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# A Critical Review of Wood Waste Cement Composite Properties (The Mechanical and Physical Properties) and its Use as Building Construction Material

James Olaonipekun Toyin[1], Modupe Cicilia Mewomo[2], Sina Abayomi Makanjuola[3], Margaret Damilola Oyewole[4].

[1,2,4] Durban University of Technology, South Africa.
[3] Federal University of Technology, Akure Nigeria.
mewomom@dut.ac.za

## Abstract
The gradual unreplaceable exploration of the natural aggregates has called for the attention of researchers and built professionals to devise suitable materials which can be used as a replacement for those aggregates. This has called for an inward investigation on using waste raw materials such as wood waste as supplementary for fine aggregate or pozzolana. Wood waste cement composites are great byproducts that can be used as building materials that are freely or cheaply available. Before any new material could be considered suitable in construction, the properties need to be known to see its suitability for construction works and the area it would be best suited for. This study aims to investigate the mechanical and physical properties of wood waste cement composite and its use as building construction material, through a critical literature review of selected published articles between 2005 to 2021, focusing on the property of wood waste cement composite. The findings reveal the physical and mechanical properties of raw sawdust and properties of selected Portland cement. The findings of this study will go a long way in assisting built professionals in making intelligent choices on how to use processed and unprocessed wood by-products as a partial substitute for cement and sand.

## Keywords
Wood Waste, Physical Property, Mechanical Property, Cement, Construction.

## 1. Introduction

Over the years, there has been a great concern abo about generating sustainable building materials capable of reducing greenhouse gas emissions (carbon dioxide emissions) within the building (Ding 2014). Carbon dioxide emissions are the primary cause of global climate change (Terrenoire et al., 2019). It is widely understood that the world must reduce emissions as quickly as possible to avoid the worst impacts of climate change. Researchers have been on the watch to derive the possibility of getting such suitable materials from waste or by-products. This reduces $CO^2$ emission and the high concentration on primary natural building materials, like sand, granite, cement. The high demand for those materials may lead to their scarcity in no time. However, one of the possible ways of sourcing suitable raw material in the construction industry is by progressing from using finite and limited building resources to easily renewable or recycling generated by-products raw materials (Terpakova et al. 2012). Sand and granite are the primary constituents of concrete; the rising in construction industry activities increases the demand for the primary natural aggregate, which gradually reduces such aggregate resources. Batool et al. (2021), through their studies, find out that the natural aggregate (sand) is universally dug out from lakes, riverbeds, and other sources is to the tune of almost 11 billion tons each year. Due to this, numerous countries like Nigeria (Lagos- Lekki Aja area) have enforced limitations on the dredging of such aggregate from waterways and sea areas to decrease the unpleasant influences on the natural environment. The actions have set the construction industry and researchers on the move to look out for suitable alternative materials. Due to these challenges, the construction industry and building material science experts have sought cheap, sustainable, and eco-friendly waste materials that are substitutes for construction works (Bołtryk &

Pawluczuk 2014). Preference has been on waste materials that could be recycled and aid the reduction of carbon dioxide emissions.

There has been a global concern on how to manage solid waste. Generally, society has been looking for legitimate ways of transferring solid waste in substantial urban communities since appropriate dumping destinations for this waste are progressively rare, due to the spread and improvement of vast urban focuses. The consideration of recycling waste materials and industrial by-products was seen as one of the ways to optimally convert the waste to valuable materials (Shahjalal & Billah 2021; Foti & Cavallo 2018; Foti et al. 2019). However, sawdust, as an example of waste material, is produced as industrial waste on a large scale that needs to be disposed of carefully into the environment (Batool et al. 2021). The high demand for wood products in different sectors in large quantities and processing forms part of daily activities. Processing the wood generates a high volume of sawdust by-products (Aigbomian & Fan, 2013). Evidence has proven that composite wood waste could be used as a partial substitute for cement (pozzolana) (Tamanna et al. 2020). In addition, it could be used as a partial replacement of fine aggregate (Hassen & Hameed 2020). Therefore this paper aims to document the mechanical and physical wood waste cement composite properties through a critical review of the literature within the context.

## 2. Research Methodology

A critical paper-based review approach was adopted using the content analysis method to study the state-of-the-art wood waste composite to discover its suitability for construction works. Criminale & Langar (2017) linked content analysis to literature. It was explained as a flexible method that can be exploited to analyze text data, which scholars have used for an unlimited period. To achieve this study's aim and objective, the flow chart shown in Fig. 1 will be employed in this research.


**Fig. 1:** Research flow chart diagram.

The steps employed in this research involve two processes; the first process was the collection of relevant academic publications on wood waste and cement properties and their uses. Using keywords: "wood waste property," "Sawdust physical property," "Sawdust mechanical property," "Cement property," and "Composite cement materials." The search conditions were used to locate relevant documents, which were repeated in selected academic databases or search engines of Elsevier (Science Direct, Scopus), Google Scholar, and Web of Science. The exploration brought about 150 published papers. The adoption of inclusion and exclusion criteria gives the population of 70. The retrieved papers consisted of journals, book chapters, and conferences, excluding papers not written in English, editorials, and forums. In addition, the retrieved papers' abstracts were read to ascertain their relevance to the current research. Exclusion criteria such as the absence of author(s)'s details, missing year of publications, duplications/ repeated paper entries, and paper written in language order than English were adopted. Adopting the exclusion criteria in the filtration of the retrieved articles produced a final population of 21 (n=21), considered in this paper. The next pace involves analyzing relevant materials retrieved during the search and discussion. Finally, the last phase encompasses the conclusion to encourage built professionals to use wood-waste composite as supplementary building materials.

## 3. Results and Discussion

### 3. 1 Cement Property

Recent research conducted by Ige (2013) in Nigeria focused on comparative analysis of portland cement. The study was conducted on five (5) cement brands commonly available in the country during the study. The study was conducted to determine each cement characteristic: setting time, strength characteristics, workability, soundness, and fineness. After that, check if they meet the minimum required standard stipulated by the British Standard Institute. Table 1 shows the fineness analysis result of the selected brands of cement. Ige (2013) noted that the results agreed with the stipulated standard. The author confirmed that the best fineness result comes from Dangote cement. The fineness of cement significantly impacts the pace of hydration and rate of strength growth. Because finner cement has a larger surface area for hydration, it develops strength more quickly (Ige 2013). Fig. 2 shows the result of the comprehensive strength for each cement brand. These indicated that the comprehensive strength progresses as the curing days increase. Dangote cement had the highest crushing strength on the 28th day of the five brands. While Diamond cement gained early strength ahead of the other cement. These findings were in agreement with the result

**Table 1**. Selected brand of cement fineness analysis.

| S/N | Brand of cement | Weight of cement before sieving (g) | Weight of residue (g) | Weight of fine cement after sieving (g) |
|---|---|---|---|---|
| 1. | Elephant | 100 | 5.5 | 94.5 |
| 2. | Pure chem | 100 | 3.5 | 96.5 |
| 3. | Bur ham | 100 | 3.0 | 97.0 |
| 4. | Diamond | 100 | 2.5 | 97.5 |
| 5. | Dangote | 100 | 2.2 | 97.8 |

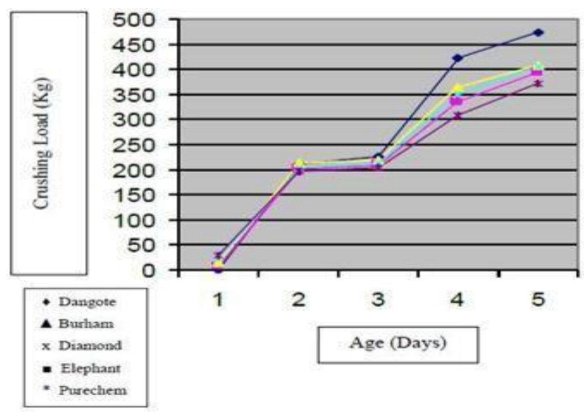


**Fig. 2**: Comprehensive strength analysis of selected cement.

of Zhang et al. (2019) defined “Metal oxides” as crystalline solids encompassing a positive metal ion and an oxide anion. They usually react with water to form bases. Faleye, Ogunnubi & Olaofe (2009) researched the Nigerian market; the authors focused on four (4) selected cement samples. The findings presented reports on Elephant, Dangote,Pure Chem, and Diamond cement using chemical analysis of metal oxides. Table 2. Presents the chemical analysis ofthe selected cement samples. The mean values and percentage coefficient of variance shown reveal that Elephant havethe highest CaO. Dangote has the least CaO and the highest MgO, K2O, $SO_3$, and $A1_2O_3$, while Pure Chem has the least $K_2O$, $SO_3$, and MgO. “The clinker soluble alkalis such as $K_2O$ and $Na_2O$ have an important influence on cementquality and performance. The influence of the soluble alkali content is strongly dependent on the $SO_3$ contents” (Faleye, Ogunnubi & Olaofe 2009). The authors noted no risk of heat cure concrete failure since the percentage of $SO_3$ in all samples is less than 3.5 percent, which is the top limit for $SO_3$ concentration. Physical Characteristics of thesamples: setting time, loss on ignition, insoluble residue, specific surface area, and Factors considered for the cementvaluation: Lime saturation factor, Silica ratio, Alumina ratio, free lime were presented in Tables 3 and 4, respectively. The period when a part of cement paste resists penetration by examining defined weight and cross-section is known as the settingtime of cement. (Ige 2013). Therefore, Dangote would first show the resistance while Pure Chem would show it last.The mean values for lime saturation factor, silica ratio, free lime and alumina ratio were 90.1 + 3.02, 2.23 + 0.10, 1.69 + 0.13 and 1.43 + 0.79 respectively as seen in Table 4. The physical characteristics and other relevant elements for evaluating the cement samples are included in Tables 3 and 4. Dangote had the smallest insoluble residue (4.7) and fastest setting time (195 seconds), whereas Pure Chem has the largest specific surface area (412m2/kg) and the lowest percentage loss on ignition (5.5). Furthermore, the findings concluded that the comprehensive strength result shows Dangote cement has the highest strength. At the same time, the least was Pure Chem in the selected cement samples. Their observation noted that Dangote cement comprises the least setting time and specific surface area; this powerfully affects early compressive strength. These findings agreed with the recent study of Ige (2013), where the author considers five brands of cement available in the Nigerian market during the study. The brand contains the initial four brands studied by Faleye, Ogunnubi & Olaofe (2009), with the addition of "Bur ham cement."

**Table 2**. Selected cement sample chemical oxide properties %.

| SAMPLE | CaO | $Fe_2O_3$ | $SiO_2$ | $Al_2O_3$ | MgO | $SO_3$ | $K_2O$ |
|---|---|---|---|---|---|---|---|
| Pure chem | 62.2 | 3.59 | 20.77 | 5.63 | 1.21 | 2.19 | 0.22 |
| Dangote | 59.6 | 3.22 | 20.62 | 6.01 | 3.65 | 2.46 | 0.71 |
| Diamond | 61.4 | 3.23 | 20.55 | 5.56 | 2.22 | 2.38 | 0.42 |
| Elephant | 62.6 | 3.20 | 20.34 | 5.09 | 1.74 | 2.19 | 0.29 |
| Mean | 61.45 | 3.31 | 20.57 | 5.57 | 2.21 | 2.31 | 0.1 |
| S.D | 1.33 | 0.91 | 0.19 | 0.38 | 1.05 | 0.14 | 0.22 |
| CV% | 2.16 | 5.74 | 0.2 | 6.82 | 47.51 | 6.06 | 53.66 |

(Faleye, Ogunnubi & Olaofe 2009)

**Table 3**. Cement samples physical property.

| Sample | LOI (%) | IR (%) | SSA ($m^2$/kg) | SETTING TIME (sec) |
|---|---|---|---|---|
| Diamond | 5.5 | 23.9 | 380 | 200 |
| Pure Chem | 6.0 | 34.5 | 412 | 200 |
| Dangote | 8.5 | 4.7 | 358 | 195 |
| Elephant | 8.0 | 33.1 | 392 | 210 |
| Mean | 7.0 | 21.6 | 385 | 201 |
| S.D | 1.47 | 11.9 | 22.42 | 6.30 |
| CV% | 21.0 | 9 | 5.82 | 3.13 |
| | | 55.5 1 | | |

SSA - Specific surface area ($m^2$/kg), IR - Insoluble residue (%), LOI - Loss on ignition (%) (Faleye, Ogunnubi & Olaofe 2009)

**Table 4**. Factors considered for the cement valuation.

| SAMPLE | LSF | SR | AR | F/CaO |
|---|---|---|---|---|
| Pure chem | 90.1 | 2.25 | 1.57 | 2.58 |
| Dangote | 86.3 | 2.23 | 1.87 | 0.95 |
| Diamond | 90.2 | 3.23 | 1.72 | 5.56 |
| Elephant | 93.7 | 2.34 | 1.59 | 1.34 |
| Mean | 90.1 | 2.32 | 1.69 | 1.43 |
| S.D | 3.02 | 0.10 | 0.13 | 0.79 |
| CV% | 3.35 | 4.31 | 7.69 | 55.2 |

LSF - Lime saturation factor, SR - Silica ratio, AR - Alumina ratio, F/CaO - Free lime (Faleye, Ogunnubi & Olaofe 2009)

## 3.2 Mechanical Properties of wood waste

For decades, many ways have been exploited to characterize the engineering properties of wood-based composites material performance. Wherein, mechanical means stands to be one of the essential properties to be considered. Ganesan, Rosentrater & Muthukumarappan (2008) noted that the mechanical properties of wood waste are powerfully influenced by moisture content and the size of the particle distribution. The size of the particle affects the flowability of some materials, "it is used as a measure of the quality of the granular product that influences its end-use value" (Stasiak et al. 2015). The difference in flowability of particles may lead to errors during mixing and weighing, thus resulting in the inconsistency of the end product (such as briquettes or pellets). The blend material must exceed the initiate flow, representing the strength of the flow function (FF). FF grainy materials' values can be considered free-flowing, cohesive solid, cohesive, and easy flowing. In addition, frictional collaboration with construction materials is an additional feature of the mechanical properties of granular materials deposited in bulk in silos and controlled in technological processes. "This behaviour is described by friction coefficient which is the tangent of inclination of the linearized relationship between shear stress and normal stress during sliding of a sample of granular material against the plane surface of construction material" (Stasiak et al. 2015).

The mechanical composition of wood-based composites rests upon a range of factors: the kind of adhesive binder used, forest management regimes, wood species, the density of the final product, and the geometry of the wood elements. However, mechanical properties have been widely accepted and used to assess wood-based composites required for nonstructural and structural applications (Cai Senalik & Ross 2021). Wherein properties and elastic strength are the leading measures considered in selecting the material or product specifications or establishing the design. The elastic properties include comprehension, tension, and modulus of elasticity in bending (Cai Senalik & Ross 2021).

Kumar & Kumar (2015) studied the mechanical properties; flexural, split tensile and compressive strengths, of fiber reinforced concrete strength characteristics, using wood waste ash as a partial substitute of cement with different percentages at (0, 10, 20, & 30%) and crimped steel fibers at different percentages (0,0.5,0.75 & 1%), tested on 28 and 60 days of casting. The compressive strength result shows the effect of adding wood waste ash and steel fibers at different design mixes. Wherein 20% and 0.75%, respectively, volume was seen as the optimum content volume (in addition, those volumes were also seen as optimum volume for the split tensile and flexural strength). With the addition of wood waste ash at 20%, there was an increase of 11.3% compressive strength over plain cube concrete tested. Also, the authors observed that there was a 10.2% increase in the compressive strength over plain concrete with a 0.75% increase in fiber. The main effect of adding wood waste ash on comprehensive strength is to reduce the quantity of cement used, since it serves as a partial substitute of cement, also to reduce concrete weight, while steel fibers were added to achieve optimal strength. Wood waste-based composites may be used for construction: for several nonstructural and less concentrated structural elements, such as support for building structures, furniture components, and panels for both interior and exterior uses. However, it is very important to have Knowledge of these products based on their proper use by looking at the mechanical properties of the products (Cai, Senalik & Ross 2021).

## 3.3 Physical Property of Wood Waste

Mangi et al. (2019) noted that the physical properties of wood waste are the way it behaves towards external influences apart from applied forces and its elementary characteristics. This includes moisture content, density, grain and texture, thermal behaviour, dimensional stability, etc. Knowing the physical properties is essential because they can substantially influence the strength and performance of the material exploited in the structural applications: the more the increase in the amount of sawdust, the lower its workability (Adebakin et al. 2012; Moreira, Macêdo & Souza 2012; Oyedepo, Oluwajana & Akande 2014; Awal, Mariyana & Hossain 2016).

Awal, Mariyana & Hossain (2016) researched the properties of sawdust concrete. The authors focused on the physical and mechanical properties. Their research presented the physical result as seen in Table 5. The slump test value varies based on the amount of sawdust used; this indicated that the higher the quantity of sawdust in the fresh design mix, the lower the slump tested. “Slump values of 40, 15 and 5 mm were obtained for mix ratios of 1:1, 1:2 and 1:3 respectively, and were found to fall within the medium, low and no-slump ranges according to Euro code Standard classifications (BS EN 206-1)” (British Cement Association 2002). In addition, the authors “study concludes that sawdust concrete can be used as lightweight concrete with a satisfactory strength performance.” Tamanna et al. (2020) carried out a critical review on wood waste ash use for construction. Several authors investigated the physical properties such as compacted bulk density, specific gravity for wood waste ash. It was found to be 760 & 2.13 kg/m3, respectively. The authors noted that wood waste ash chemical composition varied; this could be traced to the combustions process and where they are produced. Udoeyo et al. (2006) research on the possibility of using wood waste ash (WWA) as a partial substitution for cement, wherein Physical and mechanical properties were investigated (Comprehensive strength, flexural strength, water absorption, and slump test value, the findings reported that at “mix proportion 1:2:4:0.56 (cement: sand: coarse aggregate: water-cement ratio), concrete containing 5 and 10% WWA recorded the highest compressive strength of 28.66 ± 0.70 and27.54 ± 0.34 MPa respectively at 90 days of age and the reduction occurred”.

## 3.4 Sawdust Production, Uses for Construction, Non-Construction, and Disposal.

### 3.4.1 Sawdust production.

Sawdust is the by-product generated by processing logs of wood at the sawmills. The volume generated through the sawmilling operation is influenced by the efficiency of the sawmilling machine and operator. This could be calculated based on the quantity and quality of plank recovered through the operation, equated to the generated wood waste. Nevertheless, wood waste comprises sawdust, bark, split wood, trimming, sander dust, and planer shavings (Ekhuemelo & Atondo 2015). The authors researched in Benue State, Nigeria, their findings review that the operator experience with the use of the machine likewise influences the amount of sawdust produced. Kambugu et al. (2005) conducted research at Uganda softwood plantation. It was observed that the lack of appropriate machines for each stage of sawing operation on the logs of wood sawing leads to excessive sawdust production in the sawing process. It is essential to use suitable machines or tools for the right job.

### 3.4.2 Sawdust used for non-construction.

The following are the common use of sawdust for non-construction works; As a wood filler, used to smoke meat or fish, to start up a fire, used to pack fragile goods to avoid damage, and use as organic fertilizer (Kara 2021), for mulching, soil composting and bedding for livestock and poultry (Rominly et al. 2017). It forms Pyrite when mixed with water set to be frozen, its use was to preserve ice frozen during summer in icehouses, "it forms a slow-melting and much stronger form of ice," it is used in aid cleaning of dropped fluids, this enhances easy sweeping or collection of all spilled liquid in an area (Kumar et al. 2014). Despite all these various uses of wood waste, those are yet to meet acceptable use since 90% still end up in landfills as millions of tons are generated virtually every day.

### 3.4.3 Wood waste cement composite uses in building construction.

Wood waste cement composite was tested for construction use long ago. Kumar et al. (2014) reported that the use of sawdust Crete in concrete is over 40 years. Literature also reviewed that it has been used for various construction works apart from concrete. This includes concrete blocks and bricks, particleboards, cladding, partitioning floor panels, and ceiling (Mwango & Kambole 2019).

**Table 5.** Physical Property of Sawdust (Kumar et al. 2014).

| Properties | Value |
|---|---|
| Free swell index | 80 |
| Soil classification | ML |
| Optimum moisture content (%) | 19.80 |
| Maximum dry density (g/cc) | 1.40 |
| Specific gravity | 2.15 |
| Soaked CBR (%) | 2.95 |
| Un-soaked CBR (%) | 5.2 |
| The angle of internal friction | $30^0$ |
| Cohesion C ($KN/m^2$) | 7 |

**Table 6.** The chemical property of Sawdust (Kumar et al. 2014)

| Constituents | Percentage (by Weight) |
|---|---|
| Loss on ignition | 4.76 |
| CaO | 3.50 |
| $SiO_2$ | 87 |
| MgO | 0.24 |
| $Al_2O_3$ | 2.5 |
| $Fe_2O_3$ | 2.0 |

Hassen & Hameed (2020) reported the findings of (Ravindarajah et al. 2001). They studied the partial replacement of sawdust in manufacturing lightweight load-bearing blocks using cement mortar, adding calcium chloride, lime, and fly ash. It was discovered through the result that "up to 12% (by weight) addition of sawdust, the compressive strength of concrete blocks will be above 12.5 MPa (required quality for load-bearing blocks)". Similarly, Cheng et al. (2013) researched the introduction of waste sawdust as a partial substitute of fine aggregate in concrete. The orthogonal test was applied to evaluate heat lagging properties, and heat preservation. In addition, a design mix for the sawdust was applied at a different percentage. The results showed that at 5% sawdust replacement, the compressive strength is liable to meet the C25 concrete grade. The insulation property and heat preservation are also significantly better than traditional concrete. However, an increase in the sawdust content shows a gradual decrease in the compressive strength, wherein there will be a development in the thermal properties. Bdeir (2012) studied the mechanical properties (compressive strength and hardness) of the partial replacement of sand with sawdust cement mortar, using sawdust as a replacement of sand; the author used different designed percentages to replace sand with sawdust at different mix ratios. The author observed and concluded that there is a reduction in hardness values and the compressive strength because of increased higher percentages of sawdust.

Moreira et al. (2012) "studied the possibility of making lightweight concrete blocks by replacing part of the fine aggregate with treated sawdust in two ways: first by washing with an alkaline solution (lime) and the second way by immersing the sawdust in an aluminum sulfate solution." The outcome showed the significant difference in the two methods used to treat: using lime judged with the treatment carried out with aluminum sulfate. Hassen & Hameed (2020) reported the findings of (Abdulla, Salih & Salih 2013), in which they "studied the effect of adding treated sawdust by dam lock material and untreated one on the proportion of Ferro cement as partial replacement of fine aggregate." Dynamic and static loads were evaluated for samples put to the test under thermal conductivity. The outcomes disclosed that the best replacement mix ratio of sawdust for fine aggregate was at 30%; this shows an improvement in thermal conductivity and workability of mortar mixes. Xing et al. (2015) studied the possibility of using poplar sawdust in concrete using the Vibro-compaction method to make the lightweight concrete block. Through partial replacement of sand with sawdust. The mechanical properties, thermal conductivity, and compression strength of concrete blocks were investigated.

Gopinath et al. (2015) investigated the mechanical properties and physical properties of concrete, such as slump test, and compression strength, through partial replacement of the cement with sawdust ash and fine aggregate with sawdust. The results justify using sawdust for habitable buildings' structural members such as beams, finishing, foundations, slabs, columns, and foundations. The significant economic impact is also an advantage.

**Table 7.** B.S.S mesh screening sawdust characteristics.

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| | Sawdust | | | | |
|---|---|---|---|---|---|
| Mode (mm) | 500 | 355 | 250 | 212 | 150 |
| Average particle size (mm) | 153.43 | 205.143 | 1.253 | 1.836 | 298.95 |

**Table 8.** Uses of sawdust in construction

| S/N | Sawdust Composites used in construction | Reference |
|---|---|---|
| **1.** | They are used to produce oriented strand boards (OSBs), plywood, fiberboards, and particleboards. | (Abdulkaree et al. 2017; Atoyebi et al., 2018; Mwango & Kambole 2019). |
| **2.** | Use as floor panels. | (Chanhoun et al. 2018; Cai Senalik & Ross 2021; Mwango & Kambole 2019). |
| **3.** | Used for cladding and partitioning | (Antwi-Boasiako et al., 2018; Chanhoun et al. 2018) |
| **4.** | Used for Mortar Solid, Concrete block or Bricks | (Mangi 2019; Aigbomian & Fan, 2013; Turgut 2007; Turgut & Gumuscu 2013; Hassen & Hameed 2020; Ravindarajah et al. 2001; Awal et al., 2016). |
| **5.** | Use as pozzolana | (Gopinath et al. 2015; Kumar & Kumar 2015; Tamanna et al. 2020; Udoeyo et al. 2006) |
| **6.** | Use as partial replacement of fine Aggregate. | (Cheng et al. 2013; Hassen & Hameed 2020; Bdeir 2012; Moreira et al. 2012; Xing et al. 2015; Gopinath et al. 2015) |

### 3.4.4 Disposal

Abdulkaree, Raji & Adeniyi (2017) reported that massive amounts of sawdust are produced yearly through sawmills processing. The means of disposal of those wood by-products has always been a challenge to the wood industry. This has resulted in a negative impact on the environment and economy.

Conventional means for disposing of sawdust worldwide include open burning, sometimes dumping in landfills, and open dumping. Open burning emits a lot of greenhouse gases into the air. Carbon dioxide, particulate matter, and methane are examples of these compounds commonly connected with air pollution and can cause severe respiratory problems. The conversion of such waste as a building material will help eliminate such pollution within the environment.

## 4. Conclusions, Suggestions, and Further Study.

This study was able to justify some of the properties of wood waste cement composite, looking at the mechanical and physical properties (Fineness, comprehensive strength, setting time, loss on ignition, insoluble residue, specific surface area, flexural, split tensile, and the chemical properties of selected portland cement, also its use as building materials from selected published articles from 2005 to 2021. The findings of this study noted the following:

- In Nigeria, Five (5) cement samples were reported by scholars, while findings noted four (4) of them were seen as frequently available in the Nigerian construction market. It was concluded that all the cement met the minimum requirements of portland cement, wherein Dangote cement had the highest strength of crushing on the $28^{th}$ day. While Diamond cement gained early strength ahead of the other cement.
- Various scholars considered the following mechanical properties; flexural, split tensile, and compressive strengths. Wherein Comprehensive strength was considered most in mechanical property. Findings reveal the impact of adding wood waste ash and crimped steel fibers on the comprehensive strength. 20% and 0.75%, respectively, mix volume was seen as the optimum content volume.
- The physical properties of wood waste were attributed to its behaviour towards external influences apart from applied forces and its elementary characteristics. These include moisture content, density, grain and texture, thermal behaviour, water absorption, slump test value, dimensional stability, etc. The following assumptions were practically agreed on: the more the increase in the amount of sawdust, the lower its workability; the higher the quantity of sawdust in the fresh design mix, the lower the slump tested
- Ten (10) common use of sawdust for non-construction works were identified. Also, six (6) common use of sawdust composites about construction were identified in Table 8, which are: Used in the production of oriented strand boards, plywood, fiberboards, and particleboards; Use as floor panels; Used for cladding and partitioning;Used for Mortar Solid, Concrete block or Bricks; Use as pozzolana; Use as partial replacement of fine Aggregate.

This study is limited to selected articles closely related to the aim and objective of the study. Further research can be conducted to check the fire resistance, moisture absorption rate, and split tensile wood waste composite. Same original study in the area of cement property could be studied in other countries.

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