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Valorisation of Date Palm Fibres in Sahara Constructions

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Abstract

The Saharan regions in the south of Algeria have a dry climate; it's very hot in summer and cold in winter. The building materials that are commonly used in these areas are concrete and cement mortar. These materials, which represent poor thermal insulation, result in enormous expenses in terms of air conditioning or heating. To remedy this problem, it is necessary to wrap these materials with another type that is not only having a high quality of thermal insulation but less expensive as well.

This work, which focuses on the development of local materials so as to improve their thermal insulation performance, is considered as a first step to use these new materials for local building. The material used in this study is plaster reinforced with date palm fibres.

This study seeks to characterize the newly adopted materials so that we can use for wall materials in the Saharan regions.

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Keywords: thermal insulation; thermal conductivity; specific heat; density; plaster; fibre.

1. Introduction:

The concrete and mortar cement is the materials the more used in the construction, especially for the walls. But its conductivity to the heat remains a handicap of its thermal behaviour. It's therefore necessary to replace these materials with another one. That answer has thermal insulation in dry–hot region like Ouargla town in the east south

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of Algeria. The plaster reinforced by date palm fibres was used in order to improve his mechanical and thermal resistances. The use of fibres in the different materials in order to obtain heat insulating building materials became more and more a current practice and the applications are developed. That is due to the capacity of this new composite material to limit and to control the cracks, to improve the flexural and tensile strengths as well as to improve the thermal resistance.

The objective of this work is then to improve the thermal performance of plaster bricks and hence the utilisation of date palm fibres in material construction, it is also to substitute the asbestos fibres that present a dangerous problem on the human health. In this paper, it's presented the thermal properties of plaster bricks reinforced by these fibres, in the Sahara environment.

The aim of this paper is to find, via an experimental study, mixtures of date palm fibres with plaster to make bricks for wall materials, which are suitable for heat insulation.

2. Experimental Procedures

2.1. Materials

The natural fibres used in this research are from the surface of the trunk of male date palm. The male date palm surfaces fibres (MDPSF) are naturally weaved, and are pulled out from trunk in the form of nearly rectangular mesh (300-500 mm length and 200-300 mm width) formed with three superposing layers. It is easy to separate them into individual fibres of diameter of 0.1-0.8 mm in water. Table 1 [2,3] shows the upper, lower, and mean physical properties of MDPSF as well as the coefficient of variation (CV), whereas, table 2 [2,3] gives mechanical properties of MDPSF. Comparatively to what is reported in literature the mechanical performance of more common vegetable fibres, the MDPSF have average tensile strength and a weak elasticity modulus.

Table 1.Physical properties of used fibres

Property	Lower-upper	Mean-CV (%)
Diameter (mm)	0.1-0.8	0.45-54.43
Bulk density (kg/m^3)	512-1089	900-17.64
Absolute Density (kg/m^3)	1300 – 1450	1383- 5.52
Natural moisture content (%)	9.5-10.5	10-5.00
Water absorption after 5 mm (%) under water	60 – 84	74 –14.02
Water absorption to saturation (%)	97 – 203	132.5 – 20.56

Table 2.Mechanical properties of used fibres

Fibre type	Length (mm)	Tensile Strength (MPa)	Elongation (%)	Modulus of Elasticity (GPa)
MDPSF	100	170±40	16±3	4.74±2
	60	240±30	12±2	5.00±2
	20	290±20	11±2	5.25±3

The physical and mechanical properties of used plaster and cement are presented in table 3. And table 4 gives the chemical composition of cement, plaster and fibres used in this study [2,3,6,7].

Table 3.Physical and Mechanical properties of used plaster and cement

Material	Bulk density (kg/m^3)	Fineness (m^2/kg)	Compressive strength (MPa)	Bending strength (MPa)
Plaster	814-915	2100	10.5	3.45
Cement	2100-2200	3850	32.5	7.40