UK HEMPCRETE
www.ukhempcrete.com

Frequently Asked Questions

Hempcrete:

1. What is hempcrete?

Hempcrete, or "hemp-lime composite building material" to give it its proper name, is made by mixing hemp shiv (the woody stem of the industrial hemp plant) together with a binder. The binder is either a pure lime (a strongly hydraulic lime), or a formulated hempcrete binder made from lime mixed with a smaller proportion of pozzolans or Portland cement.

Hempcrete is usually wet-mixed on site and cast around a structural frame, but it can also be pre-cast off site to form blocks or panels which are then transported to site to be laid or assembled. Although very hard and self-supporting once set, Hempcrete is non-load bearing due to the flexible nature of the hemp shiv which provides its structure, and the amount of air trapped within it. Hempcrete is a medium density natural insulation material, which also has thermal mass, and is vapour permeable, or "breathable" (more about this later).

2. What can you use it for?

In new-build, hempcrete is most often used to make walls, but it can also be used to form insulating floor slabs, ceilings, and roof insulation.

In contrast to conventional insulation materials (which tend to be installed in a cavity within the wall, or added to the wall as an extra layer in the build-up) hempcrete forms the wall and insulation in one piece, with the only other integral material being the structural frame (usually untreated softwood). Wet finishes - a lime or clay plaster internally and lime render externally - are applied directly to the surface of the hempcrete wall, and these are the only other materials that need to be added to the basic hempcrete wall, although cladding (timber, stone, brick etc.) can be used in place of wet finishes if desired.

In floors and roofs hempcrete is used in combination with other materials to provide an insulating layer, which can form all, or part, of the insulation layer depending on the building design.

Hempcrete is often used in restoration projects to upgrade the thermal performance of traditional and historic buildings. It's commonly used to repair historic infill to panels in timber frame buildings, or to replace inappropriate (non-breathable) infill materials where these have been used in past repair work. Hempcrete is also often used to add insulation to solid masonry walls in old buildings. It is ideal for use in traditional buildings because of its vapour-permeability and its ability (as a wet-mixed, loose-fill material which hardens once applied) to mould itself exactly against unevenly shaped surfaces in old buildings, and support itself without sagging.

3. What are the pros and cons of using hempcrete in my building?

Pros

Hempcrete is a vapour-permeable material which is *hygroscopic*; it absorbs moisture from the air when humidity is high (releasing it again when humidity levels drop). These properties are very important, both for the health of the building's occupants and in order to keep the fabric of the building in good condition.

In historic buildings hempcrete works in harmony with the original materials, allowing the building to "breathe"; meaning that water vapour can pass in and out of the wall rather than being retained within it to cause damp, and eventually damage to the building's fabric.

Hempcrete is made entirely from natural materials and is naturally fire- and pest-resistant, which means there is no need for potentially toxic chemicals to be added to it. This fact, together with its hygroscopicity, means that hempcrete buildings are extremely healthy living environments.

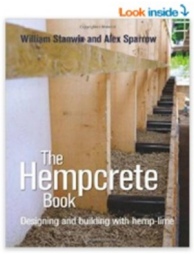
Hempcrete is a sustainable material (see next page). The hemp plant used as the aggregate in hempcrete absorbs so much carbon during its rapid growth that, even after the energy used in production of the lime binder, transportation and on site construction is allowed for, more CO_2 is locked up in a hempcrete wall than is used to build it. In other words, hempcrete has *negative* net carbon emissions – it's a "*better*-than-zero-carbon" material. The exceptional eco-credentials of this natural, sustainable material make hempcrete the obvious choice if you want to reduce your energy bills, your carbon footprint and the overall impact of your building on the environment.

Cons

As a relatively new material, which is quite different from most conventional building materials, hempcrete can be tricky to work with until some key concepts and techniques are understood. The only downside of hempcrete's recent rapid acceptance as a building material across the UK, is the fact that examples can be found where a lack of understanding of the material and proper construction techniques has resulted in problems with the build. This is especially common on large projects such as housing estates, where inexperienced contractors have expected hempcrete to behave in the same way as conventional building materials. However, the problems which arise are not usually long term or serious, and with a little basic knowledge and the proper training, hempcrete is a straightforward and rewarding material with which to build.

Architects who are not used to working with hempcrete and other natural materials may not find it easy to detail buildings correctly when using these materials. This is not an insurmountable problem and can usually be solved simply by the architect finding out about hempcrete; for example by reading around the subject, visiting existing buildings or buying in consultancy from a company such as UK Hempcrete, that specializes in using hempcrete.

For more information on detailing hempcrete buildings, see:
The Hempcrete Book: Designing and building with hemp-lime by William Stanwix and Alex Sparrow (Green Books, October 2014).



4. Why is building with hempcrete good for the environment?

As described above, hempcrete is a “carbon-negative” or ”better-than-zero-carbon” material; more carbon is taken out of the atmosphere by the growth of the hemp plant than is emitted as a result of hempcrete’s production and its application on site. Various estimates for the amount of carbon sequestered have been put forward, and of course this varies depending on the exact type and source of materials, as well as on the application technique. However a leading UK manufacturer of hempcrete materials has suggested a figure of 165kg net CO_2 sequestered per m^3 of shuttered (hand-placed) hempcrete, and 110kg net CO_2 sequestered per m^3 of spray-applied hempcrete.

The reason the hemp plant absorbs so much carbon dioxide is because it is a tall, fast-growing plant which needs to create a hard woody stem to support itself at its full height. It grows up to 4 ½ metres in 4-5 months in the UK climate. The strong woody cellulose of the stem is the part that is chopped up and used for building. Previously this was considered a waste by-product of the seed and fibre for which the hemp plant has long been grown. Now the whole of the hemp plant can be used!

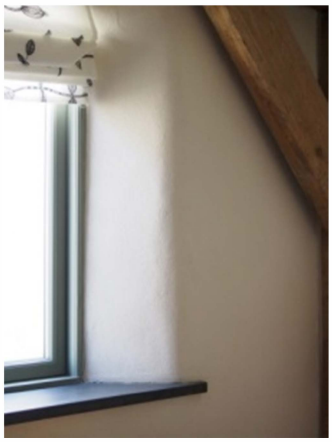
The other hard-wearing cellulose material commonly used in construction is timber, which takes many years to grow to a useable size. Compared to timber, the fast growing hemp plant, which replenishes itself every year in just a few months, is very quickly renewable, making it a *truly* sustainable material. The extra protection which the lime binder in hempcrete gives to the timber structural frame in a hempcrete wall means that faster-growing softwoods can usually be used for the frame, further increasing the sustainability of hempcrete buildings.

Hemp can be grown and processed all over the world, in a range of soil types, as long as the climate is not too arid, and so can be considered a “globally local crop”; cutting down on the energy used to transport hemp shiv for building. The hemp we use for building is grown in the UK and processed on the farm before being sent straight to the building site.

Because the hemp plant is naturally pest-resistant and weed-suppressant, it eliminates the need for chemical fertilizers and insecticides, and is great for clearing the land of pests. It requires very little fertilizer, and is deep rooting; returning key nutrients to the soil and improving the condition of farmland by breaking up the soil to a significant depth. These qualities make it an ideal “break crop” and farmers in the UK often grow it between plantings of other crops such as winter wheat.

The reduction in pesticide use brought about by growing hemp also helps to support biodiversity in our fragile eco-system, and promotes the survival of beneficial pollinating insect species. The tall hemp plants, with their close-growing strong stems and bushy leaves and branches at the top of the plant, make the ideal cover for farmland birds. Because no pesticides have been sprayed, these birds are able to make the most of the food source in the insects which live there.

Hempcrete binders are made from building lime (some are pure lime, others range from 70-90% lime content), which is produced by burning limestone (an abundant natural resource) in a kiln. Lime is a relatively high embodied energy material, but compared to Portland cement (which is produced from building lime with a proportion of other minerals), lime is burnt at a much lower temperature (900°C for lime compared to 1200-1400°C for cement) thus saving energy. The finished, bagged lime also has a much lower density than cement, reducing the energy used in transport, and when it is used on site the lime absorbs some CO_2 from the atmosphere as it sets (the amount of CO_2 absorbed varies with the type of lime used). The lime binders we use for hempcrete are all produced (and the raw materials sourced) in the UK or Western Europe.



Once constructed, hempcrete walls, floors, ceilings and roofs have an extraordinarily good thermal performance (see next page) which continues to help the environment by bringing a huge reduction in the fuel used for heating and cooling during the lifetime of the building.

Compare the "eco-credentials" of hempcrete to conventional synthetic insulation materials; these are often made from non-renewable raw materials such as petrochemicals - produced from the very fossil fuels which we are trying to conserve by insulating the building.

Synthetic insulation materials are always produced using highly energy-intensive processes – have you ever stopped to think about how they *make* Rockwool from the raw material (rock)? Raw materials are shipped halfway around the world to chemical factories, and then the finished insulation products are shipped back to the country where they are needed, using a huge amount of fuel in their extraction, transport, and manufacture. The large chemical companies which produce these materials often have a poor record on worker safety and environmental protection, with chemical leaks from their factories creating environmental pollution. Such insulation materials are also commonly treated with toxic chemicals (see below).

Synthetic insulation materials are rarely recyclable, and have a very high level of *embodied carbon* (the carbon emissions which are associated with any material or product; due to the energy used in the extraction of the raw materials, their processing, transport, use, and in its disposal or replacement at end of life).

Add to this the fact that synthetic insulations are often made from petrochemicals derived from oil, and it is all too easy to see the huge environmental impact of these materials, which ironically we are rapidly adding to our homes in the name of *conserving* fossil fuel resources. The argument used by the powerful multinational chemical companies who make these products is that using a bit more oil now in exchange for the energy saving brought by the insulation makes sense. However recent research has shown that at current levels, the use of these materials is producing a huge spike in carbon emissions that will take decades, if not hundreds of years, to cancel itself out through carbon savings from the increased insulation. We don't need a reduction in carbon emissions in a hundred years' time, we need it now!

5. Why does hempcrete create healthy buildings?

Hempcrete is completely natural and free from synthetic, fossil fuel based materials. Because hempcrete is naturally fire-retardant and pest-resistant (nothing eats lime!) there is no need to add chemicals to ensure its performance in these areas (as is usually the case with lightweight insulation materials). Chemicals added to conventional insulation materials include known carcinogens such as formaldehyde, and Volatile Organic Compounds (VOCs) which have been implicated in the recent rapid rise in incidence of asthma and allergies in western countries as synthetic materials "off-gas" toxic chemicals into our homes.

Hempcrete, and the lime and clay plasters which are applied to its surface, are "breathable" (vapour-permeable) materials, meaning that they allow water vapour to pass through them. In combination with this, the porous nature of both the hemp and the lime binder, hempcrete is *hygroscopic*. This means that hempcrete absorbs moisture into the material during times of high relative humidity in the air, releasing it again when the relative humidity drops.

This ability of hempcrete walls to passively regulate the humidity in the internal space means that when there is excess moisture in the air - for example when cooking, or in bedrooms at night; from the occupants' breathing - condensation does not get a chance to form on the surface of the wall, the moisture instead being absorbed into the wall and released later. This in turn discourages the formation of damp and mould spores on damp surfaces, which can be harmful to human health.

The regulation of humidity in the indoor environment to a healthy level (between 40-60% relative humidity) has been shown to inhibit the spread of viral and bacterial infections, allergic reactions, asthma and other respiratory conditions, and reduce the occurrence of mites, mould and fungi.

This ability of hempcrete to passively regulate indoor air quality reduces the need for powered ventilation systems to keep airtight buildings habitable, further reducing the energy load required to maintain a hempcrete building.

6. What can I expect from hempcrete in terms of its thermal performance?

The thermal properties of hempcrete are extraordinary. It provides insulation because of pockets of air trapped within the material; both in the spaces between particles of hemp shiv, and in microscopic pores in the hemp shiv itself. The thermal conductivity of most hempcrete, based on solid state lab testing by binder manufacturers, is 0.06 or 0.07 W/mK. The usual thickness of a new build hempcrete wall is 300-400mm, with typical U-values of:

Hempcrete at:	300mm thickness - 0.2	W/m^2K
	350mm thickness - 0.17	W/m^2K
	400mm thickness - 0.15	W/m^2K

When using hempcrete as a cast-on-site material (hand-placed or spray-applied), the *actual* U-value achieved can vary depending on the thickness, the type of binder used, the exact specification, application techniques and the skill of the contractor, however it is worth keeping in mind that with hempcrete *the thermal performance is not just about the U-value!*

Hempcrete also provides *thermal mass*, as well as insulation, due to density of the lime binder once it has set. This means that hempcrete is able to store heat *in* the fabric of the material itself (like a giant storage heater). In this respect it is unlike lightweight insulations, which only keep heat in a building due to the *air trapped inside* the material. Air is a very poor conductor of heat, so as long as your insulation layer remains airtight, it is difficult for heat to pass out of a well-insulated building.

This ability of hempcrete to store heat *within* itself *as well as* insulating has two important advantages:

Firstly, it allows for natural ventilation of the building. Modern buildings highly insulated with lightweight insulation rely on airtightness to trap the air within the lightweight insulation layer. This leads to an imperative to keep windows and doors closed at all times to preserve the heat inside, with trickle vents and mechanical heat recovery systems to make sure the indoor air stays fit for human habitation. In contrast: as well as insulating, hempcrete also stores heat (from the sun or from internal heating) in its thermal mass, and this is released again very slowly as the internal space cools down. This means that in a hempcrete home you can open the window if it gets a bit stuffy; safe in the knowledge that all your expensive heat is not going to flow straight out and be lost.

Secondly, the slow speed at which a typical hempcrete wall stores heat and releases it again has the effect of "buffering" natural changes in temperatures (e.g. night and day temperature fluctuations) so that with very little heating or cooling a constant internal temperature is maintained. Hempcrete keeps your home cool in the summer and warm in the winter, with a dramatic reduction in fuel bills.

Hempcrete is unique in this mixture of insulation and thermal mass. In natural building terms, it can be thought of as halfway between straw bale (which has loads of insulation, but very little thermal mass) and cob (which has loads of thermal mass and very little insulation). This combination of thermal mass and insulation, together with hempcrete's *hygrothermal* behaviour (energy changes as water vapour passes in and out of the wall) give hempcrete a truly extraordinary thermal performance. Hempcrete works passively, but dynamically, to maintain comfortable indoor temperatures with very little need for heating, cooling or mechanical ventilation. During in-situ tests, hempcrete consistently out-performs expectations based on U-values, and computer modelling of its thermal performance.

7. Where is UK Hempcrete based, and where do you work?

UK Hempcrete is a small company but our construction projects take us all over the UK. Our main base is in Derbyshire, but we have worked on projects as far afield as Devon in the South, Perthshire in the North, Pembrokeshire in the West and Essex in the East. Recent international projects have included France, Hungary and New Zealand!

We are happy to discuss acting as main contractor within 1 ½ hours of our base, and sub-contractor, consultants and trainers anywhere! Please contact us to discuss your individual requirements.

For more information: www.ukhempcrete.com

8. How much does building with hempcrete cost?

We are often asked “What is the square metre cost of your hempcrete system?” Well… how long is a piece of string? As every prospective developer or self-builder knows; the m^2 cost of a finished building can vary widely with the complexity of the design and the specification of the structure, finishes, fittings, roof covering etc. It can also change according to the geographical location of the build, how many separate contractors are involved and, last but not least, the desired quality of the finished building (from “standard” to “good” to “excellent”).

What we can say with certainty, is that **building with a softwood timber frame and cast-on-site hempcrete should cost no more than building with conventional materials**, however it will not be significantly cheaper either.

As with any material, costs vary depending on the factors outlined above. Broadly speaking though, the cost of building with hempcrete should be around the same as building with conventional “brick and block cavity” masonry construction, with a high-spec insulation and air tightness.

In certain situations however, hempcrete offers a distinct advantage and can allow considerable savings in the build cost. For example when the ground is not suitable for a strip foundation, a hempcrete building can be built on a cheaper raft foundation (due to hempcrete’s much lower density compared to masonry), thus avoiding the extra cost (both financial and environmental) of a huge concrete slab foundation.

It's important to remember also that the cost comparison above is thinking only about the build costs. The extra thermal performance which hempcrete provides, compared to lightweight insulation materials, brings significant additional cost savings over the lifetime of the building, as well as cost savings to society as a whole thanks to the improved health of the building’s occupants.

Please contact us for accurate example costs for the type of build you are considering.

For more information, please contact:

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