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TECHNICAL TEXTILES AND THIN INSULATION MATERIALS. NEW SCENARIOS FOR THE ENERGETIC RETROFITTING

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Abstract

In the building sector, there is a growing interest in the technical textiles, in particular as components for facades and also as potential replacements for the current options that seek energy efficiency through mass. The role of textiles in retrofitting from inside rooms is gaining more importance. The traditional wallpaper is evolving to interactive renovation possibilities by smart textiles, till to the thermal retrofitting. The paper deepens the feasible integration between wall covering textiles and thin super-insulating materials, coupling thermal function with sensorial and aesthetic ones. The goal is to identify which materials are suitable to achieve the new smart component.

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Keywords: Wallpaper; retrofitting; smart textiles; insulation materials; interactive surface.

1. Introduction

In the last decades the European Community has developed an energetic strategy that more and more takes into account the indissoluble link between energetic politics, environmental changes and environment's protection [1]. In this context should be considered that the building sector is one of the key consumers of energy in Europe where energy use in buildings has seen overall a rising trend over the past 20 years. In 2009, European households were responsible for 68% of the total final energy use in buildings [2]. Their construction technology is marked by the usage of massive materials, heavy, characterized by high thicknesses, both for the newly constructed building's interventions that for the already existent building's interventions. But the current tendencies show that the lifestyles are changing and new materials are becoming more and more important in the conservative world of the constructions. Among these materials, the textiles are taking over more and more market shares. They have been

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used for many years mainly as waterproof membranes and traditional wallpapers, while recently they are becoming more often the key component of innovative textile façades, shading systems and even components for the aesthetic and thermal retrofitting, thanks to flexibility, lightness, thinness and aesthetic qualities. Globally their characterization is improving and their function transformed the idea of a simple finishing layer into the concept of a dispenser with multiple functions. New textiles, so called "smart textiles", integrate in the membrane itself a high-technology content, seeming invisible. They become sensible, almost get sensorial qualities, becoming receptive to the pressure, the heat, the sounds, etc.

Focusing on the increasing need of building retrofitting and stating the current social trends towards individualization of use of living spaces in Open Buildings [3], with the introduction of architectural components with shorter use-life, such as finishing components, partitioning, ceilings, the role of textiles from the inside retrofitting is gaining more importance. The traditional wallpaper, with the minimal function of finishing layer with a wide range of pattern, is evolving to interactive renovation possibilities by smart textiles, till to the thermal retrofitting by coupling of thin insulation materials.

Nomenclature

U	thermal transmittance	ρ	density
R	thermal resistance	ε	emissivity of the surface
λ	thermal conductivity	h_r	radiative coefficient
d	insulation thickness	+ %	percentage improvements in thermal resistance

2. Objectives

By deepening the evolution of the traditional wallpaper towards new forms of interactive walls and the state of the art of the smart textiles, the study aims to foresee new components coupling a thermal function of the wallpaper with the sensorial and aesthetic ones. The objective is to suggest new possible combinations in order to guarantee: energy saving, high-technology content with new functions, restoration of the wall's aesthetic features, dematerialisation of the thicknesses. The main core of the paper is the computation of the thin insulation materials' contributes, as potential and functional addition to a new concept of "thermal" wallpapers.

3. Methodology

The paper firstly investigates the state of the art of smart textiles, in order to understand which could be able, for their features, to represent a wall covering of the insulation layer from inside the buildings, with the possible additional functions. The state of the art, we are considering, overcomes of the traditional concept of wall covering, e.g. plasters, painting, tiles, glued or nailed wallpapers, and shows the most advanced development of "smart textiles" as new active/interactive wallpapers.

Then flexible and thin insulation materials, able to be the insulation layer in a thermal retrofitting from inside the building are analysed. Their physical behaviours are deepened and compared, focusing on steady state of the thermal performances according to the standard UNI EN ISO 6946-2008, with a thickness of 7.5 mm as requirement, to be compatible with a "thermal" wallpaper (tab. 1). The economical impact of these insulation materials, rated using the available market products with a thickness $d \leq 10$ mm, was computed (the functional unit used is $R=0.1 m^2K/W$). A least the rate of the R increase, by coupling with low-e finishing textiles, according to UNI EN ISO 6946-2008, was assessed and the performance increase obtainable with PCM textiles, starting from literature data, was analysed.

The thermal computations were conducted on a brickwork cavity wall (30cm thick) with a $U = 1.1 W/m^2K$.

4. Smart textiles for smart wall covering

Smart textiles, thanks to their ability to response to a stimulus and/or thanks to their high-technology content, can guarantee additional functions. With the basic technology already available, the area of intelligent textile materials, like electrically conductive yarns and pressure sensitive fabrics, and that of sensitive textile materials, like electro active, color and optically changing materials, the textile industry is going to have a cutting-edge change. On one