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PROPERTIES OF LIME BASED THERMAL MORTARS

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ABSTRACT

Nowadays, major part of residential buildings electricity consumption is used for space heating and cooling, varying greatly during day and night and leading to differentiate tariffs. The shift, to off-peak periods, of this consumption presents a clear economical advantage and it can be achieved through energy thermal storage. Latent heat thermal energy storage, through the incorporation of PCM, presents the following advantages: narrow the gap between the peak and off-peak loads, levelling the electricity demand, decreasing the load on the network and eventual supply failure; reduce operation costs by shifting the electrical consumption from peak periods to off-peak periods; contribute to the interior thermal comfort in buildings, by using and storing solar energy (for space heating in winter) and storing natural cooling by ventilation at night during the summer, thus reducing electricity use for heating and cooling [1,2].The benefits to the comfort inside buildings appear during the change of the PCM. The transferences of energy that occur during the transitions solid-liquid and liquid-solid are generally the most used to help the acclimatization of the building. For that reason the PCM must be microencapsulated. The exterior of the microcapsules is made with a polymer [1,2].

In Portugal, there are large urban areas built during the 90's and with serious thermal insulation deficiencies, presenting both a challenge and an opportunity for the rehabilitation sector. Any solution, both for new buildings or concerning rehabilitation, must therefore be based in accurate structural, material and climatic information, in order to adequately define the location, nature and quantity of PCM to incorporate [3].

Among all the PCM applications in buildings, the most interesting is its incorporation in building materials aiming to change its thermal properties. There are a number of possibilities: PCM can be used as a thermal storage medium for passive solar heating, active heating and night cooling; they can be incorporated in the floor, in walls or in the ceiling and can make part of more complex integrated electrical systems such as heat pumps and solar collectors. One big advantage of PCM incorporation in buildings structure is that buildings offer large areas for heat storage and transfer.

The main objective of this work was the production of a lime mortar with incorporation of microcapsules of PCM, which must have a compromise between the workability, mechanical strength and aesthetic appearance.

One of the problems identified in this study was cracking, which usually leads to reduction fulfilling the requirements of visual comfort, texture, tightness and even stability of the building element.

The mortars studied in this work are based in lime. The proportion of PCM was 0%, 10%, 20% and 30%. In order to minimize some problems associated with shrinkage and consequent cracking of the mortars, the incorporation of nylon fibers, superplasticizer and gypsum was tested.

Tests were made to determine the workability, flexural and compression strengths and also some sensitivity tests to check which compositions are most affected by the cracking problem. The thermal behavior was also evaluated in test cells.

Based in the results it was possible to conclude that the incorporation of microcapsules of PCM in lime mortars causes an increase in amount of water added to the mortar, as well the cracking. The incorporation of superplasticizer, nylon fibers and gypsum causes an decrease of the cracking.

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