the raw materials are readily available within the neighbouring communities and infact some of the raw materials are end products in themselves. This could be why they are easily given out at take-away prices in order to dispose them. For example, sawdust was obtained from the wood section of the building materials section in Port Harcourt whereas the polymeric dust was obtained from Eleme petrochemical as waste product. Thus by involving these materials in the process of fabricating the ceramic- based roofing sheets; the re-cycling process is being encouraged and the environment should be more friendly.

Conclusions: Although the foreign-based roofing materials are relatively of higher quality than the locally manufactured products, it has been shown that a developing Nation such as Nigeria could improve the quality of her roofing materials through; (a) Addition of polymeric dust at the manufacturing stage. (b) Heat-treatment of final product within polymeric liquid at temperature between 50 - 60 ^{0}C. In summary polymeric organic solvent can be used to reduce the water absorption and increase the compressive breaking load of our present ceramic-based roofing materials.

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