3ème Conférence Internationale sur les Sciences Appliquées et l'Innovation (CISAI-2025)
Proceedings Book Series –PBS- Vol 25, 415-420

Valorisation of carrier sand with brick sand in ordinary concrete

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***Abstract*—Waste recycling has today become the right solution that can offer new renewable and sustainable resources that contribute to the construction process in the field of civil engineering and thus to protect the environment.**
Waste recycling has today become the right solution that can offer new renewable and sustainable resources that contribute to the construction process in the field of civil engineering and thus to protect the environment.
The experimental procedure implemented aims to determine the physical and mechanical characteristics of recycled aggregates (brick sand), and to study the properties of concrete made from these granules.
To carry out this study, we introduced these wastes with a substitution rate of 30%, 50%, 70% and 100%, and studied the development of the properties of these concretes in the fresh state (workability) and in the hardened state (compressive strength and tensile strength in flexion at the age of 7 and 28 days).
The results obtained in this experimental study allow us to conclude that the use of brick waste is very advantageous in concretes either in the fresh state or in the hardened state, makes it possible to improve the physic mechanical characteristics and more particularly the durability concretes based on 30% recycled aggregate.

***Keywords*— Substitution, Brick waste, Tensile strength, Compressive strength, Resistance.**

I. INTRODUCTION

The recycling of aggregates from demolition materials, already well underway in the public works sector but it's less in civil engineering works, seems to be an ideal solution, the most promising for waste problems. [1,3]. It has undergone a great evolution in developed countries, responds to concerns about the lack of natural aggregates for the operating needs of construction sites and to promote respect for the environment by eliminating wild dumps. [4].

Our research aims to study the possibility of using brick waste as a replacement of sand percentage in the concrete, with substitution rates of (0, 30, 50, 70 and 100 %) and analyze the behavior of these mixtures in the fresh state as well as in the hardened state by comparing them to those of a concrete composed of natural sand.

II. MATERIALS & METHODS

We have used local materials; their characteristics are studied experimentally in the civil engineering laboratory: "Eastern Public Works Laboratory of SKIKDA".

The different materials used in this study are:

- A class 0/3 quarry sand of Oued Zhor- of Skikda.
- A class 0/3 waste marble sand obtained by shell crushing.
- PJ-CEM II 42.5 (S-L) cement from the Hdjar soud-Skikda cement plant.
- Gravel 8/15 of Oued Zhor- of Skikda.
- Gravel 15/25 of Oued Zhor- of Skikda.
- Mixing water from the tap.

ISSN: 2961-6611

According to the characterization results we conclude:

- The apparent and absolute densities of ordinary sand present acceptable values for use in our concrete.
- The apparent and absolute densities of the sand brick are higher than those of sand career.
- The fineness modulus of quarry sand is 2.52, and for brick sand is 2.21 which indicates preferential fine sands to have a good resistance.
- The equivalent of quarry sand is Es = 60.63%. That indicates clean sand with a low percentage of fine clayey.
- The ―Micro-Deval‖ test proved that the gravels (8/15 and 15/25) have good to medium wear resistance.
- The ―Los Angeles‖ test proved that the aggregates are average with low impact resistance.

III. EXPERIMENTAL PROGRAM

Our research aims to study the possibility of using marble waste as a replacement of a percentage of sand in ordinary concrete, with a substitution rate of (0, 30, 50, 70 and 100%) and to analyze the behavior of these mixtures in the fresh state as well as in the hardened state by comparing them to those of a concrete composed of ordinary aggregates designated in this study under the name of control concrete.

IV. RESULTS & DISCUSSION

A. Fresh state

- *Slump test*

The workability results are expressed in the figure 1:

Figure 1: Slump test.

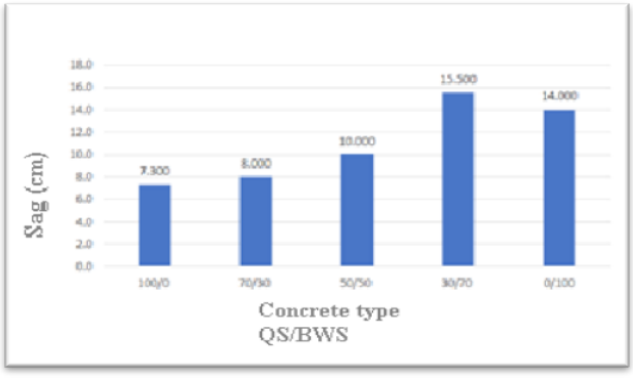

Figure 2: Slump for different mixes of fresh concrete.

TABLE I

Slum for different blends

Concrete type QS/BWS (%)	Report E/C	Amount of water actually used (L/m^3)	Water quantity from mess added (L/m^3)	Slum (cm)
100/0	0.6	215	0	7.3
70/30	0.622	223,16	8.16	8.0
50/50	0.637	228,6	13.6	10
30/70	0.653	234,04	19.04	15.5
0/100	0.675	242,19	27.19	14

We note that the mixing water actually used to ensure this slump increases according to the rate of substitution in recycled aggregates on the one hand and the type of aggregate on the other hand.

ISSN: 2961-6611

- *The report E/C*

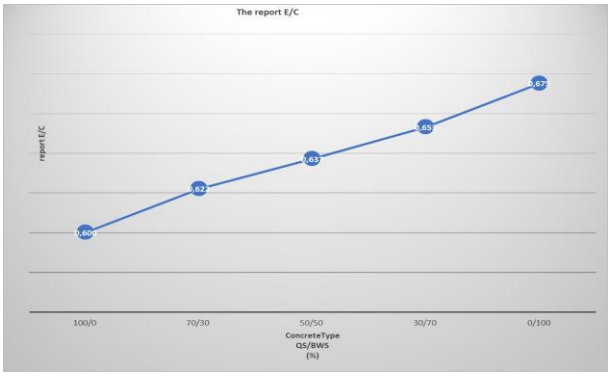

Figure 3: The E/C ratio for the different mixtures.

The E/C ratio of the same concrete composition increases proportionally with the rate of recycled sand in the concrete mix.

- *Volumic mass*

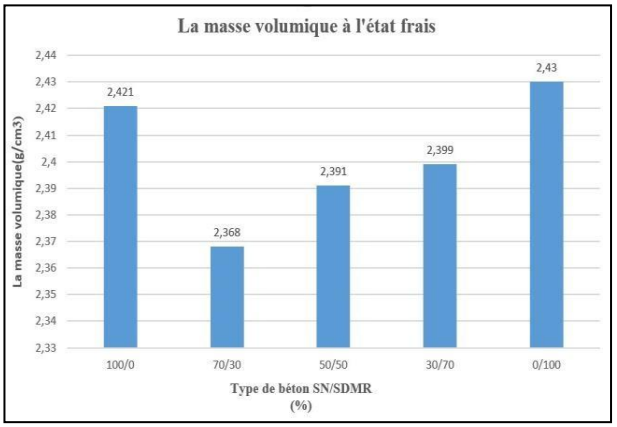

Figure 4: La masse volumique pour les différents mélanges a l.état frais

B. Hardened state

- *Volumic mass*

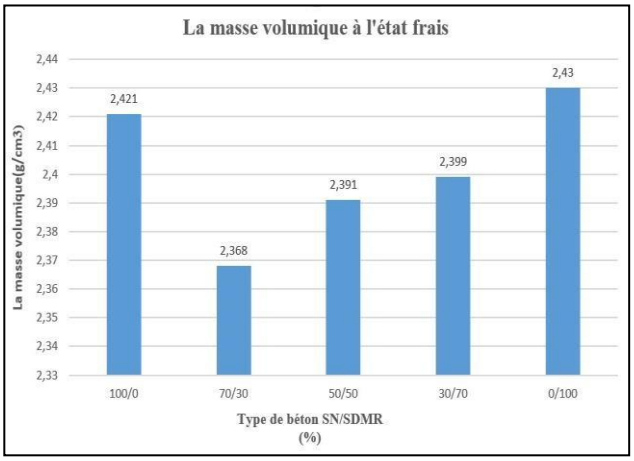

Figure 5: La masse volumique pour les différents mélanges a l.état durci

ISSN: 2961-6611

- *Compressive strength*

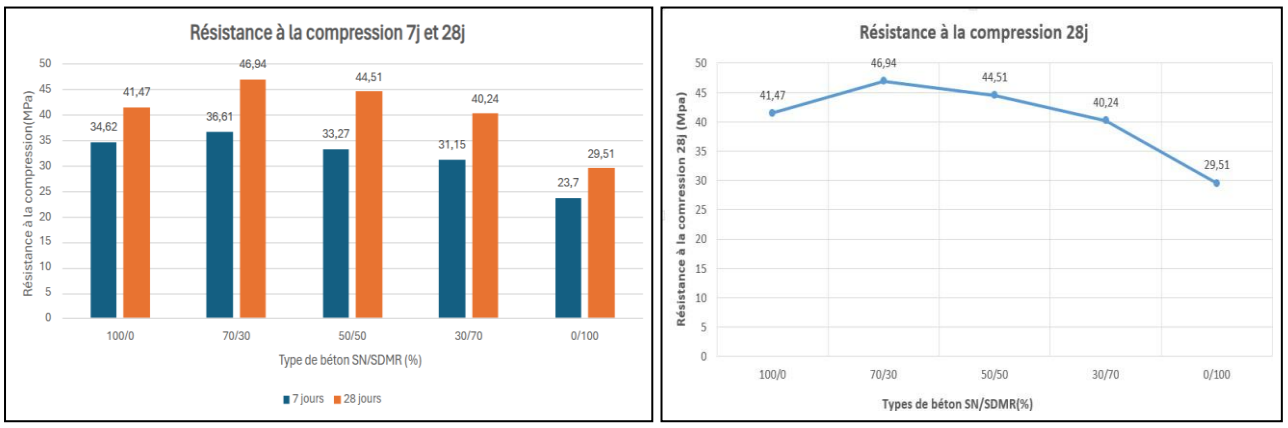

Figure 6: Résistance à la compressions pour les différents mélange

According to this analysis at 7 days and at 28 days, it can be concluded that the compressive strength decreases markedly as soon as the rate of replacement of natural aggregates by recycled aggregates exceeds 50% and that this reduction can exceed 10% of the resistance of the control concrete (100% natural aggregates).

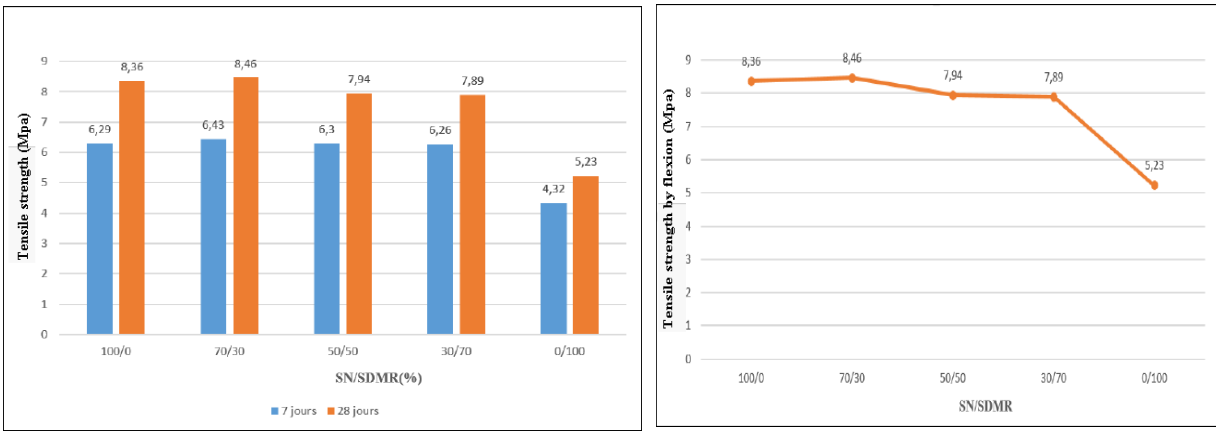

Figure 7: Tensile strength by flexion for the different mixtures

From Figures 5 and 6, we can clearly see that for recycled concretes whose fines substitution rate does not exceed the optimal rate 20 to 30%, the tensile strength by bending increases a little compared to the concrete which contains natural aggregates. As the measurements were taken, a loss of flexural strength was observed in concrete containing marble fines when the substitution rate exceeded 30%.

V. CONCLUSIONS

This experimental study was able to cover a wide variety of different conventional concrete compositions.
Our results on the behavior of recycled aggregate concretes are generally consistent with the experimental data presented in the literature, with the exception of a few previous studies.
The influence of the brick fines content, with the determination of the cement, superplasticizer, and water content, on the behavior of concrete in the fresh and hardened states was studied:

- Concrete containing 30% recycled aggregates exhibited the best performance, good workability, acceptable water demand, and considerable strength, almost identical to those observed.
- When the substitution rate exceeds 30%, a loss of strength is observed, both in compression and tensile strength at 7 days and 28 days.

ISSN: 2961-6611

- The use of recycled sand in concrete can have a negative impact on its tensile strength in the short term, but this effect is mitigated over time. The variation in concrete composition dosages is a parameter which has a significant influence on the characteristics of concrete in the fresh and hardened state.

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ISSN: 2961-6611