Research Article

OMICS International

***Corresponding author:** Mambou Ngueyep Lu5olroy, Laboratory of Material Sciences, Department of Physics, Faculty of Sciences, University of Yaoundé 1, P.O.BOX 812 Yaoundé, Camroon, Tel: +237697419489; E-mail: mambouluclroy@gmail.com

Received March 03, 2017; **Accepted** March 09, 2017; **Published** March 16, 2017

Citation: lroy MNL, Molay TGG, Joseph N, Colince FM, Bienvenu NJM (2017) A Comparative Study of Concrete Strength Using Metamorphic, Igneous, and Sedimentary Rocks (Crushed Gneiss, Crushed Basalt, Alluvial Sand) as Fine Aggregate. J Archit Eng Tech 6: 191. doi: 10.4172/2168-9717.1000191

Citation: Leroy MNL, Molay TGG, Joseph N, Colince FM, Bienvenu NJM (2017) A Comparative Study of Concrete Strength Using Metamorphic, Igneous, and Sedimentary Rocks (Crushed Gneiss, Crushed Basalt, Alluvial Sand) as Fine Aggregate. J Archit Eng Tech 6: 191. doi: 10.4172/2168-9717.1000191

concrete using metamorphic, volcanic and sedimentary rocks (crushed gneiss, crushed basalt and alluvial sand) as ne Aggregate. Economical study is also presented.

is report describes work that is aimed at improving the understanding of the role of ne aggregates in concrete. e variables considered are aggregate type, aggregate cost, and aggregate content in normal and high-strength concretes.

e cement used is a Portland cement composed of CPJ CEM II/A class 42.5 R. is is CIMAF's cement (Cement of Africa) produced and marketed in Cameroon. Its physico-mechanical characteristics are given in Table 1.

e water used for the mixing of di erent concrete comes from Cameroon's water (CDE). e water is supposed to be potable and contains no harmful impurities. It is therefore very useful for making concrete.

ree types of sands with the same size range (0/5) were used in this work. Two coming from quarry sands and other from River Sanaga (alluvial sand). River Sanaga is the longest river in Cameroon, about 918 Km of length. Concerning quarry sands, one comes from an industrial quarry located in Bamougoum, western region of Cameroon, which exploits a rock mass of magmatic origin (Basalt) and the other comes from an industrial quarry Located in Eloumdem, a locality in the central region of Cameroon which exploit a rock mass of metamorphic origin (Gneiss). ese quarry sands are respectively denoted SB for basalt and SG for gneiss. e main physical properties of these sands are shown in Table 2.

In order to make our concrete, we used coarse aggregates from gneiss with fractions (5/15) and (15/25). ese crushed stones originate from an industrial quarry exploited in Eloumdem, Some of their properties are summarized in Table 3.

e observations of thin section of gneiss and basalt rocks permit us to know the various minerals that these sands contain.

e methodology for the formulation of concrete is the Dreux-Gorisse method [8]. We choose to make concretes with the characteristics contained in Table 4.

e density was determined according to the standard norm (NF EN 12350-6, 1999) [9].

e workability of the concrete is evaluated by using the Abrams cone, according to the standard norm (NF EN 12350-2, 1999) [10].

Strength of concrete is commonly considered as the most valuable property in Portland cement concrete. Although in many practical cases other characteristics such as durability and permeability may in fact be more important. Nevertheless, strength usually gives an overall picture of the quality of concrete because strength is directly related to the structure of the hydrated cement paste. Moreover, the strength of concrete is almost invariably a vital element of structural design [11].

Compressive strength of concrete is commonly considered to be its most valued property, although in many practical cases, other characteristics, such as durability, impermeability and volume stability, may be more important. Moreover, compressive strength usually gives an overall picture of the quality of concrete.

e simple compressive strength of the concrete was determined on 12 × 16 cm cylindrical specimens. e test is carried out according to

Citation: Leroy MNL, Molay TGG, Joseph N, Colince FM, Bienvenu NJM (2017) A Comparative Study of Concrete Strength Using Metamorphic, Igneous, and Sedimentary Rocks (Crushed Gneiss, Crushed Basalt, Alluvial Sand) as Fine Aggregate. J Archit Eng Tech 6: 191. doi: 10.4172/2168-9717.1000191

Citation: Leroy MNL, Molay TGG, Joseph N, Colince FM, Bienvenu NJM (2017) A Comparative Study of Concrete Strength Using Metamorphic, Igneous, and Sedimentary Rocks (Crushed Gneiss, Crushed Basalt, Alluvial Sand) as Fine Aggregate. J Archit Eng Tech 6: 191. doi: 10.4172/2168-9717.1000191

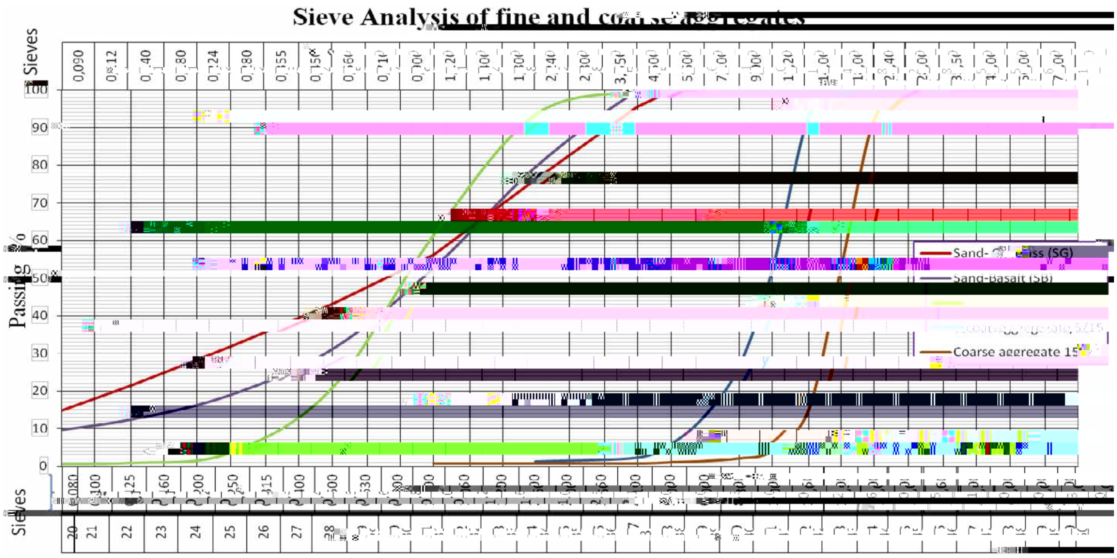


Figure 4: Sieves analysis of aggregates (fnes and coarse).

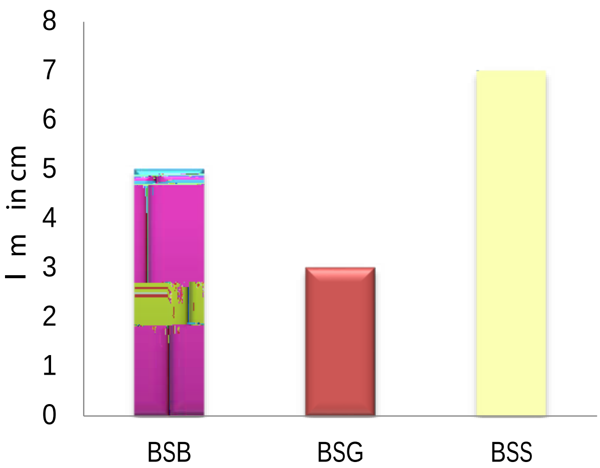


Figure 5: Workability of fresh concrete.

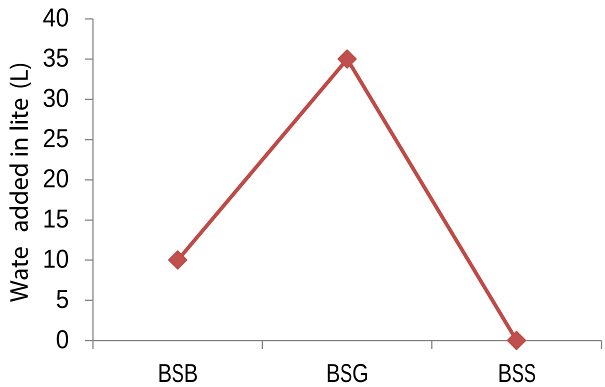


Figure 7: Water dosage for each type of fresh concrete for a cubic meter.

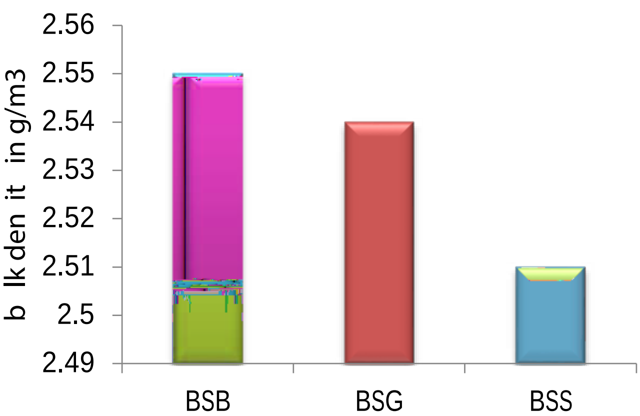


Figure 6: Density of different fresh concrete type.

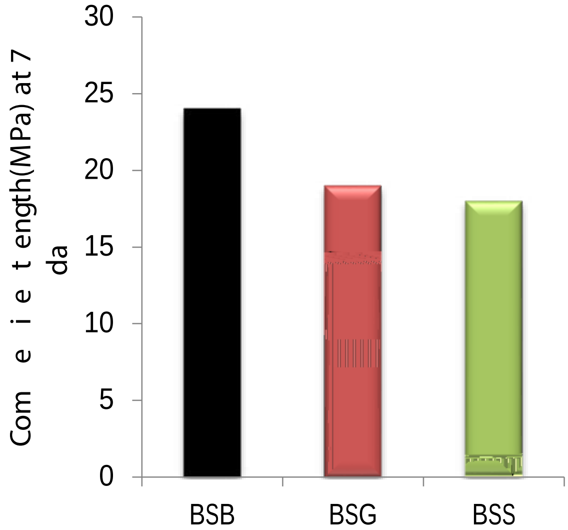


Figure 8: Compressive Strength at 7 days.

Citation: Leroy MNL, Molay TGG, Joseph N, Colince FM, Bienvenu NJM (2017) A Comparative Study of Concrete Strength Using Metamorphic, Igneous, and Sedimentary Rocks (Crushed Gneiss, Crushed Basalt, Alluvial Sand) as Fine Aggregate. J Archit Eng Tech 6: 191. doi: 10.4172/2168-9717.1000191

and opaque minerals (7 to 10%). On the other hand, a macroscopic observation of SS sand reveals that it is of terrigenous sedimentary origin and contains quartz (more than 90%) and micas (Figures 2 and 3).

e geotechnical results carried out at the National Laboratory of Civil Engineering (LABOGENIE) on these di erent sands showed that: the crushed sands SB and SG are slightly clean sands (ES=65,15 for SB and ES=75,30 for SG); ey have respectively a percentage of nes of 7.9% (maximum content for concretes of current grade according to the standard relating to this grade) and 10.5%; e alluvial sand SS is a very clean sand (ES=96.98) having almost no nes (0.3%) (Tables 2, 5 and Figure 5). ese results show that quarry sands have very high nes and are less clean than alluvial sands (Table 5).

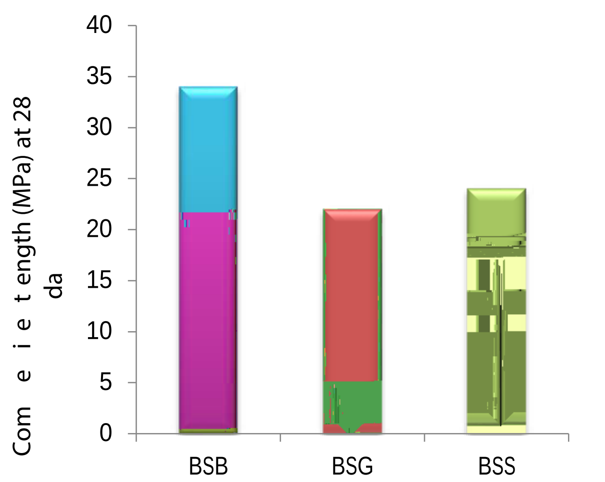
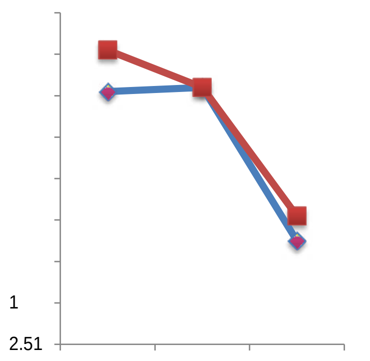


Figure 9: Compressive Strength at 28 days.



Using the DREUX GORISSE formulation method, we made six concrete test pieces for each sand. Following these formulations, we subjected these specimens to the uniaxial mechanical compression test at 7 and 28 days (Tables 4 and 6).

e results of the study of the properties of fresh concrete revealed that the alluvial sands of the Sanaga are very malleable compared to SG and SB sands. Nevertheless SG sand is more malleable than crushed SB sand, because of its very angular shape. In addition to malleability, concretes made with quarry sands SB and SG have higher densities (fresh and hardened) than that of SS alluvial sand. is is explained on one hand by the shape of the grains and on the other by the intrinsic characteristic of each sand (Figures 5 and 6). Indeed, the crushed SB sand is formed from very angular sand grains, which allows a very good bonding granulate-binder Moreover, these sand quarries contain enough nes to ll almost all the inter-granular voids and thus make the concrete more compact. In contrast, the alluvial sand has a blunted shape and has very few nes; which limits a good bonding-aggregate bond and makes the concrete not very compact. In addition these sands quarries are constituted of very dense minerals and having high densities compared to the alluvial sand (Figure 6).

e compressive strength at 28 days of the concretes formulated with the SS sand and the quarry SB, SG sands are respectively 24 MPa, 34 MPa and 22 MPa. e crushed SG sand has a low resistance due to the high nes content on the one hand. e higher the nes content, the more water will be needed; and at the same cement dosage, the resistance decreases.

On the other hand, this is related to the mineralogical properties of this sand. e SG sand is mainly composed of a very so and alterable mineral (biotite) but also moderately hard and alterable minerals. e latter will give clays under the e ect of meteoric alteration (alkaline feldspar) and thus contribute to a decrease in resistance.

In addition, this sand contains biotite which disturbing by their

Sand Type	Grain shape	d/D(mm)	Fineness	Structure	Origin	
SB	Very angular	0/5	Fine	Rough surface	Crushed basaltic origin stone	More (7.9%)
SG	Few angular	0/5	Fine	Rough surface	Cruhed gneissic stone	High (10.5%)
SS	rounded	0/5	coarse	Smooth surface	Alluvial sand	Very low (0.3%)

Table 5: Macroscopic analysis of different sands.

		Types of Concrete		
		BSB	BSS	BSG
Compressive strength (Mpa)Wishes at 28 days		30	30	30
Compressive strength (Mpa)	7 days	24	18	19
	28 days	34	24	22
Density	7 days	2.571	2.535	2.572
(g/cm^3)	28 days	2.581	2.541	2.572

Table 6: Hardened concrete properties.

Components of concrete	Cement	Water	Sand 0/5	Gravel 5/15	Gravel 5/25	Total cost	Realized savings
For CSB	32000	75	3945	3914	6930	46854	3090
For CSS	32000	72	6282	4209	7330	49893	0
For CSG	32000	84	3945	3914	7110	47053	2840

Table 7: Cost in FCFA of the components for the formulation of 1 m^3 of concrete.

shape and their weak inter-foliar cohesion not favorable to the adhesion of the binders (Figures 7-9).

e crushed SB sand has very angular grains. is promotes a good binder-aggregate bond and therefore makes it possible to obtain compact and resistant concretes. Moreover, this sand is made up of very hard and resistant minerals.

In view of all these results, it can be concluded that SB sand resulting from the crushing of olivine basalts o ers a more resistant concrete. However, the alluvial SS sand and the SG sand have similar resistances.

is study was conducted to assess the e ect of the type of sand on the mechanical properties of hydraulic concrete. is study led to the following conclusions:

- e mechanical properties of concrete are in uenced by the nature and physical properties of sand:
- Concrete with crushed Sands (SB and SG) produced Small slump when compared to the river sand.
- Concrete with crushed sands need much water to obtain the same workability than the concrete with the natural sand. is improved workability for the crushed sand due to the presence of high quantity of ne particles.

  A compressive strength of concrete with natural sand (SS) increased by 33.33% a er a fully replacement by basaltic crushed sand (SB) and 5.5% with gneiss crushed sand at 7 days.

  e same results were observed at 28 days. Concrete with natural sand increases by 41, 67% a er a full replacement by basaltic crushed sand (SB) and 8.33% with gneiss crushed sand at 7 days (SG).

  e presence of mineral like biotite in the sand can reduce the strength of the concrete.

  e e ect on compressive strength of concrete by replacement of natural sand with arti cial sand is more prominent at 7 days than that at 28 days.

References

1. Barritt CMH (1984) Advance building construction. (2ndedn), JW Arrowsmith Ltd, Bristol.
2. Raschid THMR, Hassan MR, Mondol EF (2013) Infuence of Stone Dust as Replacing Material of Cement and Sand on Some mechanical properties of Mortar. Int Journal of Advance structural and Geotechnical Engineering p: 2.
3. Safuddin M, Raman SN, Zain MFM (2007) Utilization of quarry waste fne in concrete mixture. Journal of applied science research 3: 202-208.
4. Suresh N, Manjunatha M (2016) Effect of different types of fne aggregates on mechanical properties of concrete-A review. The Indian Concrete Journal pp: 69-71.
5. Kala F (2013) Effect of Granite Powder on Strength Properties of Concrete. International Journal of Engineering and Science 2: 36-50.
6. Chiemela C, Walter IE, Ogedi IH, Peter OC, Mong O (2015) Comparing the compressive strengths Of concrete made with river sand and quarry dust. International Journal of Recent Research and Applied Studies 22: 31-38.
7. Abdullah M (2012) Effect of aggregate type on Compressive strength of concrete. International Journal of Civil and Structural Engineering 2: 791-800.
8. Dreux G, Festa J, (1998) New guide for concrete and its constituents, Eyrolle Edition. (8thedn), Paris, France p: 409.
9. European Standard NF EN 12350-2 (1999) Test for fresh concrete, Part 2 Sink test.
10. European Standard NF EN 12350-6 (1999) Test for fresh concrete, Part 6 Density, AFNOR.
11. Aguida BI, Aissa A (2011) Infuence of additions of limestone addition on the mechanical properties of sand concrete. International Seminar, Innovation & Valuation in Civil Engineering & Construction Materials, Rabat, Morocco, pp: 1-12, 23-25.
12. European Standard NF EN 12390-3 (2003) Test for hardened concrete, Part 3 Compressive strength of test specimens, AFNOR.
13. European standard NF EN 12390-4 (2000) Tests for hardened concrete, Part 4 Compressive strength-Characteristics of test machines, AFNOR.

Citation: Leroy MNL, Molay TGG, Joseph N, Colince FM, Bienvenu NJM (2017) A Comparative Study of Concrete Strength Using Metamorphic, Igneous, and Sedimentary Rocks (Crushed Gneiss, Crushed Basalt, Alluvial Sand) as Fine Aggregate. J Archit Eng Tech 6: 191. doi: 10.4172/2168-9717.1000191