

# NIGERIAN ECONOMY MEDIUM DENSITY FIBREBOARD (MDF) WOOD COMPOSITE FLEXURAL STRENGTH ASSESSMENT

Ilo, C. P.<sup>1\*</sup>, Nwanjoku, T. S.<sup>2</sup>, Olayeye, E. A.<sup>3</sup>

<sup>1\*</sup> Department of Mechanical and Production Engineering, Enugu State University of Science and Technology, P.M.B. 01660, Enugu, Nigeria.

<sup>2</sup> TOSMEZ AGENCY L. T. D., Enugu, Nigeria.

<sup>3</sup> Department of Works and Services, Council of Legal Education, Nigerian Law School, Enugu Campus, Agbani. Enugu state, Nigeria.

DOI: <https://doi.org/10.5281/zenodo.16088491>

Published Date: 18-July-2025

---

**Abstract:** In a bid to make available to stakeholders the needed technical knowledge to foreclose extraneous loss of revenue as a result of failures associated with the use of unsuitable medium density fiberboard (MDF) for diverse needs due to lack of such knowledge, flexural strength assessment of (MDF) in Nigerian market was conducted. The most frequently sought after were identified out of which the top three were subjected to test after selection to establish their bending strength at peak or ultimate bending strength. The samples were conditioned and tested as required by the testometric machine. Graphs of the stress representing flexural strength versus the associated strain were obtained from data generated with computer program. From the analysis SGK Nordic had the best ultimate flexural strength of 13.568 N/mm<sup>2</sup>, Richard Russel had ultimate flexural strength 12.986 N/mm<sup>2</sup> while MDF Hokusan (MDF) recorded 1.24 N/mm<sup>2</sup>. Even though SGK Nordic and Richard Russel had different ultimate flexural strengths, they have a common strain at peak of 0.2149 % while MDF Hokusan (MDF) attained ultimate bending strength at strain of 0.1069 %. This novel data forms a good bases for decision making as to which (MDF) is suitable for certain applications so that the usual loss of revenue due to failure from inappropriate choice should be avoided. Individuals and construction firms should utilize this novel insight to forestall unwarranted loss of resources arising from (MDF) failures due to lack of this knowledge. Future attention should be geared towards similar research on high density fiberboard (HDF).

**Keywords:** Creep, Durability, Elasticity, Flexural Modulus, Flexural Stress, Flexural Strength, Mechanical Test, Modulus of Rupture, Resilience, Rigidity, Stability, Resistance.

---

## I. INTRODUCTION

### BACKGROUND OF THE STUDY

[1] Noted that exports of forestry products industrial goods in the 1950's, 1960's and 1970's were once enjoyed by Nigeria as plywood remains a vital engineered wood product extensively used across construction, furniture, and packaging industries in Nigeria. Despite abundant raw materials and a fast-growing domestic market, it is unfortunate to note that Nigeria presently remains heavily dependent on plywood imports. At a compound annual growth rate (CAGR) estimate of 4.5%, the global plywood market valued at USD 50.2 billion in 2024 with projection to reach USD 74.5 billion is expected to grow with from 2025, [2].

Wood composites are different derivative wood products. They usually obtained through by binding the particles, fibers, strands, or boards of wood together. With chemical additives enabling the integration of polymer and wood flour while helping facilitate optimal processing conditions, similar composite products can also be made from vegetable fibers using lignin-containing materials. Such materials could be rye and wheat straw, hemp stalks, sugar cane residue e.t.c. due to an

excellent combination of mechanical, thermal and acoustic properties together with a competitive price, particle and fiberboards are widely used in the building industry as eco-friendly solutions to wood with increasing uses in thermal insulators, ceiling boards, wall partitions, etc, [3].

[3] Studied the production of highly environmentally-friendly fiberboards by hot-press molding using *Posidonia oceanica* wastes and a partially biobased epoxy resin as binder with the results revealing that there is a remarkable improvement of the mechanical properties with combination of the alkali treatment followed by silanization. Medium Density Fiberboard (MDF) are made from wood fibers that are pressed together with a binding agent, they are dense, flat, and of smooth surface often used for furniture, cabinets and molding. Achieved using adhesives, wood composites are engineered to certain specifications resulting in a material that can have diverse applications. An interesting aspect of it is wood composites can be created using smaller trees, wood waste materials and hence reduce the need to fell old-growth forests. Wood composites have numerous advantages even though that the process of their manufacture as it relates to solid timber demands for extra primary energy. This coupled with the humidity-induced warping by some fiber-based and particle based composite woods when they are exposed to moisture which is not common in solid woods. An apprehension with wood composite is that most cheap and common resins usually used in the composites and made with urea-formaldehyde bonded products release toxic formaldehyde in the finished products. Higher fire hazard could be experienced when wood composite is compared to solid wood products which is as a result of higher chemical heat content and melting properties. Despite all these stated, demand for wood composite is on the rise as projected by the earlier statistics.

Failure of form boards frameworks from wood composites (plywood) shortly after casting of concretes especially while the concrete is still not yet set has been a major source of concern to the construction industry, [4].

A correlation analysis indicated that prices of the building materials had a direct relationship with the inflation rate in Nigeria thus the cause for the high cost of building materials while analyzing the inflation rate and the prices of building materials in Benin city, [5]. It was also revealed that the purchasing power of the Nigerian currency, Naira was seen to be decreasing in the study of inflation trend pattern and its impact on Nigeria's economy, a revelation that the economy especially building materials market is badly hit by the inflation according to [6]. Inflation was revealed as the most influential factor responsible for increase in the cost of building materials. A very strong relationship has been found to exist between building materials prices and rate of residential development following their quest to assess the effect of building materials cost on housing development in Owerri, Imo state, eastern region of Nigeria by [7].

### Flexural strength

To provide a deeper understanding of flexural strength and its significance in various contexts, key aspects of flexural strength include material property, which shows that flexural strength is an important mechanical property of materials, influencing their performance in various applications. Flexural strength at peak indicates the maximum stress a material can withstand when subjected to a bending load, which can cause tension, compression. Flexural strength is often associated with failure modes like cracking, breaking, or deforming excessively. It is influenced by material composition which is the type and arrangement of atoms or molecules in the material; material structure, that is the internal structure, such as grain size, porosity, or fiber orientation; surface finish, which is the surface roughness or smoothness and environmental conditions for example temperature, humidity, or exposure to chemicals. Its importance in applications, ranges from structural integrity, where flexural strength is crucial in designing structures like bridges, buildings, or beams; material selection, understanding flexural strength helps choose suitable materials for specific applications and product design. Flexural strength considerations are essential in designing products like sports equipment, furniture, or consumer goods. Regular testing methods include the three-point bending tests a common method for measuring flexural strength as well as four-point bending test also utilized in establishing flexural strength.

## II. REVIEW OF RELATED LITERATURE

[8] studied the tensile strength of Teak Wood Saw Dust – Cashew nut shell liquid resin composites. The composite material was prepared by using a hand layup technique while samples were prepared by varying the quantity of the Cashew nut shell liquid (CNSL) resin composites and keeping the saw dust quantity constant. The simple methodology was just by increasing the percentage of (CNSL). Tensile strength test on the composites using a Universal Testing Machine (UTM) according to the ASTM D638 showed that tensile strength of the sample with the highest percentage of (CSNL) was the highest and that the tensile increased with increase in (CNSL). This implies that increase in the cashew nut shell liquid (CNSL) percentage improves the tensile strength of the composite. [9] studied the effects of carbonized coconut shell (CS) volume fraction on

mechanical properties of unsaturated polyester resin (UPR) composite. The mechanical properties tests results show that flexural strength and elongation at break increased as coconut shell proportion got increased. [10] investigated the effect of particle size on the flexural strength, ultimate tensile strength, density and water absorption characteristics of uncarbonized coconut shell/unsaturated polyester composites of particle size 425 microns sample and 170 microns sample. The result indicate that maximum flexural and ultimate tensile strength were attained at 20wt% for the 425 microns sample. [11] investigated the effect of adding a blend of tannins to commercial urea formaldehyde (UF) on the properties of particleboard made from wood particles of *Acacia seyal* var. *seyal* using the BSEN relevant standards and found high mechanical properties, compared to the ones produced by solely urea formaldehyde (UF).

It was observed that coconut fiber reinforced HDPE has 28.6 mega pascal as optimum value for flexural strength while studying performance characteristics and reinforcement combinations of coconut fiber reinforced high density polyethylene (HDPE) polymer matrixes at optimum condition of volume fractions and particle sizes of coconut fiber-filler [12]. Some technical data relevant to wide application and every plywood user came up as a result of research recently conducted on experimental analysis of flexural strength of wood composite (plywood) in Nigerian commercial sector. The research revealed a novel finding that Viewpoint plywood recorded 4.956 N/mm<sup>2</sup>, Plywood EQ recorded 9.467 N/mm<sup>2</sup> while Caledonian also a make of plywood in Nigerian market recorded 16.973 N/mm<sup>2</sup> as the maximum stress, modulus of rupture (MOR) each of them can withstand while being bent before failing or rupturing [13].

In a test conducted for the potentials of low-density polyethylene (LDPE) such as plastic films from packaging as resins for saw dust from coconut lumber for the production of wood-plastic composite (WPC) particleboard when the boards were prepared from 50%-80% by weight of LPDE to sawdust content, both physical and mechanical properties of WPC evaluated showed that the tensile strength, face screw holding and modulus of rupture meet the minimum specifications of the US standards according to [14]. The study also revealed good interfacial adhesion between sawdust particle and LDPE reduced thickness swelling and improving moisture resistance by diminishing hygroscopy hence expanding the utilization of composites from agricultural wastes and plastic wastes for industrial applications, especially in moist environments, even as well as marine use and humid environment.

Through the study of effects of carbonization on the physical and mechanical properties of coconut shell particle reinforced polyester composite, it was observed that carbonized coconut shell particle reinforced composite recorded the least density value making it desirable in light weight material application [15].

A study was done on the properties of developed composite corn cob (CC) and sawdust (SD) particle boards using 100%, 75%, 50%, 25% and 0% variations for both agricultural wastes using formaldehyde as binder at constant volume. For both physical and mechanical properties, the result showed that the panels with 50% CC had the most preferred performances [16].

In the study of panel frameworks, evolution of surface properties of concrete through measured lightness and absorption was analyzed and it was found that changes were observed on surface quality after 50 reuses with oriented strand board (OSB) panels formworks while modification of surface quality was noticed after 80 reuses with marine plywood formworks [17].

Applying Taguchi robust design while studying the optimization of hardness strengths response of plantain fibers reinforced polyester matrix composites (PFRP) it was observed that empty fruit bunch fiber reinforced polyester matrix composite has the maximum hardness strength of 19.062 N/mm<sup>2</sup> which depended greatly on the reinforcement combinations of control factors [18].

It was revealed that wear behaviors of 950<sup>o</sup>C carbonized ash were better than those of 850<sup>o</sup>C and 900<sup>o</sup>C carbonized ash due to the degree of alteration in the structure of silica upon the analysis of the effect of carbonization temperature on wear rate behavior of rice husk ash reinforced epoxy composites [19].

Medium density fiberboards (MDF) composites samples higher strength value than plywood composites samples was revealed because of the increasing thickness of the activated carbon filler while a study was conducted on the influence of activated carbon filler on the mechanical properties of wood composites [20].

From the review of related literature, it is obvious that research has not been directed towards providing technical information on medium density fiberboards (MDF) in Nigerian market with regards to flexural strength, hence the obvious need for this research paper.

III. METHODOLOGY

MATERIAL

Three major and most common medium density fiberboard (MDF) wood composite in top demands were identified in Nigerian market from the survey made. They were selected as samples for analysis. The medium density fiberboard (MDF) wood composite samples were SGK Nordic, MDF Hokusan and Richard Russel. They are represented accordingly in table 1.

In table 1, the samples are marked “k”, “l” and “m” representing SGK Nordic, MDF Hokusan and Richard Russel respectively. They are all prepared according to the requirement by the machine and tested on the machine one after the other.

TABLE: I Medium Density Fiberboard (MDF) wood composite samples tested

Sample	k	L	m
Make	SGK Nordic	MDF Hokusan	Richard Russel

EQUIPMENT

Clamping down a sample of medium density fiberboards (MDF) for test is the testometric testing machine as seen in figure 1 which is a universal testing machine (UTM). The testometric testing machine moves down in operation to clamp on the material with the jaw on appropriately placed and conditioned medium density fiberboards (MDF). Data on the flexural properties is generated as the moves down by the resistive potentials of each sample.

Prepared according to the requirement by the testometric machine shown in figure 1, the samples (k) representing SGK Nordic, (l) representing MDF Hokusan and (m) representing Richard Russel were all tested on the machine one after the other. The materials were prepared by cutting to the dimensions of 30 mm x 200 mm so as to fit in with the testing machine as required. Operated by moving the jaw of the TESTOMETRIC TESTING MACHINE down to clamp on the workpiece as earlier stated, that is the conditioned medium density fiberboard (MDF) wood composite samples, mechanical properties of the medium density fiberboard (MDF) wood composite are evaluated during the process. With computer program the dynamics of the stress in N/mm<sup>2</sup> versus strain in % plot for the test is generated from data obtained. Obviously, the plot being a function of the samples compositions resulting from their nature is a clear indication of the relationship between force per unit area and deformation per unit length in a material under load. In this case the material being the medium density fiberboard (MDF) wood composite. Under results and analysis below, the data generated is analyzed.



Fig. 1 Testometric machine

IV. RESULTS AND ANALYSIS

For each of the samples SGK Nordic, MDF Hokusan and Richard Russel, the results of the tests are shown as plots in figures 2, 3 and 4 respectively. Basically, showing flexural strength in N/mm<sup>2</sup> against strain in (%), the plots are for the tested samples of the three selected medium density fiberboard (MDF) wood composite.

Plots

The plot below is a graph of flexural strength against strain of figure 2 which gradually sustained a rise from 0 N/mm<sup>2</sup> stress at 0 (%) strain to attain ultimate bending strength of 13.568 N/mm<sup>2</sup> at strain of 0.2149 % for SGK Nordic medium density fiberboard (MDF) wood composite while the testometric testing machine was in operation. The ultimate bending strength value as expected, precedes a decline portion of the plot which is the plastic region. Of course, the plastic region succeeds the elastic region just immediately after ultimate bending strength.

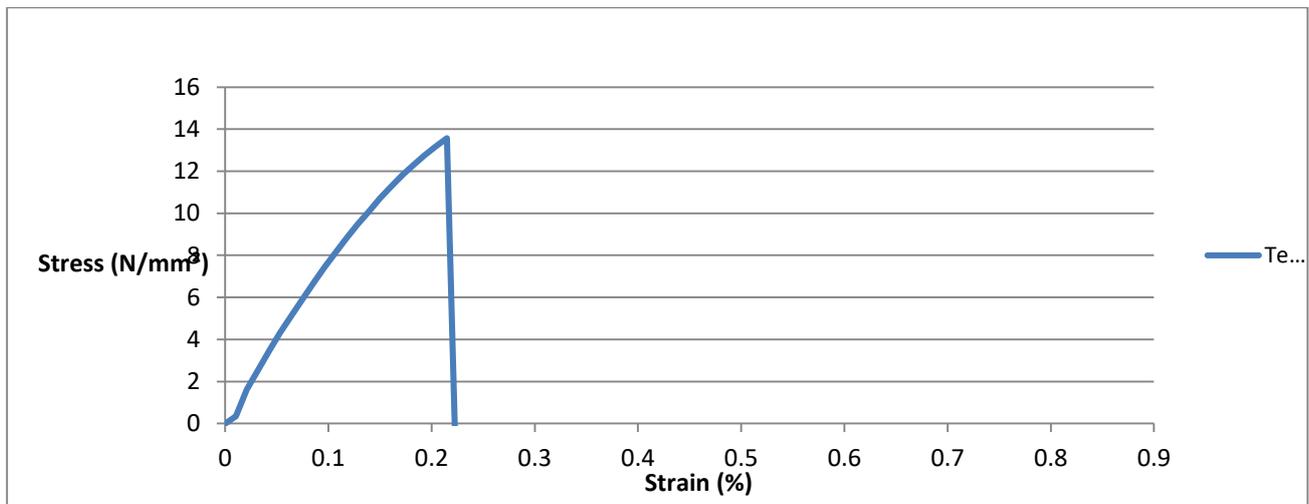


Fig 2 Graph of flexural strength in N/mm<sup>2</sup> against strain in (%) for SGK Nordic medium density fiberboard (MDF)

Below is a graph showing the plot of flexural strength against strain of figure 3 which gradually sustained a rise from 0 N/mm<sup>2</sup> stress at 0 (%) strain to attain ultimate bending strength of 1.24 N/mm<sup>2</sup> at strain of 0.1069 % MDF Hokusan medium density fiberboard (MDF) wood composite while the testometric testing machine was in operation. Again, the ultimate bending strength value as expected, precedes a decline portion of the plot which is the plastic region, while of course the plastic region succeeds the elastic region just immediately after ultimate bending strength.

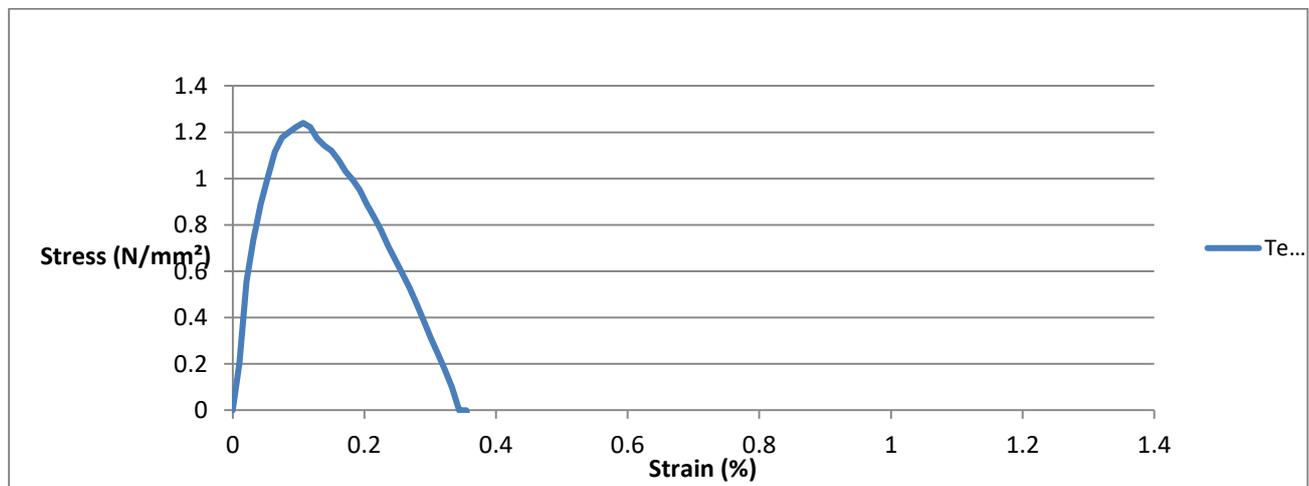
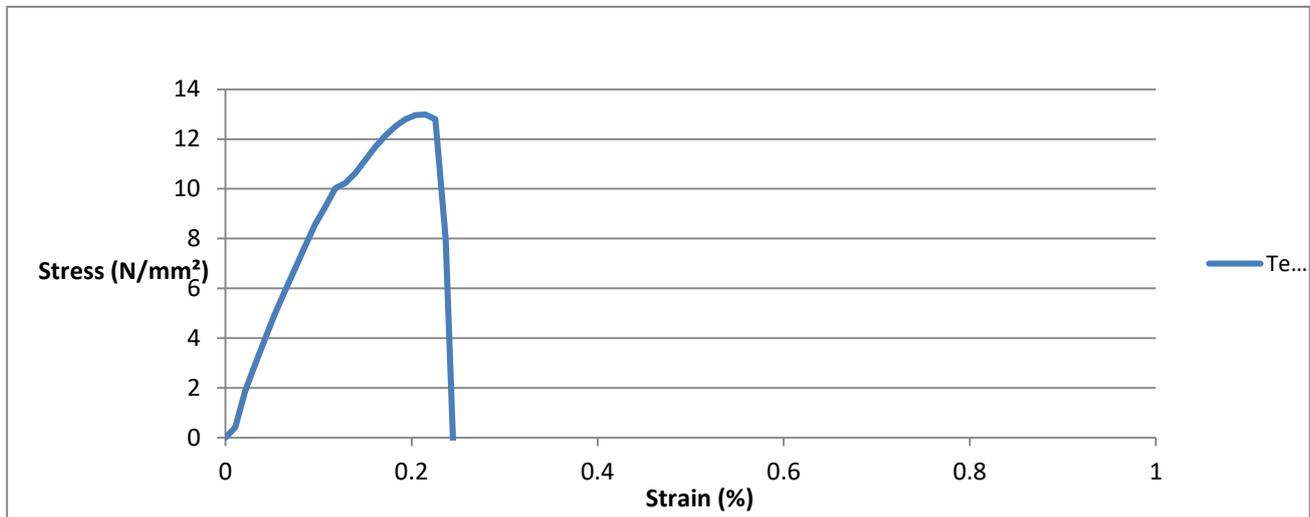


Fig 3 Graph of flexural strength in N/mm<sup>2</sup> against strain in (%) for MDF Hokusan medium density fiberboard (MDF)

The plot below is a graph of flexural strength against strain of figure 4 sustaining a rise from 0 N/mm<sup>2</sup> stress at 0 (%) strain to attain ultimate bending strength of 12.986 N/mm<sup>2</sup> at strain of 0.2149 % for Richard Russel medium density fiberboard (MDF) wood composite while the testometric testing machine was in operation. It is worthy of note that the ultimate bending strength value as expected, precedes a decline portion of the plot which is the plastic region. Again, just immediately after ultimate bending strength, the plastic region succeeds the elastic region.



**Fig 4 Graph of flexural strength in N/mm<sup>2</sup> against strain in (%) for Richard Russel medium density fiberboard (MDF)**

## V. CONCLUSION AND RECOMMENDATIONS

Results of flexural tests conducted on three common medium density fiberboard (MDF) wood composite and most widely used from Nigerian market show that in a descending order of their ultimate bending strength, SGK Nordic medium density fiberboard (MDF) wood composite recorded 13.568 N/mm<sup>2</sup>, Richard Russel medium density fiberboard (MDF) wood composite recorded 12.986 N/mm<sup>2</sup> while MDF Hokusan medium density fiberboard (MDF) wood composite recorded 1.24 N/mm<sup>2</sup>. One thing is obvious, the sharp fall from flexural strength at peak immediately it is attained. Interestingly, both SGK Nordic medium density fiberboard (MDF) wood composite and Richard Russel medium density fiberboard (MDF) wood composite had a strain of 0.2149 % at their ultimate bending strength. MDF Hokusan medium density fiberboard (MDF) wood composite attained ultimate bending strength at strain of 0.1069 %. These data generated form a good wealth of knowledge in choice of medium density fiberboard (MDF) wood composite in Nigerian market based on the use which naturally would prevent loss of revenue associated with failure of inappropriate ones. It is advised that this novel technical information should be valued by building contractors, individuals, construction companies as well as furniture makers. Flexural strength future research works in wood composites should be channelled towards that of high-density fibreboard (HDF).

## REFERENCES

- [1] Ogunwusi, A. A. (2012). The Forest Products Industry in Nigeria. *An International Multidisciplinary Journal, Ethiopia*. 6(4), Serial No. 27. Pp191-205. DOI: <http://dx.doi.org/10.4314/afrev.v6i4.13>
- [2] FMRL, (2025). Plywood manufacturing in Nigeria; The feasibility Report. <https://businessplansinnigeria.ng/business-plans/plywood-manufacturing-in-nigeria-the-feasibility-report/#:~:text=Since%201997%2C%20annual%20production%20has,%2C%20the%20UAE%2C%20and%20Austria.>
- [3] Garcia-Garcia, D, Quiles-Carrilo, L., Montanes, N., Fombuena, V. and Balart R. (2018) Manufacturing and Characterization of Composite Fibreboards with *Posidonia oceanica* wastes with an Environmentally-Friendly Binder from Epoxy Resin. *Materials*, 11(1): 35. <https://doi.org/10.3390/ma11010035>
- [4] Ilo, C.P., Ajibo, J. I. & Dim, E. C. (2025a). Flexural Strength Appraisal of Marine Board Plywood in Nigerian Market. *International Journal of Recent Research in Civil and Mechanical Engineering (IJRRCME)*. (12)1: (18-24) DOI: <https://doi.org/10.5281/zenodo.15753859>

**International Journal of Novel Research in Interdisciplinary Studies**

 Vol. 12, Issue 4, pp: (1-7), Month: July – August 2025, Available at: [www.noveltyjournals.com](http://www.noveltyjournals.com)

- [5] Obaedo, B. O., (2024). The Inflation Rate and the Prices of Building Materials in Benin City, *International Journal of Advanced Multidisciplinary Research and Studies*, 4(4):1112-1122, DOI:10.62225/2583049X.2024.4.4.3158
- [6] Barguma, W. S., Atanda, B. T., Chidiebere, U. E., Kudirat, B. F., & Busola, T. R. (2022). A Study of Inflation Trend Pattern and Its Impact on Nigeria's Economy, *International Journal of Research Publication and Reviews*, 3(4): pp 5989-5997
- [7] Igboekulie, I. E., Monye, C. & Joseph, F. F. (2022). Assessment of the effect of building materials cost on housing development in Owerri, Imo State, Nigeria, *International Journal of Advances in Engineering and Management (IJAEM)*,4(9): 455-474, DOI: 10.35629/5252-0409455474
- [8] Ganesan M. and Valarmathi T.N. (2014). Tensile Strength of Teak Wood Saw Dust – Cashew nut shell liquid resin composites. *International Journal of Engineering Development and Research (www.ijedr.org) IJEDR*. 2(1): 196-199. <https://rjwave.org/IJEDR1401034.pdf>
- [9] Iloabachie, I. C. C., Obiorah, S. M. O. & Anene, F. A. (2018). Study of mechanical properties of carbonized coconut shell polyester composite. *Journal of Engineering and Applied Sciences*. (13): 54-62
- [10] Iloabachie, I. C. C., Obiorah, S. M. O., Ezema, I. C., Okpe, B. O., Chima, O. M. & Chime, A. C. (2017). The effects of particle size on the flexural strength, tensile strength, and water absorption properties of uncarbonized coconut shell/polyester composite. *International Journal of Advanced Engineering and Technology*. (1)1: 22-27.
- [11] Elbadawi, M., Osman, Z., Paridah, T., Nasroun, T. & Kantiner, W. (2015). Properties of particleboards made from Acacia Seyal Var. Seyal using UF–Tannin modified adhesives. *Cellulose Chemistry and Technology*. **49** (3-4): 369-374.
- [12] Ihueze, C. C., Achike, M. K. & Okafor, C. E. (2016). Optimal performance characteristics and reinforcement combinations of coconut fiber reinforced high density polyethylene (HDPE) polymer matrixes. *Journal of Scientific Research & Reports*. 9(3): 1-10. Doi:10.9734/JSRR/2016/20385
- [13] Ilo, C.P., Ajibo, J. I. & Dim, E. C. (2025b). Analysis of flexural strength of wood composite (plywood) in Nigerian commercial sector. *International Journal of Novel Research in Engineering and Science*. (12)1: 30-35. DOI: <https://doi.org/10.5281/zenodo.15687650>
- [14] Valle, S. (2020). Evaluation of the potential of recycled LPDE and waste sawdust in wood in wood-plastic composite boards. In the book: 2020 ISWA-SWIS Winter School Proceedings. *Solid waste Institute for Sustainability (SWIS), The University of Texas at Arlington*.
- [15] Iloabachie, I. C. C., Obiorah, S. M. O., Ezema, I. C., Henry, V. I. & Chime, O. H. (2014). Effects of carbonization on the physical and mechanical properties of coconut shell particle reinforced polyester composite. *International Journal of Research in advanced Engineering and Technology*, 3(1), 62-69, [www.engineeringresearchjournal.com](http://www.engineeringresearchjournal.com),
- [16] Akinyemi. B. A., Afolayan, J. O. & Oluwatobi, E. O. (2016). Some properties of composite corn cob and sawdust particle boards. *Construction and Building Materials* 127, 436-441.
- [17] Courard, L., Goffinet, C., Migeotte, N., Martin, M., Pierard, J. and Polet, V. (2012). Influence of the reuse of OSB and marine plywood formworks on surface concrete aesthetics. *Materials Structures* (45): 1331-1343. <https://doi/10.1617/s11527-012-9835-0>
- [18] Okafor, E.C., Ihueze, C. C. and Nwigbo, S. C. (2013). Optimization of Hardness Strengths Response of Plantain Fibers Reinforced Polyester Matrix Composites (PFRP) Applying Taguchi Robust Design. *International Journal of Engineering*. (26)1: 1-11. Doi:105829/idosi.ije.2013.26.01a.01
- [19] Ozioko, F. U. (2011). Effect of carbonization temperature on wear rate behaviour of rice husk ash reinforced epoxy composites. *Leonardo Electronic Journal of Practices and Technologies*, (19); 172-182, <https://lejpt.academicdirect.org>
- [20] Aziz, N. A. A., Mohamed, M., Mohamad, M, Amini, M. H. M., Aziz, M. S. A., Yusoff, H. and Rizman, Z. I. (2015). Influence of activated carbon filler on the mechanical properties of wood composites. *ARP Journal of Engineering and Applied Services*, 10(1): 376-386. [www.arpnjournals.com](http://www.arpnjournals.com)