

Which Material?

Types of insulation

There is a very broad spectrum of insulation materials available on the market, with an equally broad variance in form, performance, sustainability, cost-effectiveness and availability. Some of the key types of insulant and their characteristics are set out below. Essentially there are four different types of insulation: glass and rock mineral wool; multi-foil layered, extruded polystyrene and extruded polyethylene. These in turn fall into two basic categories bulk insulation and foil insulation.

It is safe to say that one method of insulation doesn't necessarily suit all situations.

Bulk Insulation

Bulk insulation resists the transfer of heat, by relying on pockets of trapped air or gas within its structure and its thermal resistance is consistent regardless of the direction of heat flow through it. Bulk insulation includes materials such as glass and rock mineral wool, cellulose fibre, and rigid plastic insulation boards.

All products have a specific thermal resistance for a given thickness of material at a given temperature.

Mineral wool:

There are two basic types of mineral wool insulation:

Glass Mineral Wool

Glass mineral wool is made from sand and recycled glass, limestone and soda ash. These are the same ingredients that are used to make familiar glass objects such as window panes or glass bottles. The glass is spun to form millions of fine fibres. A resin is used to bind the fibres together to form a mat of material. The density of the product determines whether the insulation is a lightweight quilt supplied in rolls, a flexible slab or a rigid slab, and its thermal insulation value.

- **Characteristics:**

- Long fibre, giving good tear strength
- Suitable for temperatures up to 230 °C
- Non-combustible
- Lightweight
- Available in rolls and slabs

- **Main uses:**

- Loft Insulation
- Cavity wall insulation
- Sound insulation (absorption) within partitions and floors

Rock Mineral Wool

Rock mineral wool is made mainly from volcanic rock, typically basalt and/or dolomite. An increasing proportion is now recycled material from slag, a waste product from blast furnaces. The materials are melted and then spun into fine fibres. A resin is used to bind the fibres together to form a mat of insulation.

- Characteristics:

- Short fibre - compressive strength
- Non-combustible suitable for temperatures up to 850 °C
- Denser than glass mineral wool
- Available in the form of slabs, rolls and mattresses
- High compressive strength

- Main uses:

- Thermal insulation of flat roofs, rain screen façades and external wall insulation
- Fire protection, including smoke and fire barriers
- High temperature applications
- Sound insulation for floors and walls

Foamed plastics:

There are four main types of plastic insulation:

1. Extruded Polystyrene (XPS)

Extruded polystyrene (XPS) is made by mixing polystyrene pellets with various ingredients to liquefy them. A blowing agent is then injected into the mixture, to form gas bubbles. Next, the foaming liquid is forced through a shaping die. When cooled, it produces closed-cell foam that is rigid and moisture resistant.

- Characteristics:

- Lightweight
- Very rigid
- Excellent water resistance
- Suitable for temperatures up to 75 °C
- Typically available in 2.4m x 1.2m or 2.4m x 0.6m sheets
- Can be cut to various component shapes and thicknesses

- Main uses:

- Solid ground floor
- Flat roofs
- Heavy duty floor insulation
- Panels and other fabrication applications

2. Extruded Polyethylene (XPE)

Extruded polyethylene (XPE) is made by mixing polyethylene pellets and other ingredients; a blowing agent is injected in liquid form causing a foaming reaction. A conical shaping die is used to shape and form the XPE, producing a material that quickly cools into a flexible, closed cell plastic foam.

- Characteristics:
 - Lightweight
 - Excellent acoustic properties
 - Excellent moisture resistance
 - Good compression resistance
 - Typically sold in roll form
 - Available in cut component rolls

- Main uses:
 - Resilient layer in acoustic floors
 - Flexible edge strip in screeded floors
 - Packaging

3. Expanded Polystyrene (EPS)

Expanded polystyrene (EPS) is manufactured from small spherical beads of styrene which are pre-expanded with Pentane. The beads then expand to over 40 times their original size when heated by steam. The expanded beads stick together under heat and pressure inside a mould and the finished product consists of approximately 98% fresh air.

Expanded polystyrene is also known as 'bead board'.

- Characteristics
 - White/grey colour
 - Lightweight
 - Suitable for temperatures up to 75 °C
 - Mainly available in 2.4m x 1.2m sheets

- Main uses:
 - General/domestic-floor insulation
 - Wall insulation
 - Packaging and fabrication

4. Polyurethane (PUR) and Polyisocyanurate (PIR)

Polyurethane (PUR) is produced by blowing a non CFC (chlorofluorocarbon) gas (usually Hydro Carbon Pentane) into urethane resin to produce a free foaming insulant (the gas used helps to improve the thermal performance of the product, but gradually escapes into the atmosphere over time). For this reason (and to stabilise the foam into boards), polyurethane and polyisocyanurate (PIR) boards are usually faced with aluminium foil. Polyisocyanurate is similar to polyurethane but usually contains long strand glass fibres within the PIR foam core which is formulated to give off less dense smoke in a fire.

- Characteristics:

- Usually faced with aluminium foil or glass tissue
- Lightweight
- Good insulation performance
- Mainly available in board form, but can also be spray applied on site in domestic projects
- Suitable for temperatures up to 75°C
- Combustible
- Potential loss of thermal performance if there is a reduction in the foil facing emissivity

- Main uses:

- Flat roofs
- Pitched roofs (warm and cold roofs)
- Partial fill cavity wall insulation
- Domestic under-floor insulation
- Foamed composite panels

Reflective foil Insulation

Reflective foil insulation mainly resists radiant heat flow due to their high reflectivity and low emissivity (ability to reflect and re-radiate heat). The thermal resistance of reflective insulation products varies with the direction of heat flow and the brightness (emissivity) of the foil facing. Multi foil insulation products work in the same manner as reflective foil products whilst also containing several layers of a metallised component which are usually separated by a combination of wadding and foam.

Reflective foils and multi-layered foils are completely different types of insulation products to mineral wool and rigid plastic foam boards.

They work mainly by reducing radiant heat transfer, which is largely dependent on the emissivity of the aluminium foil facing. PUR and PIR rigid board insulation products can also claim additional thermal performance if they are foil faced and the foil is adjacent to an airspace. In order to deliver their maximum thermal performance value, one or both sides of the product should face an unventilated airspace, if this type of product is installed without the required airspace of at least 20mm width, then the thermal performance of the product can be significantly reduced.

There are two types of reflective foils:

1. Foil Faced Bubble Wrap

Standard bubble wrap which is faced with aluminised polyester film on both sides. At least one side must face an unventilated cavity in the construction to work effectively.

- Characteristics:
 - Lightweight
 - Thin layer material
 - Potential loss of thermal performance if there is a reduction in the emissivity of the foil facing

- Main uses:
 - Cavity walls

2. Multi-layered Foils

These consist of multiple sheets of aluminised polyester separated by thin sheets of polyethylene foam. To be effective, the outer faces must face an unventilated cavity in the construction.

- Characteristics:
 - Lightweight
 - Thin layer material
 - Unproven as an alternative to traditional insulation products

- Main Uses:
 - Pitched roofs in hot climates, to stop heat build-up

Insulation Comparisons

The table below compares the key properties of the above insulants. This is for illustrative purposes only for commonly used applications for each product

<u>Customer requirements</u>	Glass Mineral Wool	Rock Mineral Wool	Extruded Polystyrene	Expanded Polystyrene	PUR and PIR
Thermal performance	high	medium	high	high	extra high
Cost	lower	low	high	medium	high
Sound absorption	high	high	none	none	none
Reaction to fire	non-combustible	non-combustible	non-combustible	combustible	combustible
Compressive strength	low	medium (suitable for some floors)	high (suitable for all floors)	medium (suitable for some floors)	medium (suitable for some floors)
Water resistance	high	high	very high	high	high
Weight	very light-medium	light-heavy	medium	medium	medium
Storage space requirements	very low	medium	medium	medium	medium
Transport efficiency	very good	good	low	low	medium