STRENGTH COMPARISONS BETWEEN ROLLED SAND CONCRETE AND DUNE SAND CONCRETE

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ABSTRACT

The objective of using sand concrete is to reduce costs especially in sand rich regions where transportation costs of aggregates over long distances makes any construction too expensive. This paper presents the mechanical characteristics of two types of sand concrete, a sand concrete based on rolled sand and dune sand concrete, and compares these two types of sand concretes. It is also intended to determine the influence of the water/cement (0.4, 0.45, 0.5), cement/ sand (1/3, 1/4) and additives (plasticizers and thinners) on the mechanical characteristics: Compression and tension. It is observed that the cube strength rises with respect to time for the two types of sand concrete. The cube strength diminishes when increasing the water/ cement for rolled sand concrete and increases for the dune sand concrete. The influence of additives is quite noticeable; the rise in the cube strength is about 40 %. Taking into consideration these results, it is then recommended for the users the exploitation of rolled sand concrete with or without additives, however for the dune sand concrete, the use of additives is most important.

1. INTRODUCTION

Sand concrete is a construction material composed of sand, cement and natural or industrial Filler. Sand concrete can replace successfully the traditional concrete because of its economical cost, its compressive strength that reaches (12-80 N/mm2) [1], [2], and its high workability. Moreover, it can successfully be used where the reinforcement is overcrowded or where it is desired to have concrete surfaces that present a good appearance on removal of the formwork. It can also be used to produce bricks for construction. Sand concrete has been used for the first time in the third quarter of the nineteenth century by F. COIGNET to construct the bearing wall PASSY and F. COIGNET house in Saint-Denis in France. It has also been used in U.S.S.R in the beginning of the twentieth century to construct Kaliningrad harbor and Chernavskif bridge [3][4]. In Algeria where desert is about 80% of the total area, transportation of aggregates over long distances for construction can cause excessive cost to use the traditional concrete, also the abundance of sand in all this region can encourage use of sand concrete, mainly in Biskra (South East of Algeria) where the present research has been conducted.

This research is carried out in order to find the best content of sand concrete that can give a good workability and high compressive strength by using two different types of sand; rolled river sand and dune sand with cement of type C.P.A. 325 (Ordinary Portland Cement). Moreover, it is intended to determine the influence of water/ cement (0.4, 0.45, and 0.5), cement/sand (1/3, 1/4) and lastly the influence of additives (plasticizers and thinners) on the mechanical characteristics: compression and tension. Finally results are compared for different type of sand [5].

2. CHARACTERISTICS OF USED MATERIALS

2.1 Sand

In the present study, two types of sand have been chosen (rolled river sand and dune sand). The later is highly abundant in the region of Biskra (South east of Algeria)[6].

The density: The specific density is computed by using the pyknometre apparatus on a dry samples using sieves of 2 mm (ASTM D 845 5) and the apparent density is computed by using (ASTM C 71-29). The results are presented in Table 1, [7].

Table 1 : The density of sand

Type of sand	Absolute density γs (Kg/m3)	Apparent density ρ (Kg/m3)
River sand	2500	1550
Dune sand	2570	1500

Sand grading is performed using standard sieves (ASTM D422-63). Figure 1, shows curves representing the aggregate analysis of the different

types of sands (rolled river sand and dune sand). It can be seen that river sand is gradually distributed, whereas dune sand is very fine.

The sand equivalent values have been computed using the scale (NF P186598), and test results are shown in table 2.

Fineness scale River sand F.M=2.83 Dune sand F.M=1.22

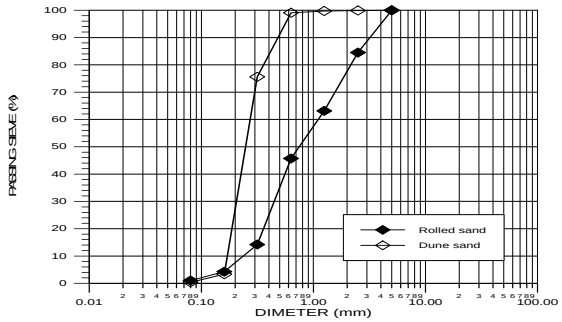

Figure 1 : Aggregate Analysis Curves (rolled river sand and dune sand)

Table 2 : Sand equivalent values

Sample	Sand equivalent value by sight	Sand equivalent value by test	Sand quality
River sand	75.5	73.4	Clean sand
Dune sand	67.11	58.65	Dusty sand

2.2 Additives

The additives are used in small quantities not grater than 5% by weight of used cement in order to improve some of the characteristics of concrete. Some of these additives are produced by Granitex Company in Algeria, among which we can mention plasticizers and thinners.

Plasticizers are liquids that can easily be mixed in water with all kinds of cements. Their color is brown and has a density equal to 1.16 with pH = (7-8). The use of Plasticizers can improve the properties of sand concrete mixes by: reducing water mixes, increasing the cube strength, increasing the plasticity of concrete, produces a good workability and lastly reduces the time for setting [6].

Thinners can improve the sand concrete characteristics by being stable and cohesive during handling and vibration. They increase the workability, the slump and the cube strength.

2.3 Cement

An ordinary Portland cement manufactured in Algeria under the commercial name C.P.A. 325 was used, and tested to obtain the real strength using AFNOR recommendations [8]. The compressive strength for 28 days was tested and found to be equal to (388 N/mm2).

3. QUALITY CONTROL

The quality control for workability of sand concrete has been conducted by using the Out Flow -Test [7]. The results are summarized in Table 3, function of the quality of sand the cement/ sand and the water/ cement.

Table 3 : Sand Concrete Workability

cement/ sand	concrete	Water/ cement	type of concrete	in terms of	Workability
			Without additives	1% plasticizers	1% thinners
		0.4	Very cohesive concrete	very cohesive concrete	very cohesive concrete
	River sand	0.45	very cohesive concrete	cohesive concrete	plastic concrete
1/3		0.5	Plastic concrete	mobile concrete	very mobile concrete
		0.4	very cohesive concrete	very cohesive concrete	very cohesive concrete
	Dune sand	0.45	very cohesive concrete	very cohesive concrete	very cohesive concrete
		0.5	very cohesive concrete	very cohesive concrete	very cohesive concrete
		0.4	very cohesive concrete	very cohesive concrete	very cohesive concrete
	River sand	0.45	very cohesive concrete	cohesive concrete	Plasticcohesive concrete
1/4		0.5	very cohesive concrete	cohesive concrete	Mobile concrete
		0.4	very cohesive concrete	very cohesive concrete	very cohesive concrete
	Dune sand	0.45	very cohesive concrete	cohesive concrete	cohesive concrete
		0.5	Cohesive concrete	cohesive concrete	cohesive concrete

4. INFLUENCE OF CEMENT/SAND RATIO

Test results show that the cube strength increases as a function of time for all types of concrete sand, and it is also dependent on the percentage of cement/sand and the quality of sand. Moreover we can also conclude out of tests that the percentage of strength can easily reach 85% in river sand concrete case and 70 % in dune sand concrete. This is when the percentage of cement sand is 1/3. When the

percentage of cement/sand is 1/4, the strength reaches respectively 75%, 65%. (These percentages are with respect to the strength during 28 days).

4.1 Cube Strength

In figures 2, 3, 4, 5, 6 and 7 the influence of water/cement is given against the cube strength. In these figures it is noticed that when this ratio is increased the cube strength is also increased in the case of dune sand. Whereas this later diminishes when it is the case of river sand, except when thinners are added with the cement/sand ratio 1/3, and then decrease again.

4.2 Strength in Tension Using Flexion

Tests studying the influence of water/cement ratio (0.4, 0.45 and 0.5) on the mechanical strength in tension shows that this later increases with increasing the (W/C) ratio in dune's sand concrete. This is apparently due to the fineness scale of sand = 1.22. Whereas in the case of river sand concrete the mechanical strength in tension decreases except when additives are not used, in this case the strength in tension increases then decreases because of the fineness of sand which is equal to 2.83. It is also noticed that for this case of sand, water is not needed in grater amount, that is way the strength decreases when additives are used, and increases then decreases again without additives, i.e. water/cement ratio = 0.45 is the optimal ratio for a better strength.

4.3 The Influence of Additives

Concerning the effect of additives, the figures 8 and 9 show that the cube strength increases when 1% of additive is used (Thinners, Plasticizers), mainly in dune sand concrete. The percentage of the mechanical strength increases with 40% in case of cement/sand ratio = 1/4 and 50% in case of cement/sand ratio =1/3. For river sand concrete the effect of additive (Thinners) is almost negligible.

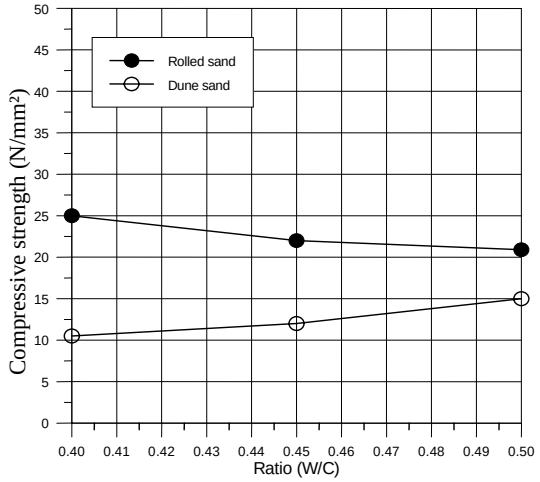

Figure 2: Influence of W/C on compressive strength with Cement/Sand ratio 1/4, without additives

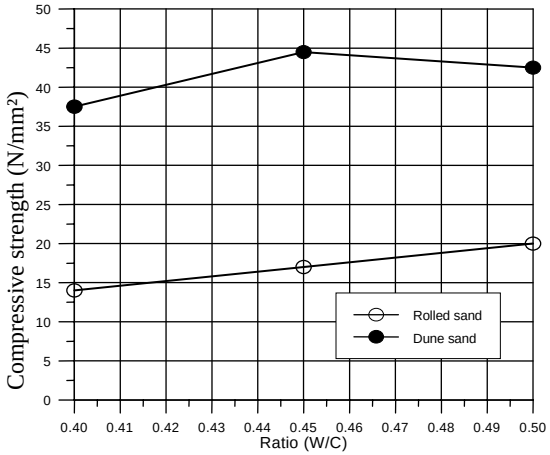

Figure 3 : Influence of W/C on compressive strength with Cement/Sand ratio 1/3, without additives

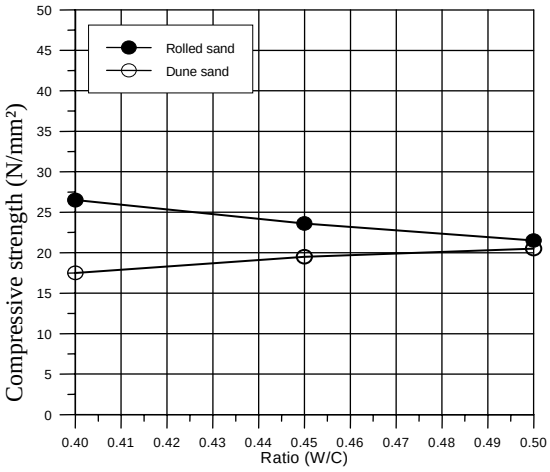

Figure 4 : Influence of W/C on compressive strength with Cement/Sand ratio 1/4, with 1% Plasticizers

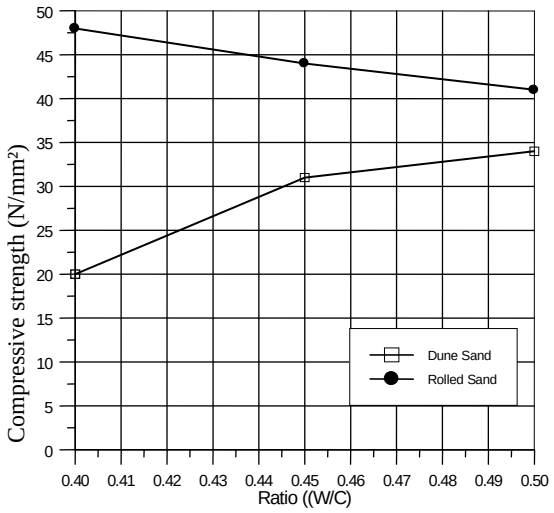

Figure 5 : Influence of W/C on compressive strength with Cement/Sand ratio 1/3, with 1% Plasticizers

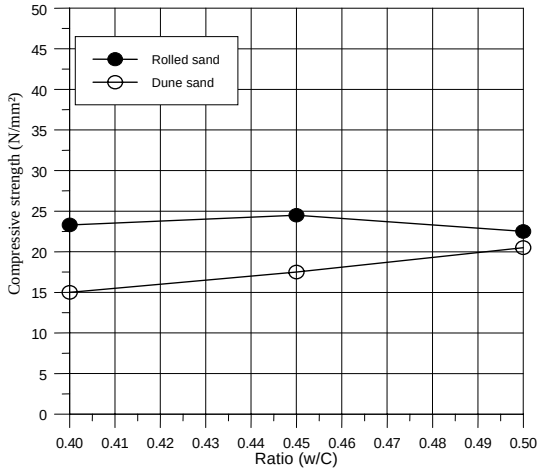

Figure 6 : Influence of W/C on compressive strength with Cement/Sand ratio 1/4, with 1% Thinners

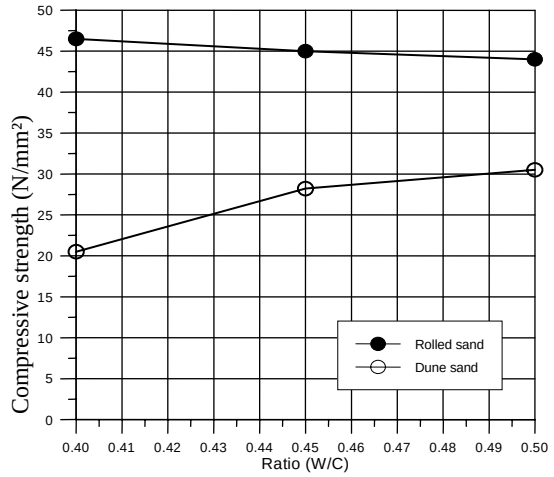

Figure 7 : Influence of W/C on compressive strength with Cement/Sand ratio 1/3, with 1% Thinners

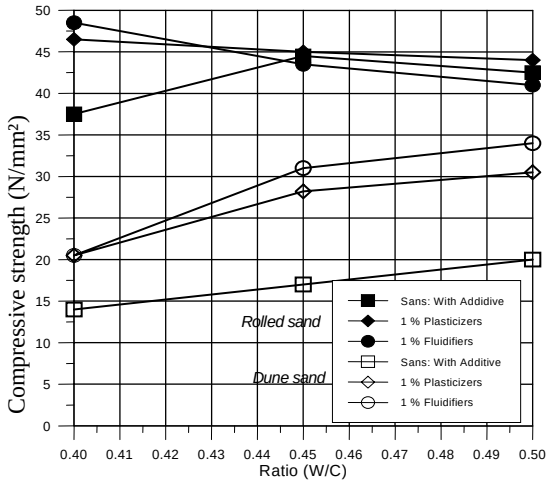

Figure 8 : Influence of additives and W/C ratio on the Compressive strength with Cement/Sand ratio 1/4

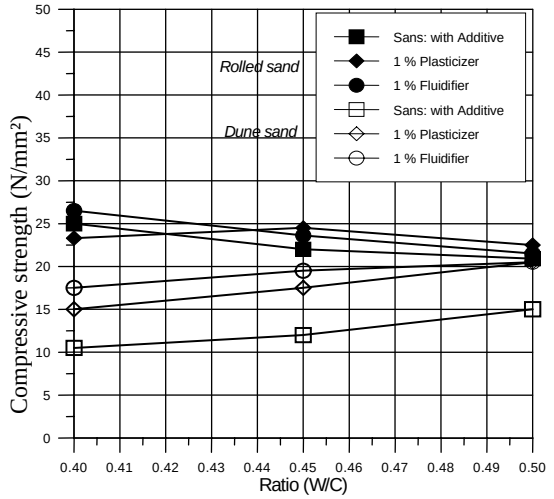

Figure 9 : Influence of additives and W/C ratio on the Compressive strength with Cement/Sand ratio 1/3.

5. CONCLUSION

It has been shown through the experiments that sand concrete has almost equal strength to the ordinary concrete, mainly in river sand concrete. Increasing water/cement ratio increases the cube strength in dune sand concrete. It is almost the reverse of river sand concrete. The use of additives causes an increase in the strength up to 40% in dune sand concrete, while this increase is almost negligible in river sand concrete.

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