

Saving tomorrow's world

In their final article on smart materials, Chris Mahony and Kevin Tinkham look forward to new technologies and how they could benefit the built environment

Aerogels are particularly attractive as insulating materials due to their light weight – typically just 15 times heavier than air – and extremely low thermal conductivity

Design trends come and go and the popularity of specific building materials fluctuates but, for a variety of reasons, the construction sector is generally quite conservative in its choice of materials and technologies. However, as Bob Dylan once wrote (though, we suspect, not about the construction sector) "The times they are a-changin".

The construction industry is worth £100bn per year to the UK economy but it also creates about 45% of UK CO₂ emissions, one third of all landfill and consumes 25% of all raw materials – hence why construction is a major focus for government sustainability targets. For example, the UK government has committed to reduce greenhouse gas emissions over the next 40 years by 80% (compared with 1990 levels) and all new houses built after 2016 should be zero carbon. These targets are ambitious and the technical challenges are demanding, so in this article we look at technologies that may help us to meet these goals.

Aerogel insulation

Aerogels are a diverse class of porous solid materials. They consist of open-celled, solid foams composed of a network of interconnected nanostructures and most have porosity levels of between 90 and 99.8%. Aerogels also exhibit a wide range of extreme properties and hold records including the lowest density solid (0.0011 g cm⁻³), the highest specific surface area for a monolithic material (3200 m g⁻¹) and the lowest thermal conductivity (0.013 W/mK).

In construction, aerogels are attractive as insulating materials due to their light weight – typically just 15 times heavier than air – and

extremely low thermal conductivity. Developed in the US by

Aspen Aerogels, the

Spacetherm family of insulating products is now supplied in the UK by

Proctor Group. By combining a silica aerogel

with a robust polyester carrier it is possible to manufacture highly insulating laminate chipboard and plasterboard.

Aerogel insulating products have only recently entered the UK construction sector but are suitable for both new build and refurbishment programmes. As always, care must be taken to follow installation instructions accurately but no specialist training is required. Once in place, Spacetherm products look like any other lining boards and can be decorated in the same way.

OLED lighting

Lighting in buildings accounts for around one sixth of electricity use in the UK. Given the targets for zero carbon buildings and greenhouse gas reductions, this is an area of significant activity and development. Most of us will be aware of the programme to replace traditional incandescent light bulbs with more energy-efficient bulbs and the energy saving potential of LED lighting. Less well known is organic LED (OLED) lighting, but it is this technology that LOMOX is developing for ultra-efficient lighting applications.

The LOMOX OLED lighting, which is currently in development, is said to be 2.5 times more efficient than current energy saving bulbs and has the potential to reduce CO₂ emissions globally by almost 7.5m tonnes by 2050. When coated onto a film, OLEDs could be used to cover walls creating, in effect, a light-emitting wallpaper that would replace conventional bulbs entirely.

In addition to being flexible, OLED film will only require a very low operating voltage (3 to 5 volts), meaning it will be capable of being powered by batteries or solar panels. Hence, OLED lighting will be suitable even for remote sites and can be powered by renewable energy technology.

Nanoparticle heat pumps

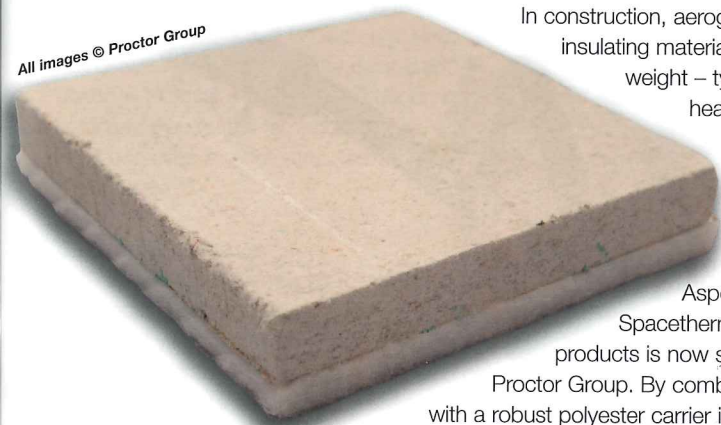
Though still at the research stage, scientists at the University of Technology in Sydney have recently described the idea of a heat pump based on nanoparticles to cool buildings without the need for energy-intensive air-conditioning. The idea is based on the 'night sky cooling' effect, in which the energy absorbed by a surface during the day is emitted back into the atmosphere at night.

Much of the heat emitted at night is reabsorbed by the atmosphere and subsequently re-emitted back to the earth's surface (and some gases, such as CO₂, are very good at absorbing radiation – but you would not want extra amounts of these in the atmosphere). However, some wavelengths – between 7.9 and 13µm – are less likely to be absorbed and the researchers have found that a mixture of silicon carbide and silicon dioxide nanoparticles emits heat radiation within this range. In the heat pump, air or water would flow in channels beneath a plate coated with the nanoparticle mix. The coating would emit radiation and cool the air or water beneath.

Colour change roofs

We have previously discussed the advantages of reflective roof panels to keep internal spaces cooler in hot weather and to reduce stresses on timber joists (see *Paint: the final frontier*, p24, BSJ, Jan/Feb 10). >>>

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Spacetherm-F is a high-performance laminate comprising Spacetherm insulation blanket bonded to Fermacell. The strength and fire resistance properties of Fermacell and the thermal insulation properties of Spacetherm combine to give a versatile insulated lining board