# EFFECT OF CASSAVA PEELS POWDER AS ADMIXTURE ON COMPRESSIVE STRENGTH OF CONCRETE

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***ABSTRACT***
*This work reports the outcome of an experiment carried out by using Cassava Peel Powder (CPP) as an admixture in concrete by determining the effects of addition of CPP of 0, 0.2, 0.4, and 0.6, %, CPP addition, respectively in cement weight. CPP used was obtained from cassava peel collected from Kara Market in Sokoto state, Nigeria. The peel was cleaned, sun dried and ground into powder in a milling machine. The powder was passed through a sieve 425µm . The concrete mixes of 1: 2: 4 with a water-cement ratio of 0.7. The cubes samples of size 150 x 150 x150 were prepared for concrete grade 30.. The compressive strength of cubes of samples of CPP concrete cured in water were determined at 28 days respectively in accordance to BS 1881, part 116, 1983. The results showed that Cassava peel powder is dominated with oxides of Nitrogen, phosphorous, silicon, sulphur, potassium and complex compounds of starch andcynogenic acid. CPP increases the initial and final setting times of cement paste and could therefore be used as a set retarding admixture. The addition of CPP in concrete decreases the workability of concrete with the same water cement ratio and increase with addition of water ratiowhich shows that it could be used as a water reducing admixture. And also thee compressive strength of concrete with addition of CPP decreases.*

**Keywords:** Admixture, Cassava, Compressive Strength, Peels Powder.

## 1 INTRODUCTION

Building materials account for between 40-60% of the total construction cost (Abalaka, 2011). This is attributed to the fact that basic conventional building materials like cement and aggregates are becoming expensive due to high cost incurred in their processes, production and transportation. The utilization of locally available materials that can either reduce or replace the conventional ones is being investigated. In the same vein, developing nations of the world are challenged with issues of managing domestic and agricultural wastes as a result of the attendant growth in population and increasing urbanization. Re-use of these wastes provide an attractive option that promotes savings and conservation of natural resources from further depletion hence creating a sustainable environment. Solid waste and its resource potential are being appraised for re-use (Amaranth, 2012).

The utilization of cement based products such as mortar and concrete as major building materials is strongly reliant on the construction sector. Concrete, an artificial stone like mass, is the composite material that is created by mixing binding material (cement or lime) along with the aggregate (sand, gravel, stone brick chips, etc), water admixtures etc in specific proportions. The strength and quality are dependent on the mixing proportions. Cement is the most commonly used binding material lime could also be used when water is mixed with the cement, a paste is created that coats the aggregates within the mix. The paste hardens binds the aggregate and form a stone – like substance cement is also defined as a material having adhesive and cohesive properties which make it capable of bonding mineral fragments into a compact mass. Cement can be classified into natural cement and artificial cement or Portland cement (Salau, 2012).

Hahn et al (1988) put cassava peel to amounts for between 10 and 13 percent of the tuber weight. Some 14 million hectares of cassava are grown worldwide, producing 120 to 130 million tones of tuber per annum fifteen countries produce in excess of a million of tones of these the five biggest producers Brazil, Indonesia, Nigeria, Thailand and Zaire each produce more than 10 million tones per annum, and together account for 63% of world output (Umoh, 2012). Admixtures depending on the type may be imported or sourced locally. The imported type are often too expensive and the demand for construction in developing countries like Nigeria is never ending, Hence the demand for building materials like Ordinary Portland Cement (OPC) and admixtures is very higher (Okafor, 2010).

According to Ogunbode et al (2012). The production of these products requires capital intensive plants and expertise. The cost of conventional admixtures is often high, which makes the cost of obtaining durable concrete too high for the common man. In this case, a study will be conducted on cassava peels to see if they have the potential to be used as an admixture in concrete. Which are locally available within the study area and in abundant quantity as a waste product of cassava processing and it is not being used for any other purpose but hipped as garbage so this study intends to put cassava peels to economically viable and environmentally friendly use. It is on this note that this study attempts to assess the potentials of cassava peels powder (CPP) as an admixture in concrete by identifying the procedures in preparing cassava peels powder, to produce concrete with cassava peel powder (CPP) as an admixture, to determine the workability of concrete produce with CPP as an admixture and to determine the compressive strength of the concrete produced with cassava peels powder (CPP) as an admixture samples at 28 days of curing.

## 2.0 LITERATURE REVIEW

### 2.1 Concrete

Concrete is an artificial material used extensively and globally for a long time. Concrete is a composite of coarse aggregate combine with hydraulic paste of cement and water (Salau, et al., 2011). Quality of sand used in the preparation of concrete plays a paramount role in the development of both physical and strength properties of the resultant concrete. Water, cement, fine aggregates, coarse aggregates and any admixtures used should be free from harmful impurities that negatively impact on the properties of hardened concrete. Sand is one of the normal natural fine aggregates used in concrete production (Sandanayake et al., 2020). Aggregate are inner granular material such as sand, gravel, or crushed stone that, along with water and Portland cement are essential ingredient in concrete (Mark et al., 2010).Despite that aggregate is a filler material, but it has very valuable role in producing a concrete properties such as durability, workability, tensile strength and compressive strength. The type and properties of fine and coarse aggregate have great effect on the hardened concrete performance, because it consist a large percentage of concrete volume (Zhang, 2011). A good quality concrete is essentially a homogeneous mixture of cement, coarse and fine aggregate, and water which consolidate into a hard mass due to chemical action between the cement and water. Each of the four constituent has a specific function, the fine aggregate fills up the voids between the paste and the coarse aggregate. The cement in conjunction with water act as a binder. The mobility of the mixture is aided by the cement paste, fines and nowadays, increased by the use of admixtures.

#### 2.1.1 Compaction of Concrete

Aluko et al., (2020) reported that after a concrete has been mixed, a large voids occurred due to entrapped air and shape of the aggregates, the objective of compaction is to get rid of the entrapped air voids. However, before compaction, concrete with a 75mm slump may contain 4% entrapped air, while concrete with a 25mm slump may contain as much as 20%, during the manufacture of concrete, considerable quality of air is entrapped and during the transportation there is possibility of partial segregation taking place if the entrapped air is not removed and the segregation of coarse aggregate not concrete may be porous, non homogeneous and reduction in strength.

### 2.2 Aggregates

The aggregates normally used for concrete production are natural deposits of sand and gravel, where available, some localities, the deposits are hard to obtain and large rocks must be crushed to form aggregate. Crushed aggregates usually cost much to produce and will require more cement paste because of its shape. More care must be taken in handling crushed aggregates to prevent poor mixture and improper dispersion of the size through the finished concrete. At times, artificial aggregates, such as blast furnace slag or specially burned clay are used.

#### 2.2.1 Fine Aggregate

These are material that would pass through No.4 sieve and will for the most part be retained on a No. 200 sieve. For increased workability and for economy as reflected by use of less cement, the fine aggregate should have a rounded shape. The purpose of the fine aggregate is to fill voids in the coarse aggregate and to act as a workability agent (Aluko, 2020).

### 2.2.2 Coarse Aggregate

Coarse aggregate is a material that will be retained on the international system of ive 4.75mm as with fine aggregate, for increased workability and economy, as reflected by the use of less cement. Coarse aggregate should have a rounded shape even though the definition limits the size of which other considerations must be accounted for. When these aggregates are properly proportioned and mixed with cement, they yield an almost void less stone that is strong and durable (Aluko, 2020).

### 2.3 Cement

This is like a binder, a substance that set and hardens independent, and can bind other materials together. Cements are of different types i.e. cements used in construction industries are characterized as hydraulic and non-hydraulic cement. Hydraulic cement (Portland cement) harden because of hydration, chemical reactions. That occur independently of the of water content; they can harden even under water or when constantly exposed to wet weather. The chemical reaction that results when the anhydrous cement powder is mixed with water produces hydrates that are non- water-soluble.

### 2.3.1 Chemical Properties of Cement

Cement contains multiple ingredients as its raw material like lime, silica, alumina, iron oxide etc. These ingredients interact with one another in the kiln during the manufacturing process and make a complex compound (Cement). The concrete or mortar should be recognized as best, if the chemical composition of the cement is well proportioned.

### 2.4 Water

Water is an important ingredient in concrete mixture and its quality has a vital influence on the strength of concrete. Combining water with a cementitious material forms a cement paste by the process of hydration. The cement pastes glues the aggregate together, fill the voids within it and allows it to flow more freely. Less water in the cement paste will yield a stronger more durable concrete; more water will give a free-floating concrete with a higher slump. Impure water used to make concrete can cause problem when setting or causing premature failure to the structure.

### 2.5 Curing of concrete

Since many of the properties of Aerated concrete depend upon the successful process of curing, outlined below are some of the methods whereby its strength can be increased. This is probably the easiest and most popular method of curing. It is a slow, but acceptable system which enables a turnaround of moulds every 24 hours on average, depending on the ambient temperature. When precast erected concrete panels and slabs are made under factory conditions in order to obtain a relatively fast turn-around of moulds, it may be economic to induce an early strength into the concrete by applying heat from steam to the underside of the moulds. This causes a rise in temperature in the concrete and a resulting increase in strength (Aluko, 2020).

### 2.5 Admixture

The relevance of cement in cement based building construction was highlighted by Neville (2003). He defined admixtures as a chemical production that is added to the concrete mix in quantities not exceeding 5% by mass of cement during mixing or during an additional operation prior to placing concrete for the purpose of achieving a specific modification, or modifications, to the normal proportion of concrete, except in exceptional circumstances. However, the amount of admixture used is determined by the type of concrete and the desired impact. Admixtures can improve the quality of concrete by accelerating or delaying the setting period, increasing frost and sulphate resistance, controlling strength development, improving workability, and improving finish ability.

## 3.0 MATERIALS AND METHOD

Materials are substance or mixture of substances that constitutes an object. Materials can be pure or impure. While methods are the procedures and techniques that are used during the building process. Below are the materials to be use in carrying out the research work.

**3.1 Cement:** The cement use in this research is ordinary Portland cement of brand produced by Sokoto Cement (Nig).

**3.2 Fine aggregate**: is naturally occurring clean, sharp sand which is collected from River area of Wamakko Local Government Area, Sokoto State.

**3.3 Coarse aggregate**: The course aggregate is crushed granite which is obtained from a supplier at Arkilla Area of Sokoto State. The nominal size of the crushed granite is 0mm.

**3.4 Cassava peel powder:** The cassava peel is obtained from cassava tuber as waste which is collected from Kara market of Sokoto State.The peels were obtained, cleaned and dried under sun. The dried peels were ground by a milling machine. The powder passed through a sieve of 425 micro umce. The absolute weight technique is followed to concrete blend percentage for 1:2 four. Mix with a water –cement ratio zero.7, cassava peel powder (CPP) of 0%, 0.2%, 0.4%, 0.6% by weight of cement at 0.4% increments were added to the concrete mix. The workability of the fresh concrete is determined and thereafter cast in 150mm × 150mm × 150mm moulds. Each mould is tampted in order to avoid voids in the cubes. And therefore demoulded after 24 hours and samples cured in water for 28 days, respectively before testing for compressive strength. A total of 12 cubes comprising 3 cubes for each percentage is produced.

### 3.5 Workability Test

The slump test is used to measure the workability and assess the consistency of fresh concrete. Generally, the slump test is used to check that the correct volume of water has been added to the mix.

#### 3.5.1 Procedure

First of all smooth the inner floor of the mold and observe oil, the mildew is region on a clean horizontal non-porous base plate, fresh provided conctere is poured into the cone to more or less on 0.33 of its depth (one hundred ml), the concrete is introduced to fill the cone to approximately thirds depth (some other 200mm of concrete), the cone is crammed to the pinnacle and tamed the usage of the very last 25 strokes with the metallic rod, the floor of the cone is stage with trowel to dispose of the extra concrete, the cone is cautionusly eliminated in vertical direction and the droop is measured right now with the aid of using flguring out the distinction among the peak of the mildew and that of the best factor of the specimen being tested.

### 3.6 Compressive Strength

Compressive strength of the concrete cubes test provides an idea about all the characteristics of the concrete. By this single test, one can observe weather the concrete has been done properly or not. Concrete compressive for general construction varies from 15MPa (2200psi) to the 30 MPa (4400psi) and higher in commercial and industrial structure.

#### 3.6.1 Procedure

The concrete cubes are removed from the drying tank after 28 days and wipe out excess water from the surface, the cubes were weighed and then place in the machine in such a manner that the load do not applied to the opposite sides of the cubes cast, the specimen is aligne centrally on the base plate of the machine, the moving part of the machine is swiveled gently by hand to touch the top surface of the sample and the load is applied progressively at the speed of 140kg/cm$^2$/ min.

## 4.0 RESULTS AND DISCUSSION

### 4.1 Slum Test for concrete

The results of the slump test on concrete with varying percentage of CPP as admixture in concrete.

Table 1

| CPP Content | Slump (mm) | W/C | SIZE OF CONE |
|---|---|---|---|
| 0 | 76 | 0.7 | 30 X 20 X 10 |
| 0.2 | 46 | 0.7 | 30 X 20 X 10 |
| 0.4 | 45 | 0.7 | 30 X 20 X 10 |
| 0.6 | 48 | 0.75 | 30 X 20 X 10 |

Source: Lab Work (2022)

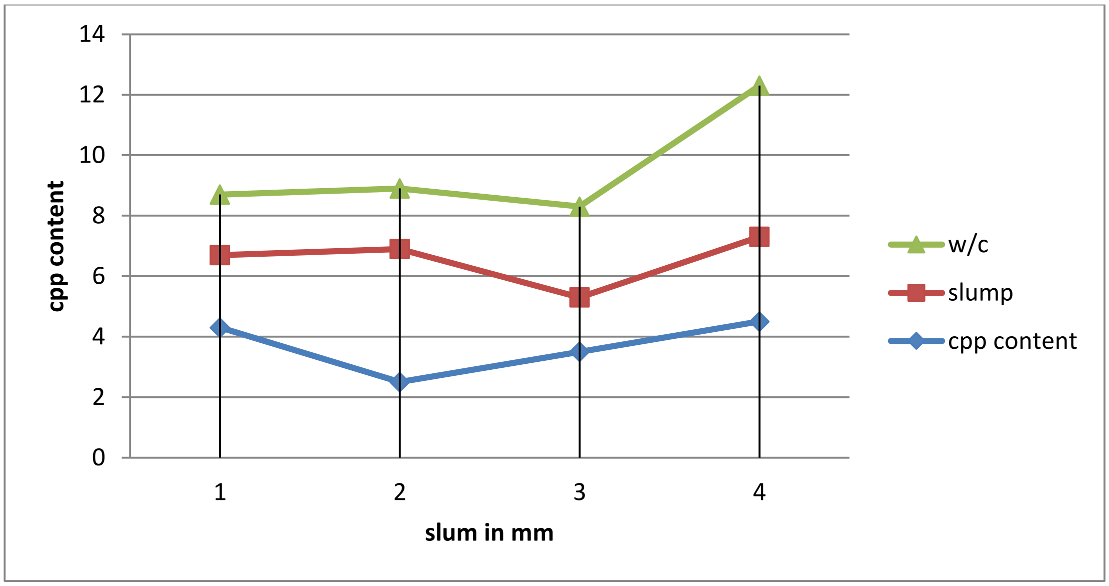


Fig 1 showing the result of slum test

### 4.2 Compressive Strength

The result of compressive strength of concrete for various dosage of CPP in concrete cured in water for 28 days and crushed in the laboratory are presented bellow;

Table 2

| % of Admixture | Average Weight (g) | Average Volume (Cm^3) | Average Density (g/cm^3) | Average Load(f) @ Failure (KN) | Average Strength N/mm^2 |
|---|---|---|---|---|---|
| 0 | 7816 | 15 | 2.32 | 856.03 | 38.04 |
| 0.2 | 7486 | 15 | 2.2 | 16.69 | 0.75 |
| 0.4 | 7291 | 15 | 2.1 | 14.44 | 0.65 |
| 0.6 | 7024 | 15 | 2.08 | 13.19 | 0.59 |

Source: Lab Work (2022)

### 5.0 CONCLUSION

The compressive strength of concrete for various dosage of cassava peel powder (CPP) in concrete cured in water for 28 days shows compressive strength with increase in percentage level of CPP, decreases in compressive strength. There is difference in strength of concrete containing CPP with that of control at 28 days of curing. The average weight of 0% is 7816g, 0.2% is 7486g, 0.4% is 7291g, and 0.6% is 7024g decreases with level dosage of CPP. The average volume of all the percentages is 15cm$^3$. The average density of all the percentage level of CPP decreases. The average density of 0% is 2.32g/cm$^3$, 0.2% is 2.2g/cm$^3$, 0.4% is 2.1g/cm$^3$, and 0.6% is 2.08g/cm$^3$. Average load failure decreases with each percentage of CPP. The load (f) failure (KN) of 0% is 856.93, , 0.2% is 16.69, 0.4% is 14.44 and 0.6% is 13.19. The average strength of 0% is 38.04N/mm$^2$, 0.2 is 0.75N/mm$^2$, 0.4% is 0.65N/mm$^2$, 0.6% is 0.59N/mm$^2$. This shows that the average strength of concrete with addition of CPP is much lower than that of control which indicates that it can't resist load.

The following conclusion stands out: Cassava bark powder is dominated by elements of nitrogen, phosphor, silicon, sulfur, potassium and complex compounds of starch and cynogenic acid, the cassava peel powder is dominated by. CPP increases the initial and final setting times of cement paste, thus could be used as a set retarding admixture, adding CPP in concrete decreased the workability and compressive strength of concrete therefore be used as a water reducing admixture.

### 5.1 RECOMMENDATIONS

From the findings recommendations are drawn as follows:

1. The slump diminishes with the addition of cassava peel powder at the same water ratio and increase with the addition of water ratio indicating that cassava peel powder consumes more water and is safe to use as a relative additives.
2. Due to a budgetary issue the curing period is extended to 28 days however, I would like to recommend
3 Anyone interested in conducting the same research to cure for 7, 14, 21, 28. Or more days in order to get the result indicated above.
4 The compressive strength of add mixture concrete diminishes and is lower than that of the controlled concrete. This is not recommended for use in concrete because it weakens it.
5 According to some studies cassava peel ash can be used as an additive or partial replacement for cement in concrete because it has the same chemical oxide as cement, despite the fact that the chemical oxide of cassava peel ash is lower. I would advise anyone interested in conducting this research on this to do so in other to have a compelling justification and see whether it can be used in construction.

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