

Information Paper

Advanced thermal insulation technologies in the built environment

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This Information Paper reviews thermal insulation products, with a focus on advanced thermal insulation technologies such as aerogels, vacuum insulated panels, gas-filled panels and phase change materials. Traditional insulation materials – such as glass, mineral wool and expanded or extruded polystyrene – are robust with respect to resistance to perforation and flexibility, so it is possible to cut to fit these at the building site. However, these have relatively high thermal conductivity values, which may require very thick building envelopes in order to achieve the goals of highly energy efficient buildings in cold climates. Renewable materials, such as wool and straw, may also require significant bulk and thickness to meet the requirements of the UK building regulations.

There is ever-increasing pressure to reduce energy use in buildings and its associated carbon dioxide emissions, and demands on thermal insulation to achieve this by preventing heat loss (Figure 1) with minimal extra bulk. Millions of homes without cavity walls also require internal or external solutions. As energy prices rise, the demand for and commercial value of new and innovative insulation solutions will rise accordingly.

Advanced types of insulation materials offer potential for either new insulation products or for combining with existing materials to achieve a greater effect. Aerogels, based on a variety of raw materials, appear to offer great potential as insulation: although more expensive than current insulation at approximately five times the cost of polyurethane, the cost is falling with increased production. Phase change materials offer a way of capturing heat, stabilising internal conditions and substituting for thermal mass in timber-frame, steel-frame and lightweight masonry buildings.



Figure 1: A thermogram of a street visualising heat in the roof of one of the terrace of houses (suggesting poor or no loft insulation), the same property's door and the engine of a recently parked car

This publication provides important background information on the advanced insulation technologies and is aimed at those designing and constructing new buildings as well as those refurbishing older buildings. After reading this paper they will be able to understand whether advanced insulation products have a role to play in their project.

Background

Maintaining acceptable temperatures in buildings (by heating and cooling) consumes a large amount of energy, which is responsible for significant greenhouse gas emissions. There is therefore a need to improve the energy efficiency of buildings. Carbon dioxide (CO₂) emissions from UK buildings (domestic and non-domestic) accounted for 226 million tonnes of carbon dioxide (MtCO₂) in 2006. This represented around 40% of the total CO₂ emissions in the UK, which amounted to 555 MtCO₂^[1]. Domestic buildings alone are responsible for 27% of UK CO₂ emissions^[2].