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Effect of the Type of Sand on the Properties of Concrete

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Abstract: The main objective of this study is to deepen the characterization studies already led on concretes in previous works. Indeed, it depends in examining the effect of the sand type on the main properties of concrete. The particularly insist on the determination of the strength characteristics of this material. To carry out this study, two different types of sand have been used: Dune Sand (DS), Sea Sand (SS). These sands differ in mineralogical nature, grain shape, angularity, particle size, proportion of fine elements, etc. The obtained results show that the particle size distribution of sand has marked its influence in all the studied properties of concrete, since, the sea sand having the highest diameter and the best particle size distribution has given the best properties. The grain shape, the angularity and the nature of sand have also marked their influence: thanks to its angularity, sea sand yielded better results compared to dune sands which. Finally, it should further be noted that the dune sand concrete presents values of compressive strength slightly lower than those of sea sand concrete but almost comparable.

INTRODUCTION

The majority of buildings in Libya have been made with sea sands. It is totally recognized that ordinary concrete strength is influenced by the ratio of cement to mixing water, the ratio of cement to aggregate, the bond between mortar and aggregate and the shape, grading, size and strength of the aggregates[1]. Quality of constituent materials utilized in the preparation of concrete plays a fundamental role in the development of both physical and strength properties of the resultant concrete. Water, cement, fine aggregates, coarse aggregates and any admixtures utilized should be free from hurtful infections that negatively effects on the properties of hardened concrete. Sand is one of the normal natural fine aggregates utilized in concrete production[2]. Quality confirmation of building materials is very primary in order to build strong, durable and cost-effective structures[3]. When construction is planned, structure materials should be chosen to perfect the missions expected from them. The higher the proportion of clay and silt content in sand utilized in concrete production, the lower the compressive strength of the hardened concrete[4]. Although, numerous studies above-mentioned have shown that utilize of poor-quality materials is one of the leading contributing factors to breakdown of buildings, testing these materials has not been carried out to check the effect of impurities in building sands to the total performance of concrete. A survey of literature has shown that numerous studies have been conducted in the

past to used sea sand as fine aggregates in concrete. But an in-depth study has not been performed to utilize the dune sand in concrete. The present study has attempted to study and compare the effect of use dune sand on the workability, compressive strength of concrete with sea sand concrete[5].

Significance of research: This study provides comprehensive test data to explore the different properties of concrete using two types of sands are sea sand and dune sand. Test results achieve that the compressive strength of concrete should be considered as a critical factor in conjunction to evaluate the strength properties of concrete.

MATERIALS AND METHODS

Materials: Concrete is consisting of a mixture of sand is a fine aggregate, cement, coarse aggregate is crushed stone and water. Besides these basic components, it typically includes one or more admixtures. Two different sands were separately used in this study: Dune Sand (DS) from the Northern area of Sayidi Alssayih (Libya) and Sea Sand (SS) from Zlitan (Libya).

Experimental methods: Sieve analysis and physical properties were carried out on the sand's samples (Table 1 and 2). Percentages of sand passing and retained was analyzed and grading curve plotted for comparison.

Table 1: Sieve analysis for sand samples

	Percentage passing standard sieve sizes (%)		BS 882	
Samples	Dune sand	Sea sand	Maximum	Minimum
Sieve size (mm)				
10	100	100	100	100
4.75	100	100	100	89
2.36	100	100	100	60
1.18	100	99.86	100	30
0.6	95.70	97.94	100	15
0.3	71.00	47.04	70	5
0.15	27.96	4.95	15	0
Bottom pan	0	0	-	-

Table 2: Physical properties of sands

Physical characteristics	DS	SS
Specific gravity	2.63	2.70
Absorption (%)	0.24	0.52
Fineness modulus	2.4	1.72
Chloride content	0.0064	0.0092
Sulfate content	0.0030	0.0033

Table 3: Concrete mix proportions

Mix No.	Cement (kg m^{-3})	Fine Agg. (kg m^{-3})	Coarse Agg. (kg m^{-3})	Water (kg m^{-3})	W/C (%)
MDS-1	350	525	1050	210	0.60
MSS-1	350	525	1050	210	0.60
MDS-2	350	525	1050	192.5	0.55
MSS-2	350	525	1050	192.5	0.55

concrete mix ratio of 1:1.5:3 (cement: sand: coarse aggregates) and water to cement ratio was 0.55% and 0.6% as it is used for most low rise structural buildings was designed for an expected compressive strength of 25-30 MPa at 28 days using 20 mm maximum aggregates size and ordinary Portland cement. Coarse aggregates from crushed stones were subjected to sieve analysis to achieve a ratio of 1:2 for 10 and 20 mm, respectively for use in all concrete castings. Slump testing was done on fresh concrete. The 150 mm concrete cubes were prepared, compacted for each concrete (DS-Concrete and SS-Concrete) which have been are given in Table 3, de-moulded 24 h after casting and cured in a water tank at 26°C±2°C for 28 days. Compressive strength testing of the concrete cubes was carried out in accordance with ASTM C39-90. Furthermore, in compressive mechanic approach, it is assumed that there are always flaws in the material from which cracks can begin[6].

RESULTS AND DISCUSSION

Two different properties are studied in this work: the workability and the compressive strength.

Workability: The slump test is used for the workability of the dune sand and sea sand concrete fresh mix. It is value varies with the change of the type of sand in concrete mix. Figure 1 describes the slump value changes with an increment of the w/c ratio in the mix. The slump value increases with the increment of water from 0.55-0.60% in the mix, sea sand decreases the slump value slightly. In order the assess the effect of workability of concrete made from dune sand and sea sand samples having varying level of silt and clay and inorganic impurities, four concrete mixes samples were cast while maintaining workability constant[7].

Compressive strength: The compressive strength of sea sand concrete is slightly better than that of dune sand concrete (SS and DS) (Fig. 2). Due to the higher absorption of the dune sand compared to sea sand, the quantity of the mixing water in dune sand concrete is decreased. The water decreased which should normally remain to complete the hydration of Portland cement in the composite is therefore smaller which improves the compactness and the properties of the sea sand concrete. In addition, the sea sand grains have different size which makes the propagation of the crack in the sea sand concrete more difficult. Moreover, sea sand fine aggregate produces a dense transition zone (interface between aggregate and hydrated cement paste. The noted that this increment is relatively small but test results show that sea sand makes the concrete stronger and more elastic[8, 9].

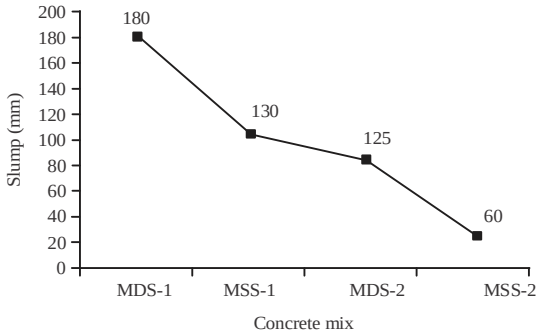

Fig. 1: Evolution of the workability

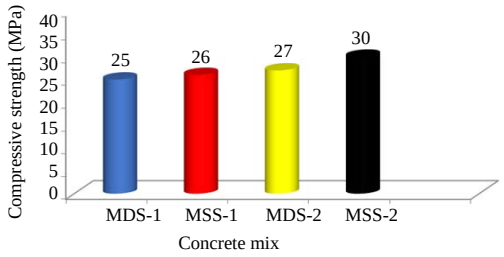

Fig. 2: Evolution in compressive strength

CONCLUSION

It can be concluded that the properties of concrete are influenced by the nature and physical properties of sand: an angular shape, a high maximum diameter, a good granular distribution, a sea sand gives the best results and improve the strength of the concrete. In addition, sea sand concrete also presents another advantage of economic nature: thanks to its high content of fine elements, sea sand concrete does not need the use of any improve. Finally, it should be noted that these results confirmed the results already found in the previous works of physico-mechanical characterization.

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