# Insulation: getting carbon smart

The Insulation Manufacturers Association discusses embodied energy and insulation...



An essential element in reducing carbon emissions from the built environment will require an understanding and appreciation of the impact construction products, design and the construction process all have on the carbon footprint of buildings.

Consideration of this carbon footprint, also known as embodied carbon, will play an increasingly important role in the journey towards achieving the UK's Net Zero Carbon target by 2050, as according to the World Green Building Council, embodied carbon may account for anything between 30-70% of a building's lifetime carbon.

Identifying and specifying the most suitable products will require a balance between the initial carbon footprint and the in-use carbon over the life of a building for any given material or process.

Buildings must achieve numerous targets over their lifetime, including thermal performance, ventilation, fire safety, comfort, wellbeing and affordability. Therefore greater understanding of products and their make-up is needed to fully appreciate the whole-life costs. A product that has a low embodied carbon may perform less well in the building over its lifetime than a product with a higher carbon footprint but very good performance over many years of use. It is this balance that will become increasingly important when making choices between different construction products.

The recent publication produced for IMA by the independent specialist low-carbon consultancy, XCO2, explains in detail why reducing the embodied carbon in homes is an essential consideration that should not be seen as an afterthought. It highlights the issues associated with energy demand and demonstrates the way enhanced insulation strategies play a crucial role in the built environment to help the UK meet its exacting targets. It also shows how this simple element of construction can provide associated benefits including sustainability, durability, as well as bringing comfort and wellbeing to building occupants.

Consideration must therefore be given to the raw materials and the energy consumed to fabricate materials. In order to attain a truly holistic perspective, other parts of the lifecycle must also be considered such as extraction, processing, transport, distribution, maintenance, reuse, recovery and disposal. The lifecycle stages associated with whole life carbon and embodied carbon are illustrated on the right, in line with the European Standard EN15978.

Because these differing influences on embodied carbon and energy vary widely between different manufacturers and insulations types, it is important that a comprehensive lifecycle assessment (LCA) is completed to gain a more defined understanding of the overall embodied carbon and energy thereby allowing a more rigorous evaluation.

Assessing the embodied impacts of insulants is most relevant to BREEAM and LEED certifications, which require construction materials to be assessed to recognise and encourage the incorporation of materials with a low environmental impact (MatO1; lifecycle impacts and MRc1; building lifecycle impact reduction - applicable BREEAM and LEED credits, respectively]. The industrystandard assumptions and relative impact of these between the major insulation types are outlined above left with a particular focus on the raw materials and manufacturing energy requirements.

#### Mineral insulants

Fibrous mineral insulants are produced by melting the constituent elements at high temperatures (>1,600°C) and spinning the malleable material into fibres. A binding material is also added to increase the rigidity (depending on the application). Additionally, a mineral oil or silicone is also added to protect against moisture susceptibility. The high temperature requirements result in a large embodied carbon and energy demand. Consideration must also be given to the additives and binding substances required.

Foamed or cellular mineral materials are produced by aerating a granulated raw product such as silica, sand or glass in a furnace or with a gaseous agent such as hydrogen sulphide (H2S). Granulation of the raw product also typically involves crushing and milling in the presence of heat. The processing of the raw materials to produce granules is deemed to be energy intensive, both relating to the mechanical and heat energy required. Furthermore, additional examination of the energy required to produce the gaseous agent must also be reviewed. Organic synthetic

Thermoplastic (typically expanded and extruded polystyrene) and thermosetting (typically polyisocyanurate and polyurethane) insulants are typically produced via a process of polymerisation or expansion. Polymerisation involves the reaction of monomer molecules, typically derived from fossil fuels, to form organic long-chain polymer molecules. Polymerisation and expansion techniques both require the presence of a catalyst as well as elevated temperatures and pressures. The temperature and pressure requirements result in relatively high embodied carbon and energy for these insulants (when compared to the demands associated with the manufacture of natural (plant and animal) insulants). When organic synthetic insulants are eventually retired from a building they can be reused if undamaged.

Natural (plant and animal) These insulants are generally manufactured by treating naturally derived components to form

fibres, batts or boards commonly bound by a plastic netting/wiring. The inclusion of additives such as boric acid or ammonium phosphate, to prevent pests and rotting and improve the fire resistance, is also required.

Plant materials such as cork, hemp, flax and cotton consume CO2 during development to produce sucrose/glucose and oxygen (as a by-product) via photosynthesis, which results in these materials acting as carbon sinks during growth. Therefore, the associated embodied energy carbon and energy is relatively low and, in some cases, may be negative.

The energy demand associated with manufacture is deemed to be relatively low as the materials can be sustainably grown. However, the manufacturing of expanded cork boards does require the presence of elevated temperatures and pressures to expand the cork granules. However, due to the additives included at the processing stage, including plastic bindings and fire/pest retardants, disposal can be difficult and specified landfills may be necessary.

#### Fabric first

With the current target lifespan for all new building developments being approximately 60 years (with many buildings operational for much longer) the need to reduce the energy demand of a building is vitally important and using a fabric first approach with the best performing insulation is the most widely recognised way of achieving this.

It is essential that new build projects are built to the highest possible standards at the outset and that existing building stock is retrofitted to improve fabric efficiency and reduce energy demand.

It will be enormously challenging for the built environment to achieve the 2050 net zero targets but understanding every aspect of where these gains can be made is vitally important in order to reach this goal.

## WHOLE LIFE CARBON

### **EMBODIED CARBON**



Operational water use

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