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Novel sustainable Phase Change Material (PCM) for the energy efficiency of buildings.

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In a worldwide society growingly concerned about the increase of global energy consumption, with severe consequences on environment, the building sector is one of the most indicted. The development of novel building materials able to improve the efficiency in energy utilization is, therefore, gaining increasing interest. To this regard, the integration of Phase Change Materials (PCMs) into a building material, such as a mortar, able to absorb and release energy from/in the environment during modification in physical state (i.e. melting and solidification) as a consequence of changes in external temperature, can reduce the temperature variations in buildings, thus improve human comfort. A new sustainable "form-stable" PCM, based on low toxic/low flammable PEG polymer (Polyethylene glycol, PEG 1000) adsorbed in a waste natural material (flakes of Lecce stone, LS, derived from its extraction and processing, available as a waste product in quarry), was proposed and tested when added to different binders to produce PCM-modified mortars. The selection of PEG was based on its range of melting/solidification temperatures in relation of the intended purpose. LS is a very porous material able to absorb a great amount of a liquid PCM; it was selected also with the aim to re-use a waste material, reducing the costs of production and respecting eco-sustainable principles. The physical and thermal characterization of the composite system (LS/PEG) confirmed its suitability to act as an efficient PCM for mortars. Mortar formulations based on different binders (aerial lime, hydraulic lime, gypsum and cement) were produced adding LS/PEG as "active PCM" aggregate [1, 2]. The mortars containing the LS/PEG PCM and based on gypsum, cement and hydraulic lime proved to offer suitable mechanical properties. On some of them, i.e. those based on cement and hydraulic lime, the thermal behavior was also investigated, reproducing the characteristic thermal climatic conditions of the four seasons of the year in Mediterranean regions. The results showed that the cement-based mortar containing the LS/PEG PCM exhibits optimal thermal regulation properties [3].

[1] M. Frigione et al. Const. Build. Mater., 231 (2020), 117-149.
[2] M. Frigione et al. Materials, 12 (2019), 12-21.
[3] A. Sarcinella et al. Materials, 13 (2020), 2055.

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