SipdECO – Development of innovative solutions for eco-efficient partition walls
(Proj.nº 3419)

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Partner Institutions: Sofalca - Soc. Central de Produtos de Cortiça, Lda; Biosafe S.A.; Pegop - Energia Eléctrica, S.A.

Period: January 2009 -

Relevant facilities: Diverse day-to-day laboratory equipment, cell test for the evaluation of thermal and acoustic behaviour of partition and enclosure walls

Objectives:

There are many by-products created in industry that can be recovered or valued for the creation of new products allowing, in this way, the decrease of environmental damages caused by its disposal in landfills and contribute to a more sustainable construction. Thus, the main aim of the project is to propose an innovative eco-efficient solution for partitions walls by valuing of several industrial by-products; (a) flue gas desulfurization (FGD) gypsum from exhaust gases of thermoelectric power plants; (b) granulate cork from insulation black cork boards and (c) textile fibres from the recycling of used tyres. Besides the study of the material by achieving the optimized composition by mixing distinct percentages of the raw materials, the design of the composite block and the technology of construction of the partitions walls should be pointed out. The main issue to be solved is the placing of electrical and hydraulic installations without making grooves after construction of the walls, reducing the waste and contributing also for the construction sustainability. In spite of partitions walls are not structural, it is intended to validate the mechanical behavior under compression, to impact loads and to eccentric compression and comparison the performance with traditional solutions. Additionally, the results of the evaluation of the thermal and the acoustic behavior should be provided. Finally, the evaluation of the sustainability of the solution is to be evaluated.

Main achievements:

The composite material results from the combination of FGD gypsum, re-granulated expanded cork, textile fibers and the setting time retarder, the citric acid. The FGD gypsum is a synthetic industrial by-product which comes from flue gas desulfurization of thermal power plants. It is chemically identical to conventional gypsum, provides more environmentally friendly applications and is highly available. Cork (part of Quercus Suber L) is a material whose characteristics are of great interest for the construction industry. It is regarded as a strategic material of great potential due to its reduced density, elasticity, compressibility, resistance to water, good vibration absorption and a good efficiency in thermal and acoustic isolation. Moreover, textile fibers obtained by recycling of used tires were also used in order to confer a greater resistance and ductility to the composite material. Four distinct compositions were analyzed, namely a pressed composition composed only of FGD gypsum and three moulded compositions (M) resulting from the combination of FGD gypsum, textile fibers and cork, by varying the percentage of cork 5, 7 and 9% mass of gypsum.

A new block has been developed for the execution of partition walls in new buildings, as well as in the rehabilitation of walls in existing buildings. The block consists of the assemblage of two symmetric halves. The block was designed so that vertical and horizontal holes are achieved.

The block has an external and rectangular part with a constant thickness of 25mm and an internal part with variable thickness, constituted of concave and convex shapes. In the concave parts, the block has a thickness of 70mm and in the convex presents a thickness of about 25mm. The connection between blocks is made through a male-female system both in bed and head joints. It is intended that the vertical joints acts as dry masonry joints and a thin layer of gypsum mortar is added at the bed joints. The major advantage of the block consists of the possibility of installation the infrastructures without the need of making holes after construction of the wall, avoiding the waste of materials and reduction of the cross section. For this, it is intended that the construction of the walls is phased according to the following steps: (1) the laying of half block up to a certain level in height; (2) installation of infrastructures and (3) connection of the other half block. The assemblage of the two half blocks is made through the perimeter of the inner face and the concave zones with appropriate adhesive material. The uniaxial compressive tests in full scale specimens and impact tests on full scale walls are under preparation.

The validation of the compressive behaviour has been carried out based on small specimens following the standard respecting the characterization of masonry and close values to the traditional systems has been found. The cell test designed to assess the thermal and acoustic performance has been calibrated on a traditional solution.

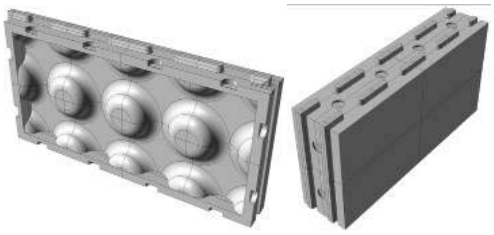

Fig. 1 Shape of the composite block for partition walls

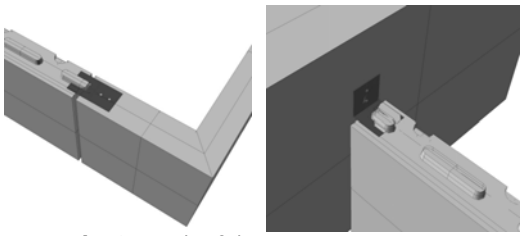

Fig. 2 Details of the constructive system

Fig. 3 Manufacture process and automatic mould

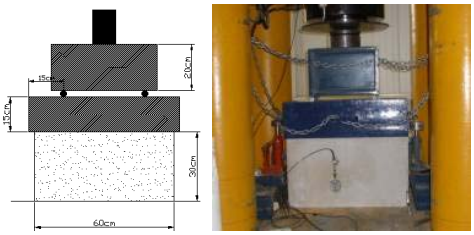

Fig. 4 Details of experimental testing on compressive tests of blocks

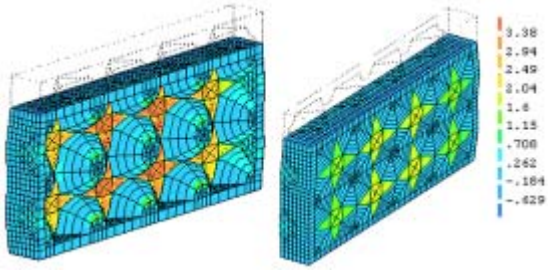

Fig. 5 Numerical simulation of composite blocks under compression

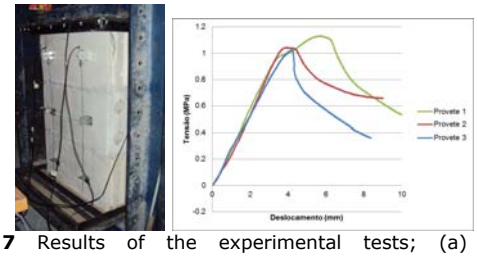

Fig. 7 Results of the experimental tests; (a) force-displacement diagrams; (b) cracking pattern

Fig. 7 Construction of specimen to uniaxial compression tests on high size specimens

Relevant publications:

Camões, A., Cardoso, C., Cunha, S., Vasconcelos, G., Medeiros, P., Eires, R., Jalali, S., Lourenço, P., Caracterização de materiais compósitos è base de FGD, 8º Congresso Nacional de Mecânica Experimental, Universidade do Minho, 21-23 de Abril, em CDRom, 2010.

Camões, A. Cardoso, C. Eires, R., Cunha, S., Vasconcelos, G., Medeiros, P., Jalali, S., Lourenço, P.B., FGD gypsum based composite for non-structural application in construction, Portugal SB10, Sustainable Building – Affordable to All, Low Cost Sustainable Solutions, 185-192, 16-18 March, 2010, Faro, Portugal.

G. Vasconcelos, E. Poletti, , P. Medeiros, P. Mendonça, P. Carvalho. S. Cunha, A. Camões, P.B. Lourenço, Innovative solution for partition walls, XXXVII IAHS World Congress on Housing, October 26 – 29, Santander, Spain, paper 178, in CDRom, 2010.

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