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PHYSIC-MECHANICAL PROPERTIES OF DESERT SAND BASED MORTARS WITH ADDITIONS: A REVIEW

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ABSTRACT

In recent years, the depletion of natural aggregate deposits and the difficulties in finding new quarries have made it necessary to look for other sources of supply. The reclamation of sand from a desert dune is now seen as a solution for the future in order to respond to the deficit between production and consumption and the exploitation of natural resources in the southern regions of Algeria. The purpose of this synthesis is to present a summary of some research work reported in the literature on the usefulness of the use of desert dune sand in the mortar and concrete industry. Several researchers have developed cementitious materials based on dune sand and additions such as rubber, Rice husk ash, olive kernel shell, grilled copper slag, glass, vegetable fiber, carbon fiber, polypropylene fiber and polyester fibers, in order to improve certain physic-mechanical characteristics of mortars and / or concrete. It has been revealed that the introduction of additions / fibers into a cementitious composition originating from desert dune sand improves mechanical strength such as Rc and Rt; and also decreases capillary shrinkage and absorption, which has recently improved the durability of cementitious structures.

Keywords: *mortar, desert dune sand, additions, physico-mechanical characteristics, durability.*

1- INTRODUCTION

After water, sand is the second most used material in the world. Incredible quantities are extracted every year, mainly for construction in housing or public works. It takes 200 tons of sand to build a single house and 30,000 tons of sand for one kilometer of road. Faced with the growing needs, industrialists exploit gigantic quarries, dredge rivers and the sea bed with sometimes disastrous ecological consequences.
The dune sand is a material available to the regions of southern Algeria in large quantities and gigantic, and practically not exploited. However, the use of dune sand is not identified as a priority objective in the field of natural resources. Due to the availability of this material, many researchers are studying its technical properties. The development of modern civil engineering construction has generated a strong demand for new types of concrete and mortar that must possess improved qualities, including mechanical strength and durability.

2- THE METHODOLOGY ADOPTED IN THIS STUDY

The approach that has been adopted in this context, to achieve our objectives of this synthesis, among the points that have been treated: the characterization of dune sand and different additions, physical-chemical and mechanical properties of concrete and / or mortars of dune sand and the durability of cementitious materials based on the material mentioned above

2- ANALYSIS AND SYNTHESIS OF RESEARCH WORKS

The making of dune sand based mortar and additions can be designed to have better mechanical properties and improved durability compared to those of traditional mortar. In addition, other supplementary materials such as rubber, rice husk ash, olive kernel shell, roasted copper slag, glass, vegetable fiber, carbon fiber, bamboo fiber, polypropylene fiber and polyester fiber and recycled concrete sand as part of the binders (admixtures) can be used for the production of dune sand-based mortar [1-21].

The possibility of making light self-placing mortars, even with a substitution rate of 100% in olive core waste (DNO), with a compressive strength at 28 days of 9.6 MPa and a thermal conductivity of 0.326 W/m.K. It also appears that DNO are light aggregates that allow the formulation of self-placing mortars with a density between 1400-1900 kg/m^3. In addition, SEM analysis performs, and indicators of durability under the action of water (porosity and water absorption). This introduction (DNO) influences the microstructure of the matrix and contributes to the improvement of thermal and sound insulation properties. Experimental study of doctoral thesis elaborated by CHEBOUB Tayyib (2020-2021) [2].

The work Abdoul Kader Babayi Bachir Souleymane (2018/2019) [4] and Boulifa Marwa et al (2016/2017) [6] they studied the effect and characteristics of the substitution of glass powder in different dosage (0to25%) [4] and (7.5; 10; 12.5 and 15%) [6] on the mortar to a water-binder ratio of 0.55 and 0.60 [4] and 0.44; 0.45 and 0.46 [6]. The result showed that the glass powder equal 12.5% and 15% give results of the highest mechanical strength. Also, improves the workability and speed of ultrasonic wave propagation [4,6]. The small particle size of glass powder is advantageous to infiltrate and plug the capillary pores in the mortar, making the pores smaller and less numerous and the mortar denser. This leads to a decrease in capillary water absorption coefficients with increasing glass powder dosage in mortars [4]. According to Yacine Abadou et al (2020) [11], the addition of crushed concrete waste on the performance of dune sand mortar not only improves the compressive strength of mortar in the short and long term, but also improves the workability and compactness of mortars studied. But also the amount of crushed concrete waste significantly influences the behavior of mortar, both fresh and hardened. Nancy Kachouch et al (2019) [12], studied the effect of steel fibers on the performance of concrete made from recycled concrete aggregates and desert dune sand, The test results showed that substitution of 30% natural aggregate GN with recycled aggregate GR in ordinary concrete did not result in a reduction in the compressive strength of the design cylinder by 30 MPa, GR replacement increased water absorption and sorptivity but decreased ultrasonic pulse velocity, overall resistivity and abrasion resistance. The addition of SF steel fiber improved the curing properties of GR-based concrete mixtures to the point of exceeding some of those of their NG-based counterpart, as in the case of SF addition. Lei Pu et al, M. Bentchikou et al and G. Zainescu et al [7-9], study the effect of fiber on rheological, thermal and physical-mechanical and structural properties respectively, the result showed that polypropylene fiber and carbon fiber present the best dispersion in the polymer solution. The higher the fiber content, the greater the influence of the fiber on the rheological properties of the solution. Compared to vegetable, mineral and synthetic fiber [7]. M. Bentchikou et al. 1st value the cellulosic fiber of waste paper to elaborate a composite material on the one hand and 2nd gives an important value of thermal insulation in building on the other hand [8]. And G. Zainescu et al presents the use of leather waste to obtain building materials for walkways, pavements and their physical and mechanical and structural properties [9]. In the same framework, Rafaela Melo et al (2021) [3], thinks to be of coast to evaluate the feasibility of the application of copper slag waste as abrasive materials, which was called shot copper slag (coarse and fine), to have the physical and mechanical properties of mortars. The work A.Benazzouk et al (2006) [5], valorization of rubber waste in construction materials improve the workability and increase the slump. and showed that the composite can reach a density of about 600 kg/m3, with compressive strengths compatible with the use in load-bearing insulation, and also showed that, for the same density, the cellular composite is more resistant in compression than the composite cement-rubber, The study of absorption by capillarity of the composite has highlighted the reduction of sensitivity to water when adding rubber dust in the matrix. The presence of rubber tends to slow down the progression of the capillary imbibition front and to reduce the quantity of water absorbed. This suggests a better resistance of the composite to degradation caused by the propagation of aggressive agents dissolved in water. These results show the interest of the lightening of the cement-rubber composite, which leads to very interesting properties and suggests a wide range of use in the field of cellular concrete applications.

Most research studies on mortars focus on the use of supplements (inert or active), and different types of fibers including (steel, vegetable, carbon, bamboo, polypropylene and polyester fibers ....etc.) as a single inclusion or combined use with other fibers-additions. A summary of review articles in the area of characterizations of dune sand-based cementitious materials, admixtures and fibers. In addition, data from about 20 recent studies in the field of mortar based on different sands (dune sand, alluvial sand, demolition sand .... etc.) have been reviewed to establish the important properties of

mortar reinforced with fibers, admixtures or both to develop cementitious materials. Although there is some overlap between the objectives of the previous studies and the present study, the main objective of this work is to summarize the effects of different types of supplements on the physical-mechanical properties of mortar and/or concrete, and durability of dune sand-based cementitious materials. This review article aims to make a significant contribution towards a better understanding of the behavior of dune sand-based cementitious materials, supplements and/or fibers.

3- CONCLUSION

The south of Algeria is known for its immense sand dunes which cover a part of its territory (Sahara). Recently most of the researches push and encourage this subject, to valorize the use of the dune sand in the cement materials in civil engineering field as well as in the sector of public works. The results synthesized in this contribution show that the use of dune sand aggregates with additions is certainly an economic solution on the one hand and leads to an improvement of different properties such as lightness, thermal, acoustic and mechanical conductivities on the other hand. Therefore, we recommend, through this documentary research, exploit gigantic quarries.

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