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Short Communication

Effect of the Mass Rate of the Straw on the Mechanical and Hydric Characteristics of Mortars in Earth

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Abstract

This work presents an experimental study concerning the characterization of a mortar in raw earth chosen as material of construction in which we have to strengthen him by fibers of vegetable (chopped straw), to improve these mechanical performances. In this respect, we preceded to develop composites in earth by a protocol traditional, with various percentages of straw fibers (1 %, 2 %, 3 %, 4 % and 5 %). The realized test tubes were also tested in axial close compression, what allowed to highlight the importance of the percentage of the addition on the mechanical behavior of the material. The results showed that the mortar of earth(ground) strengthened by vegetable fibers in 3 % possesses an improvement of its mechanical properties in the flexion.

Keywords: Mortar of earth, vegetable fibers, straw, mechanical performances.

Introduction

Since the man builds, her is in hiding believed (raw) was and lives one of the main building materials used throughout the world[1,2]. Every earth is a grain mixture of various sizes (pebbles, gravels, sands, silts and clays) in varied proportions[3]. It is an extremely heterogeneous material, the characteristics of which are very diverse from a region to an other one[4], its characteristics, to improve these, the earth was sometimes added by materials of origin mineral or vegetable or even animal[5].

The properties of the earth are: his plasticity (property to undergo deformations without notorious elastic reaction), his compressibility (capacity to be allowed compact according to its rate of humidity), its cohesion (traction resistance of a test tube of raw earth) and its granularity. The more or less red color of the earth is essentially due to its content more iron or less important in iron oxide. These oxides have only not much impact on the physical qualities of the material of construction[6].

Our manuscript will settle by different interventions according to several parameters which can influence the mechanical and physical properties of the earth, thus our intervention aims at the possibility of improving its various properties and of making himlong-lasting (sustainable).

Material and Methods

To answer the objectives of this work, we have to characterize the main first materials used for the formulation (the clay: which play the role of sociable disposition and give the plastic character in test tubes), the yellow sand as streamlining (dry-cleaning) allowing to regulate the plasticity of clays and physical characteristics of the used fibers.

The experimental method of formulation of this brick is mainly based on the optimization of the proportions of the various constituents (clay, sand and the straw results from the wilaya of Laghouat, the South of Algeria). The choice of the elaborate compositions is based the standard (NF IN 196-1 and NF P 15-471), the preparation of samples is realized in molds prismatic wood of dimension (4x4x16 cm).

The protocol of elaboration of the present adobes of the main stages in the formulation: i. Preparation of the mixture: drying in steam room of raw materials (clays, sand) during 48 hours in 110°C; weighed by some clay, sand and the straw in the desired proportions; ii. Dry kneading (between 5 and 10 minutes) then progressive addition of the quantity of water wished (approximately 15 minutes); conditioning in bag blows up tight laying 48 hours. iii. Elaboration of test tubes: transfer of the mixture in the wooden molds covered with a plastic film; manual Compaction in 4 in 5 coats with use of a needle between every coat vibration textbook (manual worker); iv. Drying and storage: the drying was made at room temperature (free Drying has the hombre), the temperature varies according to the days of (22 in 38°C ±2).

Stamped them chosen as this study are: i. M0: 1 Volume of clay + 3 Volume of sand + the water, ii. M1: 1 Volume of clay + 3 Volume of sand + 1 % of the chopped straw + the water, iii. M2: 1 Volume of clay + 3 Volume of sand + 2 % of the chopped straw + the water, iv. M3: 1 Volume of clay + 3 Volume of sand + 3 % of the chopped straw + the water, v. M4:

1 Volume of clay + 3 Volume of sand + 4 % of the chopped straw + the water, vi. M5: 1 Volume of clay + 3 Volume of sand + 5 % of the chopped straw + the water.

The mass of used addition (chopped straw) in a composition is taken (in percentage) by the mass of the clay used in the same composition.

The mechanical characterization of realized mortars was made according to the modality of the NF standard P-196 in 28 days, and followed by a pétro-physical study (density is similar NF P 98 250-6) and specific (NF P 94-054), the humidity and the total porosity).

The size grading of sand is determined according to the standard (NF P 94-056), as well as the fine fraction (clay) is determined with the method of sedimentation by the pipette of Robinson according to the standard (NF P 94-057), in a working temperature of 20°C.

A try by contact where we place a wet compress on the surface of the brick for 24 hours shielded from the dehydration. The test tube is then preserved during 2 days in an atmosphere in 23°C and 50 % HR.

The obtained results allow to move forward hypotheses on the optimal introduction of fibers in this traditional composite.

Results and Discussion

The experimental study concerning the pétro-physical properties, the raw materials gives indications onto the choice of the material with the aim of the mechanical improvement, presented in the table 1:

Table-1
Physical Characteristics of the used raw materials

Raw materials	Density (g/cm^3)	specific Mass (g/cm^2)	Humidity (%)	PH
Clay	1.74	2.21	2.89	8.43
Sand	1.52	2.33	3.38	9.18
Straw	0.215	-	5.21	-

The figure 1 show the granular distribution of sand and some clay.

According to the figure 2, we observe an increase of the fold resistance according to the straw content, this increase of the constraints of flexion is due to the role play by fibers (as an armature resuming the tractions and in the good connection between the earth and the fibers). From 3 % of the introduced straw the resistances decrease, because of the adhesion between fibers and pastas of earth which becomes low (increase of the number of straw fibers)[7].

The increase of the rate of the straw in mortars is proportionally inverse according to the mechanical resistance in the compression.

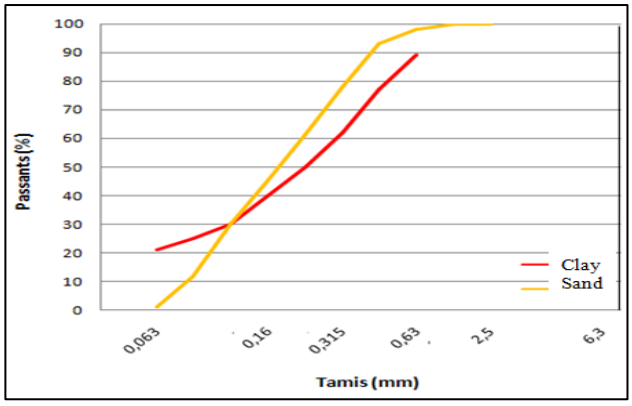

Figure-1
Grading curve of raw materials (sand and clay)

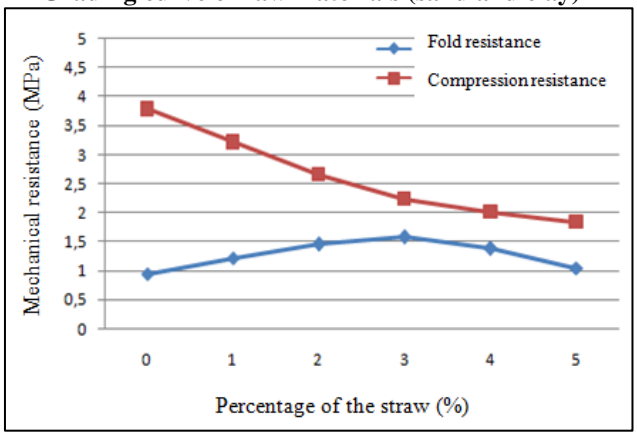

Figure-2
Evolution of the mechanical resistance of mortars developed according to the straw content

The evolution and the variation of the porosity (figure 3), to put in relation as well with the heterogeneousness of the material (the introduction of the straw makes increase the microstructural disorder, which makes increase in her turn the size of the space and the presence of microcracks: rise of the porosity).

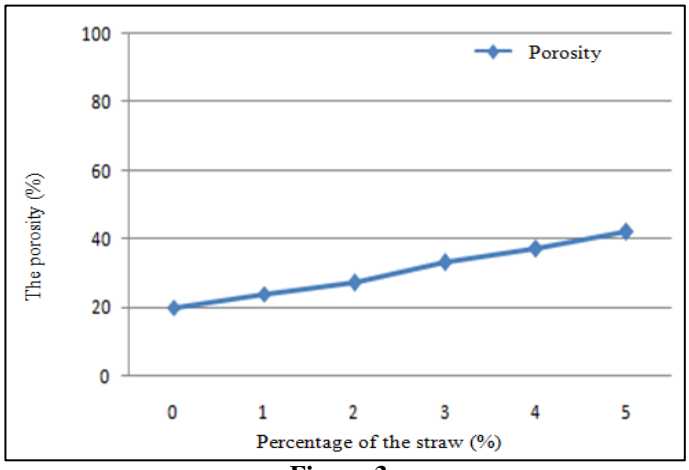

Figure-3
Evolution of the total porosity of mortars developed according to the straw content

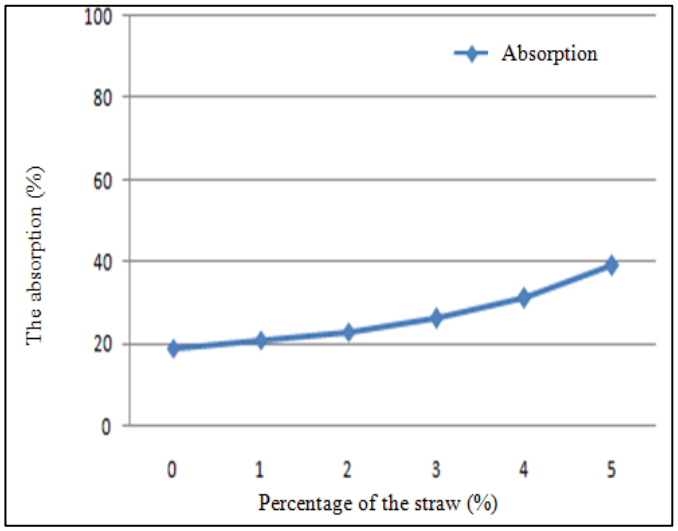

Figure-4
Evolution of the adsorption of mortars developed according to the straw content

The figure 4 shows that the absorption is proportional in the percentage of the introduced due straw in the increases of the porosity of its mortars and the presence of another type of absorption (secondary absorption by the very straw: hydrophobic materials[8]).

Conclusion

The vegetable fibers (straw) used as reinforcements in composite materials present competitive specific mechanical properties with regard to (compared with) the other additions (natural or artificial). Furthermore, they: i. To be renewable and recyclable. ii. Their main inconvenience is their sensibility in the humidity, what has for consequence to lead (infer) a reduction in the mechanical properties in the compression, so in the exfoliation of the interface fiber / mortar.

In a composite strengthened by vegetable fibers, it is generally the fibers which absorb some water because the matrix is supposed hydrophobic. The absorption of water in the composite has for consequence a dimensional instability, an inflation of fibers and an exfoliation of the interface fibers / mortar (a reduction in the properties of the composite is observed further to the grip in water of fibers).

The results (profits) of this study we allow to use local materials, and to study the influence of the vegetable fibers (straw) on the physico-mechanical characteristics of the mortar of earth.

The incorporation of the chopped straw, can well improve the physical characteristics (density: light mortar) and the mechanical characteristics (flexion) of mortars in earth (the earth as material of construction has no important mechanical characteristics, but the addition of the straw remedies this defect).

The addition of the straw (0-3 %) showed that the best compositions having mechanical characteristics in the superior flexion.

A rate of the straw superior to 3 % made decrease the mechanical resistances for the flexion of elaborate mortars. The introduction of the straw makes decrease the compression resistance.

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