Sub-Sahara African Academic
Research Publications
September, 2022 Editions

JAAS
Journal of African Advancement & Sus. Studies
Vol.25, No.2, ISSN: 3125-5521

DETERMINATION OF COMPRESSIVE STRENGTH OF CONCRETE USING DIFFERENT BRANDS OF CEMENT IN MAIDUGURI, BORNO STATE.

***AHMED TIJANI GUBIO; **ALHAJI BUKAR AJI; *ZARA KYARI KOLO; & *YAKUBU BUNU MELE**

**Department of Civil Engineering, Ramat Polytechnic, Maiduguri, Borno State, Nigeria. **Department of Civil Engineering, Federal Polytechnic, Damaturu, Yobe State, Nigeria.*

ABSTRCT

This project is aimed at determining the compressive strength of concrete using different brands of cement purchased in the open market in Maiduguri. The brands of cement used were Bua, Dangote Block Master, Dangote 3×, Dangote Falcon, Ashaka Elephant Supaset, Ashaka (Ordinary). A mix ratio of 1:2:4 was used and concrete cubes cast were cured and crushed at 7, 14 and 28 days interval respectively. The result obtained after crushing the concrete cubes was used to calculate the average compressive strength of concrete for each ordinary Portland cement. The results of compressive strength of concrete for various brands of cement using different brands were compared. The result shows that Bua Portland cement has the highest value of compressive strength value, followed by Dangote Block Master, Ashaka Elephant Supaset, Dangote 3×, Ashaka (ordinary) and finally Dangote Falcon with the least. Although the cost of each brand of cement varies, selecting to optimize cost should

Keywords: *compressive strength, Portland cement.*

INTRODUCTION

Concrete is one of the world's most widely used materials. The strength of concrete is highly dependent on the quantity of cement in the mixture of cement, aggregate and water to form concrete. Therefore, the study of the different brands of cement would lead to user making a good choice in selecting the best cement that suit their needs. For instance, in a block making industry or during rainy season, a rapid hardening cement would be more preferable at that time in order to allow for the concrete to set fast before it is affect by water while a normal setting cement would be preferred during dry/hot season because of rapid setting enhanced by high evaporation at that time. So, the knowledge of the properties of cements cannot be overemphasized.

This project was inspired by producers of interlock and block industries as there were new cement brands introduced in the market and laymen were confused with which brand to use for what purpose economically to maintain reasonable profit. Therefore, this lead to determine the compressive strength of concrete using different brands of cement in the concrete and maintaining the same mix ratio and water/cement ratio in our batching.

LITERATURE REVIEW

Fehlinhg, E. *et al.* (2015). Ultra High Performance Concrete (UHPC) is a new cement-based material developed in the era of modern concrete technology. The presence of fiber in UHPC composition is necessary to increase strengths and durability, which then lead to name the material as Ultra High Performance Fiber Reinforced Concrete (UHPFRC). However, the exact determination of UHPC and UHPFRC has challenges due to its very high compression strength. Some issues are the limited capability to purchase high load capacity testing machines, and the surface preparation requirement for cylinder specimens. In this study, three series of experimental programs were conducted to investigate the compressive strength of UHPC and UHPFRC using cylinder and cube specimens, and to determine its converting factors (ratio). The results show that the compressive strength relationships between specimens differ from those of conventional concrete.

Jada, D.T. *et al.* (2015). Concrete is regarded as the most used construction material and natural aggregates used in concrete must be preserved by any acceptable means. This paper presents the results; compressive strength and tensile strength, of using Recycled Concrete Aggregate (RCA) and Crushed Clay Brick (CCB) as partial replacements for coarse and fine aggregates respectively in concrete. Three factors: RCA, CCB and CD were considered and combined at different levels of replacement in the determination of the compressive and tensile strength of concrete. The Response Surface Methodology (RSM) was used to determine the combination of these factors. RCA was used at 30%, 22.5% and 15% representing the high, middle and low replacement levels. Similarly, CCB was replaced at 20%, 15% and 10% which represents the high, middle, and low level respectively. CD was set to 28, 18 and 7 days representing the high, middle and low level. 20 combination set was generated using the RSM. It was found that RCA and CCB included concrete gains compressive strength faster within the first 7 days than the Normal Aggregate Concrete (NAC) but may not gain much more strength afterwards.

Ekolu S. O. (2018). This paper reports an experimental study conducted to asses durability characteristics of concretes made using different types of recycled aggregates. Different types of recycled coarse aggregates comprising natural dolomite (DOL), crushed concrete (RCA), recycled rubble (RUBL) and brick (BRIC) were studied using concrete mixtures of water-cement ratios (w/c) = 0.60 and 0.45 containing 100% of the recycled stone. The same type of crushed natural sand was used in all the mixtures. In addition to compressive strength and workability, water sorptivity and oxygen permeability (K) properties of the concretes were measured. It is found that the recycled aggregates showed higher porosity than the control crusher dolomite aggregate. Oxygen permeability results of the recycled aggregate concretes were of the same order of magnitude, giving about K = 2.0 x 10-10 m/s. Recycled brick aggregates produced concretes of consistently higher permeability and water sorptivity than the others. The oxygen permeability values for the various recycled aggregate concretes increased in the order kDOL < KRCA < KRUBL < KBRIC. Permeability of brick aggregate concrete was four times higher than that of control dolomite concrete. The relatively adverse influence of recycled brick on concrete properties is attributed to its highly porous characteristics.

Hassan, M. E. (1994). A comprehensive experimental study was carried out to investigate the engineering properties of high strength concrete in the range of 10,000 to 15,000 psi. The study included the determination of the uniaxial compressive strength, static modulus of elasticity, tensile strength, flexural strength, stress distribution parameters and Whitney block assumption and temperature rise of high strength concrete due to chemical reaction. The concrete was produced by using silica fume, locally available aggregate, cement type I, super plasticizers and retarders. Three concrete mix designs were obtained from ready recipes and tests were carried out at six different ages. Test results were compared with ACI code formulas for predicting modulus of elasticity and modulus of rupture for low strength concrete by using uniaxial compressive strength. Also, results were compared with existing data concerning the modulus of elasticity for high strength concrete and the tensile strength for low strength concrete. Experimental results are presented and discussed along with SHORT AND LONG TERM PROPERTIES OF HIGH STRENGTH CONCRETE: previously established relations for relations for normal strength concrete. Recommendations and conclusions are made for different relations and measurements

Materials and Method

Materials:

Cement: The cement used for the research was from five different brands purchased from the market, which includes:

i. Bua Cement
ii. Dangote block master Cement
iii. Dangote falcon Cement
iv. Dangote 3X Cement
v. Ashaka Supaset Cement
vi. Ashaka Cement

Aggregate: Alau River sand was used as fine aggregate while crushed stones was used as coarse aggregate in concrete mix.

Water: Potable water was obtained from a borehole in the department of Civil Engineering Technology for use in mixing and curing of concrete.

Equipments:
Those used for casting concrete includes:
i. Mould for casting concrete into cubes,
ii. Weighing balance for batching cement and aggregate,
iii. Measuring cylinder to determine water cement ratio,
iv. Tamping rod for compacting concrete,
v. Shovel for mixing concrete,
vi. Head pan for measuring aggregate and cement,
vii. Curing tank for curing concrete,
viii. Universal crushing machine for measuring the compressive strength of concrete.

Methods

Mix Proportions

The nominal mix ratio used in this project was 1:2:4 (i.e. cement: fine aggregate: coarse aggregate) and a water/cement ratio of 0.6.
The concrete to be cast generally for all brands of cement must have the same mix ratio of 1:2:4, and placed in a 150mm × 150mm ×150mm moulds. The source of water and aggregate must also be the same in order to vary only the cement used.
Batching by weight was carried out as follows:

- Coarse aggregate - 40 kg
- Fine aggregate - 20 kg
- Cement - 10 kg
- Water - 6 litres

Casting, Curing and Testing of Specimen

After measuring the above, hand mixing was employed thoroughly to ensure good mix. The wet concrete was then place and compacted in the mould in three layers with 25 blows each using a tamping rod. A total of 54 cubes were cast with each brand having 9 cubes for each. After 24 hours, the cast concrete are removed from the mould and placed into a curing tank. After 7, 14and 28 days, 3 concrete cubes for each brand of cement are removed from the curing tank and allowed to dry before crushing to obtain the compressive strength of the cube specimens.

ANALYSIS OF RESULTS

ASHAKA SUPASET

S/No.	Production Date	Crushing Date	Concrete Weight (kg)	Crushing Load (kN)	Compressive Strength (N/mm^2)	Average Strength (N/mm^2)	Cube Density (kg/m^3)	Cube Age (Days)
1	12/3/2019	19/3/2019	9.4	405	18.0		2785	7
2	12/3/2019	19/3/2019	9.4	405	18.0	16.44	2785	7
3	12/3/2019	19/3/2019	8.7	300	13.3		2578	7
1	12/3/2019	26/3/2019	8.3	520	23.1		2459	14
2	12/3/2019	26/3/2019	8.5	530	23.6	21.48	2519	14
3	12/3/2019	26/3/2019	8.4	400	17.8		2489	14
1	12/3/2019	2/4/2019	8.5	530	23.6		2519	28
2	12/3/2019	2/4/2019	8.6	545	24.2	24.22	2548	28
3	12/3/2019	2/4/2019	8.9	560	24.9		2637	28

ASHAKA (ORDINARY)

S/No.	Production Date	Crushing Date	Concrete Weight (kg)	Crushing Load (kN)	Compressive Strength (N/mm^2)	Average Strength (N/mm^2)	Cube Density (kg/m^3)	Cube Age (Days)
1	13/3/2019	20/3/2019	8.6	295	13.1		2548	7
2	13/3/2019	20/3/2019	8.7	390	17.3	16.81	2578	7
3	13/3/2019	20/3/2019	9.3	450	20.0		2756	7
1	13/3/2019	27/3/2019	9.1	490	21.8		2696	14
2	13/3/2019	27/3/2019	8.6	400	17.8	19.11	2548	14
3	13/3/2019	27/3/2019	8.6	400	17.8		2548	14
1	13/3/2019	3/4/2019	8.1	500	22.2		2400	28

2	13/3/2019	3/4/2019	9	445	19.8	20.67	2667	28
3	13/3/2019	3/4/2019	8.5	450	20.0		2519	28

DANGOTE BLOCK MASTER

S/No.	Production Date	Crushing Date	Concrete Weight (kg)	Crushing Load (kN)	Compressive Strength (N/mm^2)	Average Strength (N/mm^2)	Cube Density (kg/m^3)	Cube Age (Days)
1	15/3/2019	22/3/2019	8.2	410	18.2		2430	7
2	15/3/2019	22/3/2019	8.2	410	18.2	17.93	2430	7
3	15/3/2019	22/3/2019	8	390	17.3		2370	7
1	15/3/2019	29/3/2019	8.4	450	20.0		2489	14
2	15/3/2019	29/3/2019	8.4	450	20.0	18.67	2489	14
3	15/3/2019	29/3/2019	8	360	16.0		2370	14
1	15/3/2019	5/4/2019	9.2	650	28.9		2726	28
2	15/3/2019	5/4/2019	8.2	550	24.4	26.07	2430	28
3	15/3/2019	5/4/2019	8.5	560	24.9		2519	28

DANGOTE 3X

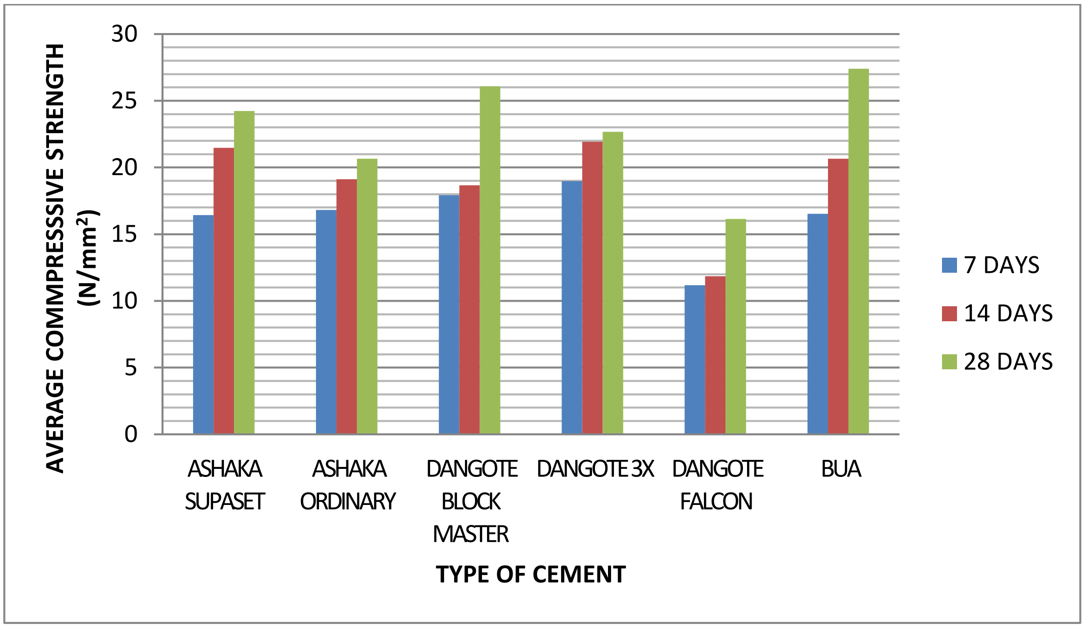
S/No.	Production Date	Crushing Date	Concrete Weight (kg)	Crushing Load (kN)	Compressive Strength (N/mm^2)	Average Strength (N/mm^2)	Cube Density (kg/m^3)	Cube Age (Days)
1	16/3/2019	23/3/2019	8.3	405	18.0		2459	7
2	16/3/2019	23/3/2019	8.9	466	20.7	18.98	2637	7
3	16/3/2019	23/3/2019	8.5	410	18.2		2519	7
1	16/3/2019	30/3/2019	8.6	510	22.7		2548	14
2	16/3/2019	30/3/2019	8.3	460	20.4	21.93	2459	14
3	16/3/2019	30/3/2019	8.6	510	22.7		2548	14
1	16/3/2019	6/4/2019	8.1	510	22.7		2400	28
2	16/3/2019	6/4/2019	8.2	530	23.6	22.67	2430	28
3	16/3/2019	6/4/2019	8.4	490	21.8		2489	28

DANGOTE FALCON

S/No.	Production Date	Crushing Date	Concrete Weight (kg)	Crushing Load (kN)	Compressive Strength (N/mm^2)	Average Strength (N/mm^2)	Cube Density (kg/m^3)	Cube Age (Days)
1	17/3/2019	24/3/2019	8.1	225	10.0		2400	7
2	17/3/2019	24/3/2019	8.1	260	11.6	11.19	2400	7
3	17/3/2019	24/3/2019	8	270	12.0		2370	7
1	17/3/2019	31/3/2019	8.2	260	11.6		2430	14
2	17/3/2019	31/3/2019	8.2	290	12.9	11.85	2430	14
3	17/3/2019	31/3/2019	8.3	250	11.1		2459	14
1	17/3/2019	7/4/2019	8.5	370	16.4		2519	28
2	17/3/2019	7/4/2019	8.5	360	16.0	16.15	2519	28
3	17/3/2019	7/4/2019	8.5	360	16.0		2519	28

BUA

S/No.	Production Date	Crushing Date	Concrete Weight (kg)	Crushing Load (kN)	Compressive Strength (N/mm^2)	Average Strength (N/mm^2)	Cube Density (kg/m^3)	Cube Age (Days)
1	20/3/2019	27/3/2019	9.2	405	18.0		2726	7
2	20/3/2020	27/3/2019	8.7	355	15.8	16.52	2578	7
3	20/3/2021	27/3/2019	8.7	355	15.8		2578	7
1	20/3/2023	3/4/2019	8	430	19.1		2370	14
2	20/3/2024	3/4/2019	8.4	455	20.2	20.67	2489	14
3	20/3/2025	3/4/2019	8.5	510	22.7		2519	14
1	20/3/2027	17/4/2019	8.5	670	29.8		2519	28
2	20/3/2028	17/4/2019	8.7	660	29.3	27.41	2578	28
3	20/3/2029	17/4/2019	8.5	520	23.1		2519	28



From the histogram above, the trend shows 7 days compressive strength is lowest at each cement brand and the trend increases up to 28 days. Bua cement shows it has the height compressive strength at 28 days but not at the early days especially at 7 days.

CONCLUSION

In conclusion, the determination of the compressive strength of concrete using six brands of cement shows Bua Portland cement brand has the highest value of compressive strength value, followed by Dangote Block Master, Ashaka Elephant Supaset, Dangote 3×, ordinary Ashaka and finally Dangote Falcon with the least. Although the cost of each brand of cement varies, selection to optimize cost should be considered.

REFERENCE

British Standards Institution (BSI) (1986), BS 3148:1986 Method of test for water for making concrete, BSI, London.

British Standards Institution (BSI) (1983), BS 1881: Part 108, 1983, Method of making teat cubes from fresh concrete, BSI, London.

British Standards Institution (BSI) (1983), BS 1881: Part 111, 1983, Method of normal curing of test specimen, BSI, London.

Ekolu S. O. (2018). *Permeation properties of recycled concretes containing various types of recovered aggregates*.

Fehlinhg, E., Ismail, M. and Kusamawardaningsih, Y. (2015). *UHPC Compressive Strength Test Specimens: Cylinder or Cube?*, by Elsevier Ltd. DOI:10.1016/j.proeng.2015.11.165

Hassan, M. E. (1994). *Short and long term properties of high strength concrete*. University of Dayton

Jada, D.T., Momoh, G. O., Shanmugam, T. and Sundaram, H. (2015). *Influence of Recycled Concrete Aggregate and Crushed Clay Bricks on Mechanical Properties of Concrete.* The Inter ational Institute for Science, Technology and Education (IISTE).

Neville, A. M. (1995). *Properties of concrete*. Fifth Edition. Pearson Education Limited. pp. 2025-2035