# CEMENT BASED FIBER-REINFORCED MORTAR: THE FIBER INFLUENCE ON THE MORTAR PERFORMANCE

**Cristiana Gonilho-Pereira*[1], Paulina Faria[2], Raul Fangueiro[3], Pedro Vinagre[1] e Ana Martins[1]**

[1]Polythecnic Institute of Setubal (ESTB) - Setúbal, Portugal
[2]Nova University of Lisbon, Faculty of Science and Technology - Caparica, Portugal
[3]University of Minho, Departament of Textil Engineering - Guimarães, Portugal
**Email:* cristiana.pereira@estbarreiro.ips.pt

## ABSTRACT

The extraction and processing of natural resources is accompanied by a significant amount of waste materials - only 1/3 of extracted raw material is used to produce industrial output; the rest 2/3 turn into waste materials and by-products (AABMCI, 2009). The textile sector is responsible for a significant percentage of the waste material produced. Nevertheless, it is also the textile sector the one that presents successful by-products and/or second-line products. Although the usage of waste fibrous materials in the building construction industry is nowadays a reality, namely in the production of thermal and acoustic insulation panels, the disposal of waste materials in landfills is still reality common practice. Waste fibrous materials are accumulated at textile factories and the technical challenge is the search for new applications for waste fibers with more added values. An interesting application for the waste fibers seems to be the reinforcement of mortars for masonry applications.

The selection of appropriate mortar mixtures is an important research problem once three main factors should be considered in their design - compatibility, durability and economy. Fiber reinforced cement based mortars have been suggested as one of the most effective methods to improve performance behavior, namely: mechanical (Segre et al, 1998); shrinkage, expansion and related phenomena which lead to cracks (Veiga, 1997), (Puertas et al, 2003); and durability (Puertas et al, 2003). Fibers present the ability to act as a bridge between the grains of the cement mortar matrix. When the fibers are uniformly distributed into the mortar, plastic shrinkage may be minimized and micro cracks are prevented from developing into macro cracks. Therefore the consequent strength reduction, water intake increase and subsequent decay of the mortar by freezing–thawing cycles, and aesthetic involvements may be avoided.

In the present paper, the behavior of cement-based mortars reinforced with waste fibers is described. An experimental work is presented which main objective is the evaluation of the influence of the percentage of fibers usage on the performance of cement based fiber-reinforced mortars.

Mortars were produced using Portland cement, CEM II/B-L 32,5N and two washed calcareous sands, coarser sand 0/4 and finer sand 0/2, with a volumetric composition of 1:6 - cement:sand (one volume of finer sand and two volumes of coarser sand). Four different mortars were prepared varying the percentage of waste fibers used to reinforce the cement-based mortars. The percentage of waste fibers was function of binder weight, according to Table 1. The waste fibers used in this study are nonwoven fabric wastes and due to its aspect ratio are categorized as micro-fibers. The waste fibers contain: 85% of cellulosic fibrous materials which most likely is cotton; 10% of polyester; 2% of wool; small % of diverse materials such as polypropylene, polyamide, among others.

The mixture of the mortars components was mechanical and the procedure was maintained constant between mixtures. Despite the percentage of waste fibers added, the same quantity of water was added. Special attention was paid to the waste fibers in order to guarantee their correct dispersion. The waste fibers were dispersed in the mixing water prior to enter in the mixer recipient. Mortar samples were produced using prismatic metallic moulds 40x40x160 mm and mechanical compaction and were subjected to 95 ± 5% relative humidity, at 20 ± 3 ºC temperature until age test – 30 days. Mortars performance evaluation was carried out through flow consistency, bulk density, dynamic modulus of elasticity, flexural and compressive strength tests and test results are presented in Table 2. Mortars presented flow consistency from 123,13mm (CF6) to 145,02 (CF2).

Table 1. Mortars composition

| Mortar ID | Volumetric composition | Waste fibers [%] | Mortar Mix |
|---|---|---|---|
| CF | 1:6 | 0 | 2 volumes of coarse sand<br>1 volume of fine sand<br>CEM II/B-L 32,5N<br>Water/Binder =0,7 |
| CF2 | | 0,125 | |
| CF4 | | 0,25 | |
| CF6 | | 0,5 | |

Table 2. Mortars tests results (average values and standard deviation- S.D.)

| Mortar ID | Bulk density [kg/m$^3$] | S.D. | Dynamic modulus of elasticity [Gpa] | S.D. | Compression Strength [Mpa] | S.D. | Flexural [Mpa] | S.D. |
|---|---|---|---|---|---|---|---|---|
| CF | 1903 | 8 | 7985 | 511 | 3,78 | 0,23 | 1,16 | 0,14 |
| CF2 | 1885 | 9 | 8978 | 258 | 4,14 | 0,32 | 1,29 | 0,10 |
| CF4 | 1881 | 10 | 7343 | 276 | 3,77 | 0,26 | 0,99 | 0,06 |
| CF6 | 1837 | 17 | 7751 | 66 | 3,83 | 0,11 | 1,21 | 0,06 |

The addition of this type of fibers can optimize the mortars characteristics and complementary mortars will be made with other percentages of fibers addition. Also complementary tests will be made in order to evaluate other mechanical (like adherence to substrate) and physical characteristics (in terms of water capillary and drying).

## REFERENCES


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