New technologies for energy storage applied to Cultural Heritage buildings: the microclimatic monitoring of S. Croce Museum in Florence

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Abstract

The energy management of historical buildings devoted to cultural heritage conservation and/or exhibition is a well known problem. The knowledge and technology developed in the civil field can give new solutions to this complex problem, but they need to be adapted to specific requirements. In fact, when dealing with cultural heritage, besides the important objectives of economy and people comfort, the microclimatic conditions have to be suitable for the conservation of the works of art preserved, taking into account the compatibility of the different materials. Moreover, very often the historical buildings housing the works of art need also to be preserved, so the adaptation of the new technologies hasn't freedom of action. Critical points are for example the confined spaces for installation, the need to reduce the aesthetic impact, the non-destructivity and reversibility of the interventions.

The overall objective of the European MESSIB (*Multi-source Energy Storage System Integrated in Buildings*) project is the development, evaluation and demonstration of an affordable multi-source energy storage system integrated in buildings, based on new materials, technologies and control systems, for significant reduction of its energy consumption, improvement of energy management in terms of quality, security and indoor environment.

This paper presents the application of the PCMs (*Phase Change Materials*) technology developed within MESSIB project in the S. Croce Museum in Florence. The heating system in the museum dates back to the 70's and its terminals consist of radiators and fan-coil elements. None conditioning system is installed. The microclimatic monitoring performed in the museum has singled out wide daily thermo-hygrometric cycles experienced by the internal atmosphere especially in summer and winter. These cycles could have negative effects on the conditions of the works of art preserved, especially the ones characterized by low thermal inertia, such as canvas paintings.

Laboratory tests have been set up to evaluate VOCs (Volatile Organic Compounds) emissions by PCMs, before installing them in the field. PCMs with different melting points, chosen on the basis of the thermal levels measured in the museum, will be exposed in controlled atmosphere to different values of temperature and relative humidity. Both PCMs powder sample and PCMs incorporated in a building material, i.e. gypsum, will be tested. Gypsum panels with and without PCMs will be installed in two rooms of the S. Croce Museum in Florence in order to evaluate their effect in the reduction of thermal cycles experienced by canvas paintings.

The results of the laboratory tests and of the field application will be presented and discussed.