

Types of insulation

- MANMADE PETROCHEMICAL
- MANMADE FROM NATURAL MINERALS
- NATURAL MATERIALS

cellulose fibre

Recycled and recyclable

Made from post-consumer recycled newspaper, cardboard

Biodegradable

Safe to install; non-hazardous fiber

Possible odor and formaldehyde outgas (small amount) from printing inks and additives

Contains additives for fire retardancy, a fungicide, and sometimes a binder to reduce settling. Borax

Durability: Performance can be compromised if brought into contact with moisture.

Settlement of the fibre can occur but can be compensated for by additional quantity.

Strength and resistance to compression is very low- avoid using in trafficked areas.

K0.038 W/m°C - 0.040 W/m°C
£2.70/m² at 100mm.



sheeps wool

Recyclable

Renewable resource

Low embodied energy (but can increase significantly if imported)

Safe to install; non-hazardous fibre

Biodegradable

High natural content

Mixed with 5% polyester for stability

Has been argued that wool demand will stimulate methane production (a load of hot air)

Organophosphates in sheep dips are linked to illness in farmers; they can also damage fish stocks when released into the water courses.

Durability: Wool can absorb water whilst remaining an efficient insulant. This feature can help maintain the temperature above dew point.

Wool is naturally resistant to decay and fungal attack.

Can absorb formaldehyde, de-toxifying air.

K value 0.037 W/m°C - 0.040 W/m°C

£9.50/m² at 100mm.



flax

Fibres of the linseed plant

Recyclable

Renewable resource

Safe to install; non-hazardous fibre

Low embodied energy

High natural content (85% hemp + 15% polyester matting to maintain shape)

Biodegradable

Imported to the UK from Germany, Finland and France - increasing embodied energy

Insect and fire repellent added: borax

Some products may use polypropylene binding agents

Rolls and batts.

High thermal mass. Good moisture control properties.

Locks up CO₂

Supplied in rolls and batts.

High thermal mass. Good moisture control properties.

0.042 W/m°C

£7.54/m² at 100mm.



hemp

Recyclable

Renewable resource

Safe to install

Biodegradable

Low embodied energy

High natural content (85% hemp + 15% polyester matting to maintain shape)

Naturally resistant to insect attack

Contains additives for fire retardancy

Imported to the UK from Germany, grown in France - increasing embodied energy

Crop requires little to no pesticides, replenishes soil with nutrients and nitrogen, controls erosion of the topsoil, and converts CO₂ to Oxygen very well, considering how fast it grows

Supplied in rolls and batts.

High thermal mass. Good moisture control properties.

K 0.043 W/m°C
£8.30/m² at 100mm.



hemp/cotton

"Isonat"

Renewable resource

Safe to install; non-hazardous fiber

Biodegradable

Low embodied energy

High natural content (85% hemp + 15% polyester matting to maintain shape)

Naturally resistant to insect attack

Contains additives for fire retardancy

Imported to the UK increasing embodied energy

Supplied in rolls and batts.

High thermal mass. Good moisture control properties.

K 0.039 W/m°C
£8.30/m² at 100mm.



wood fibre

Renewable resource

Bio-degradable

Some products are made from recycled cellulose

Manufactured from quick growing species or from forest thinnings.

Can be impregnated or coated with bitumen to enhance moisture resistance and durability

Uses natural wood resins to bond particles together.

Some boards contain latex to provide water-resistance.

High thermal mass

Low embodied energy

K0.038 - 0.047 W/m°C
£22.84/m² at 100mm.



expanded cork

Recyclable and can contain recycled cork.

Very low embodied energy at factory gates

Renewable resource from largely sustainably managed cork forests, harvested every 7 years from cork oak.

Bio-degradable or can be used in energy recovery

Imported to the UK primarily from Portugal - increasing embodied energy

A small amount of formaldehyde off-gassing

Durability: Dimensionally stable. Naturally resistant to decay and fungal attack. Resistant to compression makes it ideal for flat roofing.

K 0.042 W/m°C - 0.050 W/m°C

£23.65/m² at 150mm plus delivery. (compare with £24.20 for polyurethane @120mm)



ryveta
with cheddar



LECA

Lightweight expanded clay aggregate

Reclaimable

High natural content

Safe to install

Non-flammable

Balances relative humidity

High embodied energy through the firing process and transportation to the UK

Mining causes landscape degradation

Silicon coating makes waterproof

Available in bags or bulk delivery

K 0.09-0.1 W/m°C

£10/m² at 100mm.

Add cost of excavation, deduct cost of hardcore



rock

EXFOLIATED VERMICULITE

Natural mineral that expands when heated.

Reclaimable

High natural content

Safe to install

Non-flammable

Can be used as an insulating aggregate in concrete

Relatively high embodied energy through heat processing and transportation to the UK

Mining causes landscape degradation

Avoid Vermiculite produced in the US prior to 1990- it contains asbestos

K0.065 W/m°C

PERLITE

Natural volcanic mineral that expands when heated

Reclaimable

High natural content

Safe to install

Non-flammable, moisture resistant

Increases fire resistance of cavity walls

Can be used as an insulating aggregate in concrete

Non renewable resource

Mining causes landscape degradation

Relatively high embodied energy through heat processing and transportation to the UK

Must be installed in sealed spaces

K0.065 W/m°C



foam glass

Reclaimable

Non-flammable

Some use of recycled glass

High thermal mass

Moisture resistant

Resistant to insect infestation

Photochemical oxidants as well as SO₂ and NO₂ released as part of manufacturing process

High embodied energy

Mining of raw materials causes landscape degradation

Uses bitumen or synthetic adhesives to install

Installation hazards

Durability: Long-lasting with an inherent resistance to moisture, air movement and rot. Dimensionally stable and resistant to compression.

K0.040 W/m°C - 0.050 W/m°C

£25-45/m² at 100mm



mineral wool

Mineral (Slag) Wool is comprised of steel slag (over 75%) with some basalt rock (25% or less). In some plants the recycled steel slag makes up almost 100% of the content

Rockwool, made from rocks, has a high natural content, plus resin binder

Fireproof

Performance reduced when wet

High embodied energy, rock melted at 1600C

Non-biodegradable

Some concern and study regarding possible health effects from inhaling fibres

Installation may cause irritation to skin, nose, eyes

Durability: Long-lasting with an inherent resistance to rot.

However, moisture ingress will reduce performance. Compression will reduce performance.

$K0.033 \text{ W/m}^\circ\text{C} - 0.040 \text{ W/m}^\circ\text{C}$

£4.50/m² at 100mm.



glass fibre

Some brands utilise recycled glass

Fibres made from glass, a product of silica, an abundant mineral, heated to 1450C, binder added, then baked at 200C to bond fibres.

Can be re-used (though there are no facilities for recycling)

High embodied energy

Non-biodegradable

Manufacturing can result in the emissions of chlorides, fluorides, particulates, VOCs and solvents.

Some concern and study regarding possible health effects from inhaling fibres

Asphalt treated papers may emit odors

May cause irritation to skin, nose, eyes and surveyors

Durability: Long-lasting with an inherent resistance to rot. However, moisture ingress will reduce performance. Compression will reduce performance.

K0.033 W/m°C - 0.040 W/m°C

£2.50/m² at 100mm



polystyrene

Expanded and Extruded

Non-biodegradable

Most boards are CFC and HCFC free

Durability: Long-lasting with an inherent resistance to moisture, air movement, rot and compression.

Non biodegradable 2000 years to decompose

Emits toxic fumes when burnt

Deteriorates releasing gases under ultra-violet light

Performance can degrade over time.

Ensure manufacturer's quoted conductivity is in accordance with the European Standard BS EN 13165 giving the 'aged' or long-term value.

Extruded has greater load bearing capacity and water resistance.

K 0.028 - 0.032 W/m°C (lower value-pentane as propellant)
£5/m² at 100mm.

Manufactured from petroleum, an aromatic polymer



polyurethane

Non-biodegradable

Some boards are still expanded using HCFCs

Older boards hazardous waste if not ZODP

GWP

Will create toxic fumes when burned (hydrogen cyanide)

Injected foam exposes installers to formaldehyde

Durability: Long-lasting with an inherent resistance to moisture, air movement, rot and compression.

Performance can degrade over time.

Ensure manufacturer's quoted conductivity is in accordance with the European Standard BS EN 13165 giving the 'aged' or long-term value.

The use of gas-tight foils such as aluminium can reduce the degradation.

K 0.022 - 0.028 W/m°C (lower value-pentane as propellant)
£12-22/m² at 100mm.

Ingredients:

catalysts, surfactants, blowing agents, cross linkers, flame retardants, light stabilizers, and fillers, polydimethylsiloxane-polyoxyalkylene block copolymers, phenylmercuric nedeconate, Alkyl tin carboxylates, oxides and mercaptides oxides, N,N,N-trimethyl-N-hydroxyethyl-bis(aminoethyl)ether, N'-(3-dimethylamino)propyl)-N,N-dimethyl-1,3-propanediamine, cyclohexane diisocyanate (CHDI), 1,3-bis(isocyanatomethyl) cyclohexane (H₆XDI), tetramethylxylene diisocyanate (TMXDI),



phenolic foam

Reclaimable (?)

Lowest conductivity of all insulants.

High cost

Some boards are still expanded using HCFCs Hazardous waste if not ZODP

Expanded using pentane (Zero-ODP), no damage to ozone but produces smog

Will create toxic fumes when burned

Non-biodegradable

High embodied energy

Durability: Long-lasting with an inherent resistance to moisture, air movement, rot and compression. Some degradation over time.

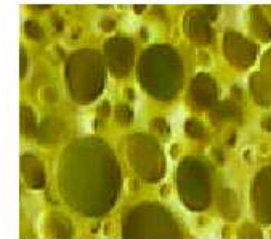
Ensure that the manufacturer's quoted conductivity is in accordance with the European Standard BS EN 13163 giving the 'aged' or long-term value.

K 0.020 W/m°C

£26-35/m² at 100mm.

Ingredients

Phenols and formaldehyde and ?!



New developments

Vacuum insulation panels

- Vac-Q-vip: Silica k 0.005, vac-Q-mic: micro fleece k0.0035
- 50 year lifetime
- k increases by factor 4 or 10 if panel damaged
- 20mm silica panel = 0.25W/m²K
- 14mm micro fleece panel = 0.25W/m²K
- Available from newformenergy.com
- Airtight, not breathable

New developments

Nanogel/Aerogel

- Lowest density product known to man
- made by extracting water from silica gel and replacing it with CO₂
- very expensive
- an 18mm layer can protect an astronaut from -130C extremes
- use in glazing units or insulated panels

