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Influence of Polypropylene Fibers upon the Mechanical Characteristics of Reinforced Composite Mortars

Andrei Mustea[a,]*, Daniela Lucia Manea[a]

[a]*Technical University of Cluj-Napoca, Str. Memorandumului 28, Cluj-Napoca 400114, Romania*

Abstract

Today, one of the most important demand in the field of materials engineering, and not only, is to achieve more efficient materials by increasing their mechanical strength. The main purpose of the present study is to investigate the influence of various polypropylene fibers dosages on the plaster mortars, to compare the results reached and to propose optimal dosages. Witness specimens are used for comparison. The findings of the tests are seen as immediately applicable, representing an alternative to the materials to be found in the market. Instead of applying a classical plaster mortar and a reinforcing net, it is recommendable to use a composite mortar including PP fibers, in a proper dosage, that can lead to a more suitable outcome.

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Keywords: Fibers; polypropylene; dosage; plaster mortar; mechanical strength; composite.

1. Introduction

The first types of mortars were discovered a long time before our era. They were based on a mixture of clay and mud, being used in Pakistan, beginning with year 6500 B.C. [1]. The lime based mortar followed and it was mainly found in Ancient Greece and Rome, replacing clay or gypsum based mortars, familiar with Ancient Egypt. [2]

When ordinary Portland mortar - OPC was produced (patented on December 18th 1824, but common only at the end of the 19th century), lime-based mortar began to be less used, as the Portland cement had more specific advantages, such as easiness in work, fast preparation, high resistance to compression values. [1] However, the properties specific of lime-based mortars still remain invaluable in the case of materials with low strengths, more porous or more permeable materials that can be applied in the refurbishing of historical buildings. [1][2]

* Corresponding author. Tel.: +40-748-652283.
E-mail address: andrei.mustea@yahoo.com

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Nomenclature

b	width of specimen cross-section (mm)
h	height of specimen cross-section (mm)
L	length of specimen (mm)
A	area of specimen (mm^2)
l	distance between specimen supports, fitted in the Fruhling-Michaelis device (mm)
f_c	value of experimental mortar specimen compressive strength (N/mm^2)
F_f	force registered in the breaking moment, in the prism middle (N)
f_t	value of experimental mortar specimen flexural tensile strength (N/mm^2)
F_u	force registered in the breaking moment, under compression (N)
CSII	mortar type (lime-cement) classified according to its resistance to compression
M.R.	common mortar, own formula
M.P.	common commercially available mortar
OPC	ordinary Portland cement
PP	polypropylene
R1, R2	conventional control mortar formulae
Rf3, Rf4, etc	composite fiber reinforced mortar formulae

1.1. Theoretical background

The research starts from the idea that at present there is no design standard regarding the use of polypropylene fibers (PP fibers) in reinforced composite mortars. An alternative to existing solutions for wet reinforced mortars is wanted to be implemented. The fibers included in a proper amount can provide for a faster and much improved technology. This is the reason for which composite materials are created and developed.

Polypropylene fiber mortars are also composite materials, dispersely reinforced with fiber or particle reinforcing members, arranged in no preferential orientation. In our case, the matrix has a mineral origin, being made of cement paste. The reinforcing members are mineral grains, such as sands, or fibers, namely synthetic polypropylene (PP) fibers. Other admixtures can also be introduced, (setting time retarders, water proofing agents, etc.), the final material being produced by aggregation (agglomeration and cementation). [3]

The reinforcement provides a high resistance to the composite material and mainly takes over the loads, while the matrix works as a linking material between the reinforcing members and the environment through which the external load is transferred to the former. [4]

The fiber orientation is much more difficult to control in this specific case, but the dosage of the components can be established in the laboratory by experimental methods. The ratio of polymer fibers used as reinforcement in composite mortars is compulsory when considering the physical and mechanical properties of the materials in question.

1.2. Purpose of the paper

At present, in our domestic market, one can find only a limited range of fiber reinforced composite mortars, mainly used in many precast components, in horizontal floors, blankets or similar elements, and less in plasters, where the research seems to be less developed.

The main objective of the present study is to investigate the influence of various polypropylene fiber dosages (1,0 kg/m^3, 1,50 kg/m^3, 2,0 kg/m^3 and 3,0 kg/m^3) on the plaster mortars, to compare the results reached and to propose optimal dosages.