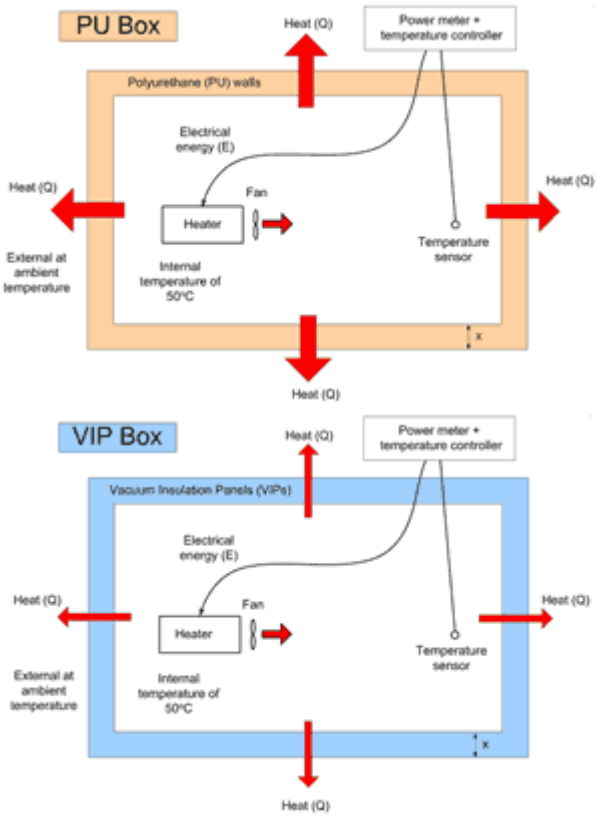
Vacuum insulation panel energy efficiency demonstrator for the Food Processing Faraday Partnership Ltd

Background



Vacuum insulating panels (VIPs) are a highly efficient insulation material that can be used for reducing the external size, increasing the internal size or increasing the thermal performance of many kinds of insulated containers and spaces.

For more information on VIPs, see the VIPs research topics page and for more information on a previous frperc VIP research project, use the following link to the VIP project page.

frperc have designed and built an energy efficiency prototype for the Food Processing Faraday Partnership Ltd (FPFP) to demonstrate the energy saving aspects of VIPs.

The prototype was first displayed at a conference on Energy Efficiency in the Food and Drink Industry held on 12 January 2005 at Hazlewood Castle, near York. FPFP planned to use the demonstrator as a portable, energy-saving demonstrator at later conferences and seminars.

Project results

The demonstrator was designed and built over a short time scale to show the energy savings that could be achieved by replacing standard polyurethane (PU) insulation panels on a small insulated container with equivalent thickness VIP panels.

Two boxes were made, both with internal dimensions of 295mm long by 185mm wide by 260mm high, and floor, wall and lid thicknesses of 40mm. One was made with PU as the insulating material, and one with VIP panels.

During operation, the insides of the boxes are maintained at a constant, elevated temperature (50°C) in order to maintain a steady temperature difference between the inside and outside of each box. This is achieved using a heater with a circulation fan, controlled by a temperature controller, which measures the temperature within the container using a thermocouple.

Power meters attached to each of the fan-heater power cables measure the energy each fan and heater needs to input into the boxes to maintain the temperature at 50°C.

This demonstrates the power required to maintain hotter-than-ambient temperatures in the boxes but equally gives a comparison of the cooling powers that would be required to keep the insides of the boxes below ambient temperatures (under chilled or frozen conditions).

A larger version of the PU and VIP setup diagrams can be viewed by using the following link to the Enlarged image page. Both of the temperature controllers and power meters were incorporated into a sealed enclosure so that they could be seen side by side. The demonstrator was built so that it could was compact and could be set up easily for future demonstrations.

A simple comparison of mid-panel conductivities for VIPs and PU panels would suggest an insulation performance ratio of 5:1. However, results from the demonstrator showed that the VIP box requires approximately half the heat input to the PU box in order to maintain 50°C, equating to a performance ratio of 2:1.

This is typical of many practical applications of VIPs, and is mainly due to heat transfer at the relatively high conductivity edges of the VIPs, due to the laminate film that covers the panels. This problem is especially prevalent when the panels are small in surface area relative to their thickness, as in the case of the panels used in these boxes. Larger panels that may be used for larger boxes, rooms, etc. should not exhibit such large edge effect problems.

Although the improvement in thermal performance was not as good as would be predicted from the mid-panel conductivities, the resultant impact of saving half of the energy used to maintain hot or cold temperatures is still significant.

Contacts

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