

# CIBSE

JOURNAL



The official magazine of the Chartered Institution of Building Services Engineers

July 2012

## LOW-ENERGY LEGACY

OLYMPIC AQUATICS CENTRE AIMS FOR DEEP CARBON SAVINGS

**ACTIVE COLLABORATION**  
CIBSE PRESIDENTS SHARE  
THEIR STRATEGIC VISION

**STORING AIRCON HEAT**  
THE CIBSE AWARD-WINNING  
DATUM PHASE CHANGE

**MODEL CHALLENGE**  
THE DIFFICULTIES OF MAKING  
BIM A PRACTICAL REALITY

**CAR PARK VENTILATION**  
ANALYSIS OF CURRENT  
STANDARDS AND GUIDES





# NATURAL BORN REMEDY

**CIBSE BUILDING  
PERFORMANCE  
AWARDS 2012  
WINNER**  
RECOGNISING EXCELLENCE  
IN MAKING BUILDINGS WORK

Datum Phase Change's RACUS system claims to be the first bio-based passive phase change material to be used in building services systems. **Andrew Brister** takes a look at this CIBSE award-winning innovation

**S**oya is good for you, right? Well, when it comes in the shape of Datum Phase Change's RACUS system, it certainly could prove to be good for the environment, too. RACUS, which stands for Reducing Air Conditioning Units and Systems, is a passive suspended ceiling tile incorporating bio-based phase change material (PCM) that makes use of the oil and fatty acids from the soya plant.

The company behind RACUS, Datum Phase Change, has designed and patented a number of building products incorporating organic, inorganic and eutectic PCMs.

Datum claims that this is the world's first bio-based PCM ceiling tile that absorbs, stores and releases latent heat gains to achieve indoor comfort for occupants, and to reduce the energy demand of HVAC systems.

'In our latest generation of PCMs, we've moved away from paraffin-based materials to soya-based modules,' explains Mike Berry, managing director of Datum Phase Change. 'With soya, we can achieve twice the thermal storage capacity and they are biodegradable, which is very important to clients that are considering cradle-to-grave solutions.'



The CIBSE Building Performance Awards recognise, reward and celebrate the best performance, innovation and practice in design, commissioning, construction, installation and operation of sustainable buildings and the manufacturers whose technologies enable energy efficiency.

For further information on this year's winners, as well as details of how to enter the 2013 awards, please visit [www.cibseawards.org](http://www.cibseawards.org)

➤ The RACUS ceiling tile was developed for new and retrofit building projects where there is a need to reduce the carbon emissions associated with traditional air conditioning systems, and to give thermal mass to lightweight structures in a passive, easy-to-install ceiling system. It caught the eyes of the judges in the recent CIBSE Building Performance Awards 2012, where it won the Passive (energy-related) Product of the Year category.

The product has been extensively tested, both under laboratory conditions at Brunel University London using its thermal chamber test facility, and at live, independently monitored projects.

The testing at Brunel University London examined the effect of the RACUS ceiling tile on the temperature inside a test cell, repeatedly subjected to typical summer day and night temperatures under different states of ventilation in a climate chamber. The test cell was designed to simulate an actual room that contained a 150W electrical heater to provide a cooling load.

Results from the testing at Brunel showed that when the RACUS tiles were installed, indoor temperatures were reduced by between 2C and 7C for different ventilation rates, proving that the RACUS PCM tested had an important thermal energy storage potential in ceiling tiles (see Figure 1).

But would the product break down over time? Datum carried out more than 45,000 thermal cycle tests on RACUS to determine the longevity of the bio-based PCM and found no deterioration. This equates to a life-cycle performance of more

than 122 years. Additional analysis included biodegradability testing, which showed that under aerobic conditions, 100% biodegradability of the PCM occurred in less than 12 months. The binding formulation of the RACUS ceiling tile is made using various natural minerals which, in contact with soil, act as a soil improver and fertiliser.

So how has the product performed in practice? Datum was asked by MITIE Facility Management to incorporate the RACUS ceiling tile into two of MITIE's clients' buildings so that they could monitor the performance. MITIE was looking at options to meet their clients' objectives of significantly reducing both their annual energy use and carbon footprint, under the Carbon Reduction Commitment legislation.

**Ofcom head office**

The RACUS ceiling tile was installed into Ofcom's head office in London. The trial took place in two identical, adjacent meeting rooms, with each room making use of fan coil units to provide comfort cooling. Temperature sensors and data loggers were installed by MITIE, which also recorded the occupancy rates in each room.

In one room, 25% of the ceiling area was installed with the RACUS ceiling tile; the other was left as it was. Over an initial 45-day period, the result of MITIE's monitoring showed that the fan coil units in the room without RACUS operated for 257 hours, compared to just over seven hours in the room with RACUS. That equates to a massive 97% reduction in energy use – an estimated annual saving of more than £1,520 and 7 tonnes of CO2 per room (see Figure 2).

A further seven meeting rooms were installed and monitored and Ofcom was able to turn off the fan coil units completely as the RACUS ceiling tile was able to provide sufficient cooling to maintain comfort conditions. Annual cost savings were estimated to be more than £10,650, with a reduction of 49 tonnes of CO2. This equates to an estimated payback period of 2.92 years.

'It's not just about being green,' says Mike Berry. 'RACUS has to perform and offer a competitive payback for clients and it does.'

**Great Ormond Street Hospital**

RACUS has also been fitted at Great Ormond Street Hospital, London.

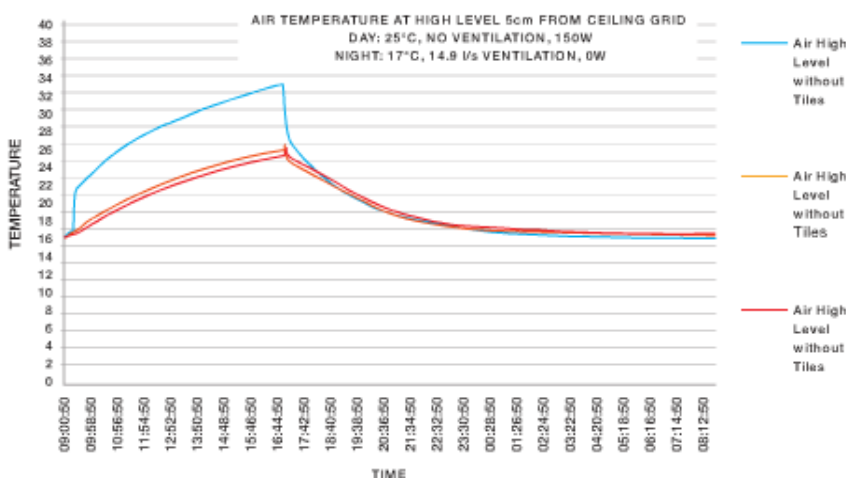


Figure 1: Testing at Brunel University London examined the effect of the RACUS ceiling tile on the temperature inside a test cell, repeatedly subjected to typical summer day and night temperatures under different states of ventilation in a climate chamber

This is a listed building that was experiencing severe overheating problems in certain areas where there are no HVAC systems in place.

Indeed, internal temperatures as high as 36°C were being recorded in some consulting rooms, and this when the average external temperature was monitored at around 20°C to 21°C.

Given the unusually high heat gains, Datum decided to incorporate a honeycomb tile to give more cooling capability. This is an aluminium tray with an aluminium honeycomb insert filled with the RACUS PCM compound.

The benefit of this particular tile format is that it can incorporate a greater concentration of PCM within each honeycomb cell, thus improving the heat transfer rate through the matrix of the RACUS PCM compound.

At Great Ormond Street, two adjacent and identical consulting rooms were selected, and again both rooms were monitored using heat flux sensors and data loggers for a period of two months. The monitoring results identified that the RACUS ceiling tile was able to reduce the room temperature to 4°C below that of the adjacent room without RACUS, maintaining temperatures at a more comfortable 25°C to 26°C.

'We strongly believe that the RACUS ceiling tile is a fantastic innovation that is easily installed in new and retrofit projects where there is a demand for space cooling and thermal mass requirements utilising a passive system,' says Mike Berry.

Indeed, the company has just won a £3m order for a company headquarters building in Barcelona. The future looks very healthy for soya. **CJ**

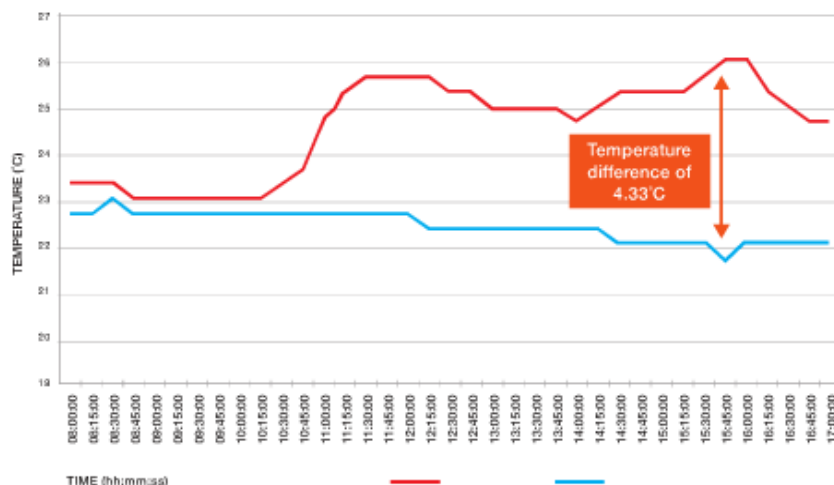


Figure 2: The Ofcom head office trial took place in two identical, adjacent meeting rooms, with each room making use of fan coil units to provide comfort cooling. Temperature sensors and data loggers were installed by MITIE, which also recorded the occupancy rates in each room

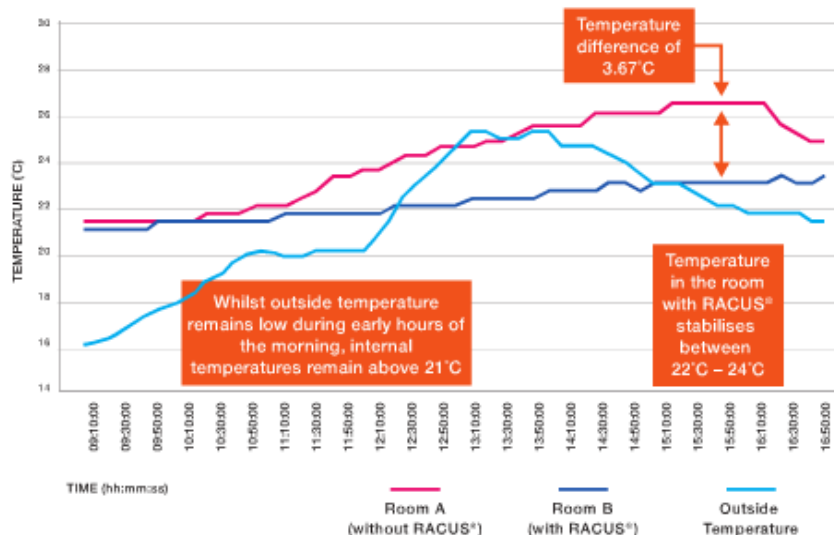


Figure 3: At Great Ormond Street Hospital, two adjacent and identical consulting rooms were monitored using heat flux sensors and data loggers for a period of two months. The monitoring results identified that the RACUS ceiling tile was able to reduce the room temperature to almost 4°C below that of the adjacent room without RACUS



## Fatty acids: The basis of Datum's organic phase change material

Phase change materials have several forms such as organics, inorganics, or eutectics (a combination of both). The RACUS ceiling tile uses an organic microencapsulated phase change material (PCM), derived from soya oils and fatty acids that, according to Datum, has twice the heat storage capacity of alternative organic PCMs, such as petroleum-based PCM or inorganic salt hydrates. Datum claims its bio-PCM is the only organic PCM on the market today that is biodegradable within 12 months, compared to more than 100 years



for petroleum-based PCMs.

PCMs store energy in a latent form. They undergo an endothermic process of phase change to store heat energy when ambient temperature rises, and an exothermic process to release this energy when the temperature drops. In building applications,

these processes are desirable in a narrow temperature range close to the human comfort temperature, with large amounts of heat being absorbed and released.

During the transition phases, the core of the microcapsule will melt as the room temperature reaches this temperature, and in doing so will be stored until such time as the room temperature cools to around 20°C. At this point the PCM core has started to solidify and emit the stored latent heat.

The RACUS ceiling tile is available in two formats. The

first is a preformed mineral tile incorporating various abundant minerals that encapsulate the bio-PCM microcapsules. This tile has a latent heat storage capacity of up to 75Wh/sq m, and can easily replace a standard mineral fibre tile using the existing suspended ceiling grid.

The second is a metal ceiling tile that is predominantly used in commercial buildings, and is a composite panel assembly comprising a solid or acoustic metal tile with a RACUS insert, having a higher latent heat storage capacity of up to 224Wh/sq m.