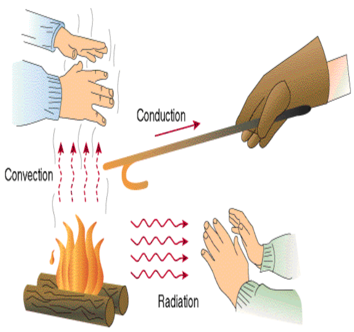
Heat Reflecting Membranes

The technology explained

Long-life Heat Reflecting Membranes (HRM's) made from a various sheet materials were conceived by NASA space scientists to protect orbiting craft from solar radiation. This heat control technology has spawned a variety of terrestrial applications. These include the famous "space" blankets that keep athletes and accident victim's warm, heat-reflecting sheaths for water tanks, air- conditioning ducts, heat-sensitive equipment and even Formula One racing car components.

Apollo Energy Research HRM's are a further development where mass production techniques have provided tough, cost-effective membranes for use within domestic buildings.

HRM I being installed in an attic room prior to fitting plasterboard



Heat transfer by: Conduction, Convection and Radiation

Introduction

There are many types of insulation available that reduce heat gain and heat loss.
Some materials provide greater resistance to heat transfer than others depending on the mode of heat transfer: radiation, conduction or convection.

The concept behind a Heat Reflecting Membranes

The primary function of a Heat Reflecting Membrane (HRM) is to block infrared energy radiating across air spaces. Infrared energy (radiation) converts to conducted heat when it strikes a surface such as a wall or roof. The energy transmits through materials, molecule to molecule, until it reaches the next air space where it then radiates from the surface to the next object. The molecules of air touching the solid surface warm, so energy can also leave the surface as rising convective air currents.

A HRM works either by reflecting back most of the radiating infrared energy striking its bright non-tarnish surface (reflectance) or by *not radiating heat* (emittance).
Emissivity is a measure of the amount of heat a surface can either absorb or emit.
For instance, an emissivity value of 1.0 represents a perfect absorber or emitter of infrared energy. Typically, most building materials have an emissivity value of between 0.85 and 0.95 (see table overleaf). Heat Reflecting Membranes from Apollo have an emissivity of less than 0.05, so more than 95% of the radiant heat is blocked. Whether stated as reflectance or emittance, the performance is the same; an HRM effectively blocks the passage of infrared energy through structures.
To act as a radiant barrier the HRM is installed within a structure facing at least one air space, usually 19 to 25mm. Heat conducting through the structure and crossing the air space as infrared energy is then blocked by the membrane.

Eliminating infiltration and air leakage

It is generally accepted that air leakage and infiltration through a building have a detrimental effect on energy efficiency and the comfort level of occupants. In temperate climates during winter, warm air can be literally blown or sucked out of building's and be replaced by cold, damp air. Apollo membranes incorporate layers of aluminium film and vacuum-metallised polymer so they are easily moulded around adjacent framework (see photograph) and once positioned will not spring back. Apollo's aluminium-faced, self-adhesive tape is then used to seal joins between sheets of membrane, around doors, windows and other fittings, obviating the need for many of the mastics usually employed.
Assuming outer doors and windows are of adequate specification to stop unwanted draughts, by sealing the envelope of the building, factors for air infiltration and leakage may be eliminated from the energy calculation. In addition, the flow of ventilation air through rooms is easier to control as it is not disrupted by unwanted draughts or stack effect where buoyant air in the building can draw in outside air. This is good news for the home builder and their heating contractor who needs only to calculate for the ventilation required.
Used in floor construction, the system can also restrict the ingress of methane and carbon dioxide from landfill sites and the movement of airborne radon from subsoil into the home.

An excellent vapour barrier

With low moisture transmission rates, Apollo HRM Systems, also act as excellent vapour barriers, halting moisture migration into the building's other insulation layers. The systems ensure "mass" insulation materials keep dry and maintain their performance.

Attic room example

An Apollo HRM system used to line an attic room will reduce the thickness of the soft insulation required, substantially reduce energy needs and improve comfort for occupants. The membrane eliminates excessive heat gain caused by incoming solar radiation yet can keep the room warm during cold weather. No matter the season, room temperatures are far easier to control.
Normally, solar heat striking a roof will conduct through the tiles and insulation layers crossing any air spaces as unwanted infrared energy, eventually warming the plasterboard and over heating the room.

Continued

Conversely, useful heat from within the room will conduct through the plasterboard, radiate across any air space into the insulation and be lost. In both scenarios the HRM system blocks the radiating heat. Furthermore it can show the thickness of fibre insulation can be reduced from say 130mm to less than 90mm with the product installed and still achieve the U values required by the current Building Regulations.

Under-floor heating example

A number of under-floor heating suppliers have discovered how Eco-Brite UF greatly improves heat distribution when installed below their piped systems. With heating pipes located under the flooring a high percentage of the heat radiates downwards and is wastefully absorbed into the foundation void. Draped over the floor joists and below the pipes, the HRM membrane reflects the radiating heat back up to the floor, warming its surface more rapidly and evenly so providing better temperature control and comfort levels in the room".

In conjunction with fibre insulation, Apollo HRM,s can provide the most cost-efficient insulating method available that meets the requirements of current Building Regulations.

Nominal infrared *emissivity value of materials commonly used in the building industry.
i.e. Emission of energy from a surface. 0.05 nominal emissivity value = 95% reflectivity

Material /surface	Nominal emissivity value	Infrared reflectivity %
Asphalt	0.90 to 0.98	10 to 2
Brick	0.93	7
Concrete	0.85 to 0.95	15 to 5
Normal window glass	0.95	5
Low E window glass (Low Emissivity)	0.15	85
Fibreglass / cellulose	0.80 to 0.90	20 to 10
Iron (polished)	0.06	94
Iron (rusty)	0.85	15
Limestone	0.36 to 0.90	64 to 10
Marble	0.93	7
Paint (depending on colour and surface finish	0.80 to 0.91	20 to 9
White paper	0.92	8
White plaster	0.91	9
Wood	0.90	10
Medium density polyurethane insulation foam	0.85 to 0.90	15 to 10
Heat Reflecting non-tarnish aluminium surface on Apollo HRM products	0.04	96
If an aluminium surface is tarnished or dull then the emissivity value can be 0.80		
NB: Reflective materials as used by NASA	Emissivity = 0.03 to 0.04	

*Emissivity is the ability of a surface to absorb or emit electromagnetic radiation.

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