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Bilal Boulkenafet, Houria Hebhoub and Assia Abdelouahed

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Boulkenafet.B[1], Hebhoub. H[2] and Abdelouahed.A[3]

Civil engineering ,institute of tecnolgy,university of 20 Aout 1955 Skikda , Algeria
Civil engineering ,institute of tecnolgy,university of 20 Aout 1955 Skikda , Algeria
Civil engineering ,institute of tecnolgy,university of 20 Aout 1955 Skikda , Algeria

E-mail:boulkenafet.billal@gmail.com

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ABSTRACT

This work falls within the framework of the preparation of a doctoral thesis which aims at the valorization of solid waste in the formulation of a UHPFRC because this formulation is not based on a method of usual known formulation of ordinary concretes and solely based on compliance with some recommendation. To fix an optimal formulation of a UHPFRC, using a local materials, we carried out a preliminary experimental study to fix a performant formula used in this work. To carry out this study we have targeted two essential qualities: superior compressive strength a130MPa at the age of 28 days and the workability given by the sagging at the cone greater than 30cm. This experimental study allowed us to fix an optimal formula for this type of concrete

1. Introduction

Ultra-Performance Fiber-Reinforced Concretes (UHPFRC) are the cementitious materials with the most exceptional performance. They are distinguished by characteristic 28-day compressive and tensile strengths greater than 130 MPa and 6 MPa respectively [1]. Their self-compacting capacity in the fresh state offers an excellent quality of implementation particularly suited to prefabrication.
At present, there is no general method for formulating UHPFRC, but rather principles and recommendations. These principles proposed by (Richard and Cheyrezy, 1995) [2] are based on different criteria:
*Reduction of the Water/Binder (W/L) ratio;
*Improvement of the homogeneity of the mixture by reducing the size of the inert grains (aggregates);
*Increase in fines content (cement and additions);
*Improvement and optimization of the compactness of the granular skeleton;
*Addition of fibers to improve the ductility of the concrete (≥ 2% by volume);
*Possible improvement of the microstructure by heat treatment.
The purpose of this study is to propose UHPFRC formulations characterized by a better economic and ecological balance, and compliant with the requirements of UHPFRC standards (PR NF P18-47

2. Materials

The materials used in this work are:
- Siliceous dune sand class 0/1 from the Oued Zhor-Skikda region.
- Cement CEMI class 52.5 from the Ain Kbira cement plant.
-Silica fume, these characteristics are given in Table1.
-Polypropylene fibers (BASF) 7mm long.
- Super plasticizer adjuvant
-Tap water

Table 1: caracterestics of slica fume.

Properties		Value
Density	g/cm^3	2.20
SiO_2	%	95
SSA	cm^2/g	220 000

3. Experimental program

The choice of the formulation is based on a bibliographic research and some recommendations and formulas proposed by companies such as (Ductal, BSI, CEMTEC) [1]. To formulate this type of concrete, it is necessary to look for two essential qualities, resistance and workability. Two formulations were selected in (Table 2)

Table 2 Formulations of mixtures.

Designations		Formula f1	Formula f2
Cement	kg	950	950
Fine sand	kg	950	1010
Silica fume	kg	130	130
Fiber	kg	9	9
Additive	kg	25	30
Water	kg	250	220

The mixing is done in a mixer with a vertical axis, the introduction of the materials into the tank and the mixing process is of the order :
-Pre-mixing of dry materials and fibers for 1 minute
-Addition of water and superplasticizer, the superplasticizer being mixed with water
-Wet mixing for 5 minutes at high speed (4.17 R/S)
The total mixing time obtained with this mixer is approximately 10 minutes.
The tests carried out on the mixtures are: measurement of spreading, compressive and tensile strength by bending on cubic specimens of dimension 10x10x10cm3 and prismatic specimens of dimension 4x4x16 cm at 2 and 28 days.

4. Results and discution

4.1. Spread : The reduction in the W/C ratio (0.26 for formulation F1 to 0.23 for formulation F2) leads to a reduction in spreading (Fig 1), this reduction remains within the range of UHPFRC

4.2. Compressive strenght : The compressive strength for formulation F2 and higher, compared with formulation F1 (Fig 2), an increase of 32% at 2 days and 53% at 28 days is observed. This increase is due to the decrease in the W/C ratio [4].
The compressive strength increases with age for both formulations, the variation is more marked at 28 days of age.

4.3. Tensile strenght : The minimum bending tensile strength is 6 MPa recorded at 2 days of age for formulation F1, the reduction in the W/C ratio causes an increase in this strength to a value of 15 MPa (Fig 3). Formulation F2 gives a very high tensile strength which is around 25MPa in comparison with formulation F (15MPa). Resistance increases with age. It can be said that the two formulations give satisfactory strengths that meet the requirements of UHPFRC standards.

5. Conclusion

According to the results obtained, it can be said that the two formulations do not meet the requirements of UHPFRC standards from the point of view of compressive strength, it is therefore necessary to increase the fiber content and the binder content, thus reducing the E/l ratio. It is also necessary to revise the method of mixing and the procedure for introducing materials into the mixer.

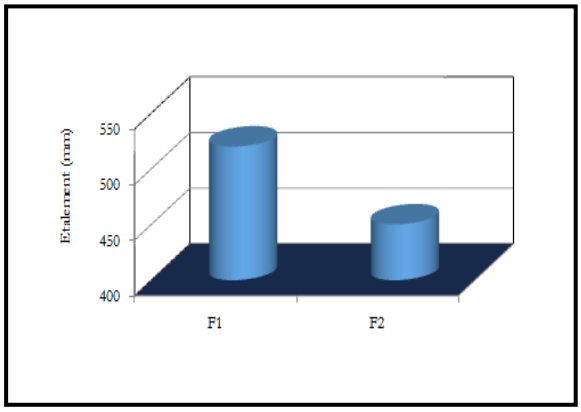

Figure 1: spreading of the two formulations.

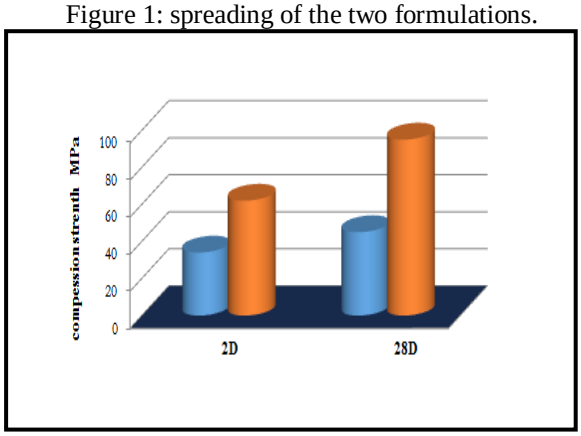

Figure2 : Compressive strength by age.

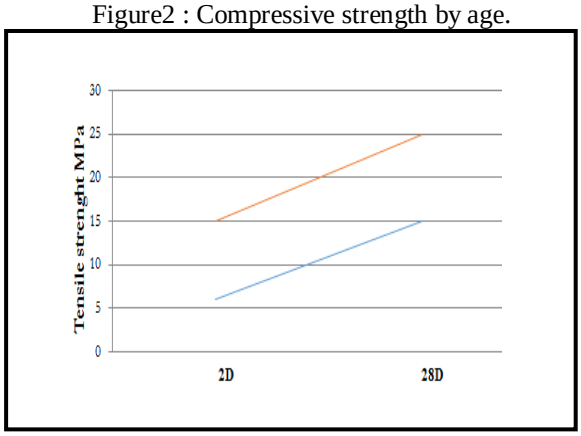

Figure3 : Tensile strength by age.

6. References

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