www.ijecs.in
International Journal Of Engineering And Computer Science ISSN:2319-7242
Volume 4 Issue 5 May 2015, Page No. 12076-12079

Comparative Study of Some Engineering Properties of Aluminium Roof Sheets Manufactured In Nigeria and China

Obam, Sylvester Ogah[1] (Corresponding author) and Taku, Kumator Josiphiah[2]

[1]Department of Civil Engineering; University of Agriculture Makurdi, Nigeria

Email: ogahobam@gmail.com

[2]Department of Civil Engineering; University of Agriculture Makurdi, Nigeria

Email: kumataku@yahoo.com

Abstract: Man has utilized various natural resources through technological methods to create environmentally safe, effective roofing materials. The materials include straw, mud, wood, tile, metal, aluminium, etc. A good roofing material should adequately withstand the loads it is subjected to within its life span. This depends on the quality of the material such as tensile strength, density and material composition. Roof materials are often destroyed by wind and heavy rainfall in Nigeria. Nigeria imports most of her Aluminium roofing sheets from China. This research compares some Strength properties of aluminum roof sheets produced in Nigeria with that from China. Both samples were subjected to some laboratory tests. The mean specific gravity of the local and foreign roof sheets was found to be 2.64 and 2.61 respectively. The local sheet was found to be 14 per cent more elastic. The mean ultimate tensile strength for the local and foreign Aluminium Roof Sheets is 52 and 43 N/mm^2 respectively. The average Young Modulus for the local and foreign materials is 190 and 225 N/mm^2 respectively.

Key Words: Aluminium, Density, Roof, Tensile Strength

1. Introduction

Although most of the growth within the roofing industry has been within the last 200 years, the complete history of roofing started much earlier [1]. Dreadnought clay tiles began production in 1805 and industrial roofing at that time had little insulation but a good slope for rainwater and other debris. One hundred years after that, concrete tile roofing was first utilized. While the history of roofing began to evolve, American roofing styles and all of those abroad were still dependent upon the regional availability of materials [2].

Today, materials such as metal sheets, slate, and felt are among the most common roofing materials. It is hard to predict the future of the roofing industry and what technology can shape for the future, but for certain, the history of roofing has evolved and will continue to evolve forever [3]. Metal roofing is the most common material used on roofs in many homes, commercial and industrial premises [4]. Metal roofs come in a number of different forms including long run roofing (corrugated, trapezoidal, trough section/ concealed fix), tile, shakes and flat sheets. Galvanized steel sheet was the most commonly used form of profiled metal roofing prior to the development of zinc/aluminum alloy coatings. Aluminum, stainless steel, copper, lead and zinc can also be used for roofing [5].

Metal roofing sheets such as aluminum, zinc, galvanized coated sheets etc, expand when heat from the sun and air temperature change. They are also expected to move and stretch with typical building shifts [6]. Aluminum is a soft, lightweight metal with a dull-silvery appearance caused by a thin layer of oxidation that forms quickly when the metal is exposed to air. Aluminum oxide has a higher melting point than pure aluminum. Aluminum has a tensile strength of about 49 MPa in a pure state and 400 MPa as an alloy. Aluminum is about one-third as dense as steel or copper; it is malleable, ductile, and easily machined and cast. It has excellent corrosion resistance and durability because of the protective oxide layer. Aluminum is one of the few metals which retain full silvery reflectance, even in finely powdered form, which makes it a very important component of silver paints [7]. Aluminum is one of the most abundant elements found in the environment [8].

Tensile property is used to predict the behavior of a material under forms of loading other than uni-axial tension. The strength of a material may be measured in terms of either the stress necessary to cause appreciable plastic deformation or the maximum stress that the material can withstand. These measures of strength are used, with appropriate caution in engineering design [9]. Tensile Strength is an intensive property and, does not depend on the size of the test specimen. However, it depends on the preparation of specimen and the temperature of the environment and material [10].

Roofing sheets, like any other structure, should withstand its loads and be durable. Many roof sheets are often blown off from buildings in Nigeria, often by windstorm. Aluminium roof sheet is one of the predominant roofing sheets in Nigeria. The importation of the commodity is mostly from China. This research compares some of the strength properties of aluminium roof sheets imported from China with those

manufactured locally. The research results showed that average specific gravities of the local and foreign roof sheets are 2.64 and 2.61 respectively. The average percentage elongation for the local and foreign materials is 31 and 17 respectively. The local Aluminium Roof Sheet proved to be more ductile than the foreign one. The mean ultimate tensile strength for the local and foreign Aluminum Roof Sheets is 52 and 43 N/mm^2 respectively. The average Young Modulus (elastic modulus) for the local and foreign materials is 190 and 225 N/mm^2 respectively

2. Body Text

2.1 Materials

The following materials were used to carry out these experiments: Aluminum roof sheets, Measuring Cylinder, Water, Weighing Balance, Universal Testing Machine, Scissor, Caliper and measuring metal tape. The foreign and local aluminium roof sheets used were purchased from Narrow Aluminum Company and Ifeco Aluminum Company, Makurdi, Nigeria respectively. The foreign sheets were made from China and the local ones were produced in Port-Harcourt, Nigeria.

2.2 Methods

2.2.1 Density (Specific Gravity)

The initial volume of water in the cylinder (V_1) was noted. Aluminium Specimen was weighed and its mass (M) noted, it was then inserted into the cylinder. The final volume of water in the cylinder (V_2) was again noted. This procedure was repeated for four more specimens of the aluminium roof sheet.

$$\text{Density} = \frac{M}{V_2 - V_1} \quad (1)$$

2.2.2 Tensile Strength and Elongation

Experimental specimens shown in Plates 1(a) and (b), of size 30 x 600 mm were cut from the Aluminum roof sheets. The specimen was positioned in the jaw of the Universal Testing Machine (UTM), using rack and Pinion Flat Grips. The grip retainers were assembled at the top and lower crossheads placed in position and loosely fastened the screws holding the retainers. The Pinion Shaft Handle was turned so that the gears engaged the teeth on the wedge grips evenly. The handle was turned until the grips were fully inside the crosshead and the roof sheet specimen was inserted between the crank handle. Gauge of the UTM was connected to the Specimen to record extension. The load and extension were recorded at intervals until the specimen fractured. This process was repeated for two more specimens. The tensile strength and percentage elongation were calculated using equations 2 and 3 respectively.

$$\text{Tensile strength } (\sigma) = \frac{Load}{Cross-sectional\ area} \quad (2)$$

$$\text{Percentage Elongation} = \frac{\Delta L}{L_o} x100 \quad (3)$$

ΔL is extension

L_o is original length

Plate 1(a): Specimens for the local (Nigeria) Aluminum Roofing Sheets

Plate 1(b): Specimens for the Foreign (China) Aluminum Roofing Sheets

3. Results and Discussion

The average specific gravities of the local and foreign roof sheets were found to be 2.64 and 2.61 respectively. These values are very close to the specific gravity of pure aluminum, given as 2.65 [8]. The results of elongation are shown in Figure 1. The average percentage elongation for the local and foreign materials is 31 and 17 respectively. The local Aluminium Roof Sheet proved to be more ductile than the foreign one. Figure 2 shows the stress-strain curves for the materials. The mean ultimate tensile strength for the local and foreign Aluminum Roof Sheets is 52 and 43 N/mm^2 respectively. The values are within the range given by Larrablee [7]. The average Young Modulus for the local and foreign materials is 190 and 225 N/mm^2 respectively. The foreign Aluminum Roof Sheet might contain more alloy (or impurity) such as nickel and manganese because it has lower value of ductility (percentage elongation) and higher Young Modulus.

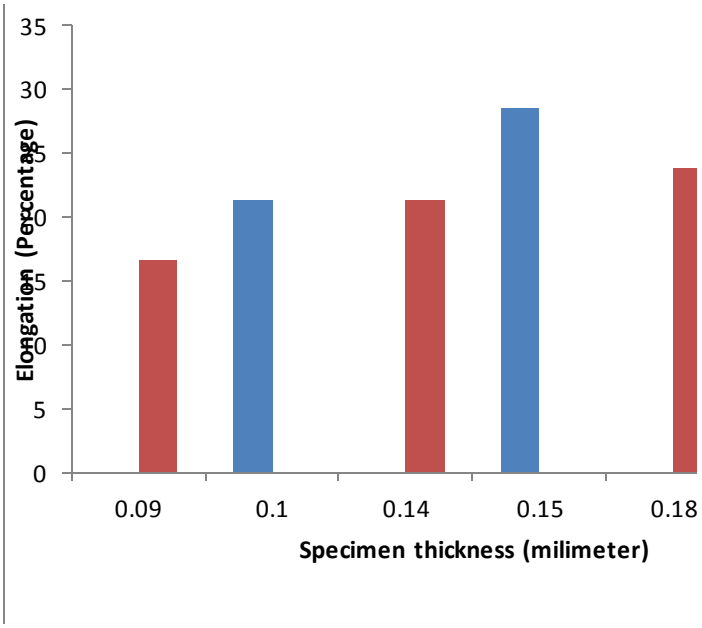

Figure 1: Average Percentage Elongation for the Specimens

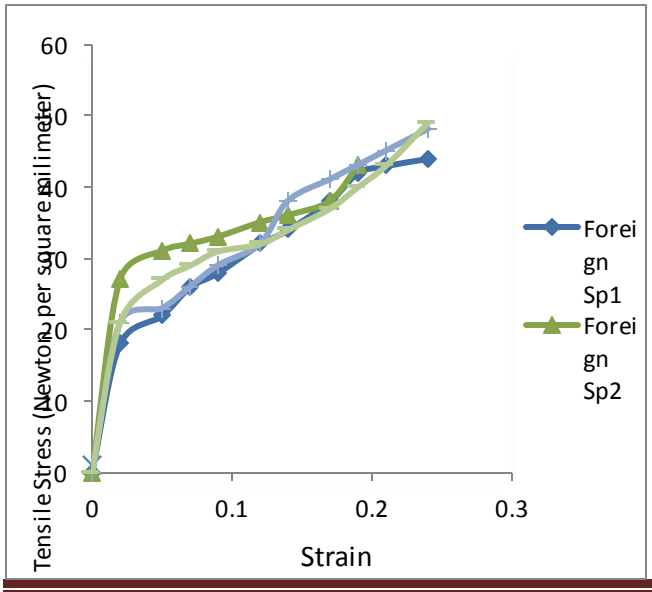

Figure 2: Stress-Strain Curves of the Aluminium Specimens(Sp)

4. Conclusion

The use of Aluminium Roof Sheet is growing rapidly in housing in Nigeria and the rest of West Africa. American roofing styles and all of those abroad were still dependent upon the regional availability of materials [2]. Today, materials such as metal sheets, slate, and felt are among the most common roofing materials. It is hard to predict the future of the roofing industry and what technology can shape for the future, but for certain, the history of roofing has evolved and will continue to evolve forever [3].

A good roofing material should adequately withstand the loads it is subjected to within its life span. This depends on the quality of the material such as tensile strength and material composition. This work compares the tensile strength property of aluminium roof sheets produced in Nigeria with that from China. Both samples were subjected to some laboratory tests. The local sheet was found to be more ductile. The average Young Modulus for the local and foreign materials is 190 and 225 N/mm^2 respectively. Irrespective of the slight differences in this case study, generally, Aluminium has good corrosion resistance, relatively light and I believe, its use as roofing material will continue to grow.

References

[1] Szab´o B, "Developments in the Roofing Industry, Historical Perspective", Available: http://www.Electrospec.ca/lib.pqr.roof.htm. [Accessed: Feb. 20, 2015].

[2] A. Palladio, "Four Books of Architecture on the Basis of I UATTRO LIBRI DEARCHITETTUR", Available: http://www. Electrospec.ca/lib.pqr.roof.htm. [Accessed: Feb. 20, 2015]

[3] R. Barry, The Construction of Building I, Ilesemi Press Limited, Ibadan, 1980.

[4] A. Horvath and A. P. Abraham, Wooden Roof Structures in the 19th Century, Ushen Press, Budapest, 2002.

[5] A. Vandor, Timber Roof Structures in Hungary in the 16-19th Century, Oriento Press Limited, Budapest, 1999.

[6] C. Schapcot, Investigation of English Roof Structure Types, Pitman Publishing Limited, London, 1997.

[7] C. P. Larrablee, Corrosion Resistant Experimental Steels for Marine Application, Hutchinson & Co. Limited, London, 1988.

[8] A. U. Malik, N. A. Saddiq, S. Ahmed and I. N. Andijani, "Relative Properties of Some Metals in Humid Environment", Corrosion Science, XXXVII (10), pp. 1521-1535, 1999

[9] J. W. Oldfield and B. Todd, "Corrosion Consideration in Selected Metals for Flash Chamber", Desalination, XXXII (1-3), p..365.

[10] H. P. Hack, "Corrosion behavior of 45 mo-containing stainless steels in Seawater", Corrosion, LXXXII (65), pp. 12-15, 2001.

Authors Profile

Obam, Sylvester Ogah received Bachelor of Engineering, Master of Engineering and PhD degrees in 1988, 1998 and 2007 respectively, from the University of Nigeria Nsukka. He started work as Lecturer II, at the Benue State Polytechnic Ugbokolo, in 1991. He is at present, an Associate Professor in the Department of Civil Engineering, University of Agriculture Makurdi, Nigeria. He published over 20 papers in both local and international journals. He is a member of several professional bodies, example, Council for the Regulation of Engineering in Nigeria (COREN) and Nigerian Society of Engineers (NSE). He has attended several conferences and workshops.

Taku, Kumator Josiphiah received Bachelor of Engineering and Master of Engineering from the University of Agriculture Makurdi in 2007.and Ahmedu Bello University Zaria, in 2013 respectively. He started work in the Department of Civil Engineering, University of Agriculture Makurdi as a Graduate Assistant in 2010. He is now at the rank of Lecture II in the same department