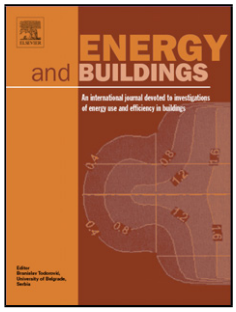

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Innovative cool roofing membrane with integrated phase change materials: Experimental characterization of morphological, thermal and optic-energy behavior

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Abstract

The capability of Phase Change Materials (PCMs) to improve indoor thermal comfort conditions and reduce cooling energy demand when included in building components is widely acknowledged. In particular, the possibility to integrate PCMs in building envelopes for latent heat storage has been largely investigated in the last decades. This study deals with the development and prototyping of an innovative cool polyurethane based membrane with PCMs inclusion for roofing applications. The thermal-optical properties of such membrane are determined through laboratory analyses. Additionally, calorimetry and nanoscale morphological tests are carried out in order to verify the effectiveness of PCMs inclusion into the medium and to define the thermal storage/release potential of PCMs with transition points at 25°C and 55°C. The composite membrane showed good workability properties even with high (i.e. 35%) PCM concentration. Optical properties were modified in the superficial layer by PCM inclusion, meaning that a further non-composite finishing layer of polyurethane is required to complete the field application of the new building material. Also, a promising thermal behavior and a consistent and effective increase of phase change enthalpy was registered with increasing PCM concentration within the polyurethane membrane. Therefore, the combination of cool materials and thermal storage effect produced promising results as passive technique for building thermal energy efficiency, also highlighted by the relatively simple production process of the shape stabilized PCM inclusion.