3. HEMPCRETE INSTALLATION: General

3.1 COMPOSITION

‘Hemcrete’ s are conglomerates consisting of a plant aggregate (hemp core) and a binder. Their composition consists of:

- Insulcore or ‘hemp wood’ - the aggregate
- Insulime - a lime based binder
- Water

Hemcrete mixes used to construct walls have a bulk specific weight of approximately 420kg/m³. Please refer to Appendix charts, Weight & Thermal Properties.

The mechanical, thermal and acoustic properties of hemcrete depend on the proportions used. Please consult with Hempcrete Australia regarding mixes. The mix of one 25kg bag of Insulime to 10kg of Insulcore hemp is standard.

3.1.1 Physical characteristics of the material

Hemcrete falls into the category of ‘light building materials’ with specific features:

- Flexibility
- High deformability
- Good thermal insulation
- Good acoustic absorption
- High permeability to humidity

Hemcrete is used to construct monolithic walls. Air-tightness and air leakage through the walls is negligible. Tests came to approx. 0.75 g/m²/mmHg. Typical air leakage 1-3 air changes/hour @ 50 pascals.

Testing for strength and flexibility is done according to AS1012.9 and AS 1478 2 Appendix D (concrete testing) by putting pressure on test cubicles until they fail. The compression is determined by test samples cured over minimum of 28 days.
3. Hempcrete Installation: General

3.1.2 Hemp

The hemp core (also known as hemp shiv, wood or hurd) is derived from industrial hemp plants. It is a natural material suitable for making lightweight insulating mortars. Hemp core is approximately 70-80% of the hemp stalk depending on the hemp variety. The ‘bast fibre’ that surrounds the hemp stalk is separated and utilized for other products.

Density can vary between 110 and 115kg/m$^3$. Thermal conductivity of hemp alone is 0.05 W/m.K.

**Size, shape and characteristics of hemp core:**

- Particles are generally parallel piped in shape from 1-5mm wide, and from 1-30mm long.
- Granulometry (by screening): Lower limit - less than 0.5% by mass of fines of under 0.5mm.
- Approximately 90% by mass between 1mm and 4mm. Upper limit - less than 3% by mass above 4mm.
- Colour: very light beige to pale green.
- Density: in the order of 100kg/m$^3$ bulked out.

Only hemp that meets the above criteria is to be used in hemp construction.

All these characteristics are provided for dry hemp core.

All hemp wood used in construction must have undergone a decortication / retting process. The use of non-defibred hemp or hemp that has undergone processing is not regarded as usable for safe construction methods.

Particular attention has to be given to making sure that hemp is not subject to dampness due to storage conditions of the raw material.

Hemp core with a large amount of dust fibre or containing a large percentage of dark-coloured particles should be examined and reported to Hempcrete Australia before use.

3.1.3 Lime Binder

A special binder INSULIME has been thoroughly tested and prepared for making hemp mortars.

The binder consists of products based on non-hydraulic lime (in accordance with standard NF EN 459-1 to 3), hydraulic lime (in accordance with standard NF EN 459-1 to 3) and cement (in accordance with standard NF P 18-308) and AS 1672.1-1997.

These are the binders recommended by the manufacturers specifically for use with hemp hurd.

The selected binder allows the hemp concrete to obtain the characteristics specified for each application. Insulime comes in 25kg bags and there are grey and white (35kg) options.

The binder should be stored as per manufacturer’s recommendations and has a 12 month shelf life from date of manufacture.

The binder is guaranteed when used as instructed. Any alteration of the hemp/lime mix with other products will nullify all warranties.
Hempcrete that has set can be re-used in a new mix after crushing - up to 10%.

Testing for strength and flexibility is done in accordance with AS1012.9 and AS 1478.2 Appendix D (concrete testing) by putting pressure on test cubicles until they fail. The compression is determined by test samples cured over minimum of 28 days.

The compression strength at the end of the time is calculated in the following way:

\[ f_{c,t} = \frac{F}{A_c} \cdot f_c \]

- \( t \) is the resistance under compression, expressed in Mega Pascal (MPa; 1MPa=10^6Pa=10^6 N/m^2)
- \( F \) is the maximum load, expressed in Newton (N)
- \( A_c \) is the area of the sample section on which the compression force is applied. It is calculated from the initial dimensions of the sample and is expressed in square meters (m^2). For samples made from 16x32 moulds, \( A_c \) is equal to 200cm^2, i.e. 0.02m^2.

The bending tensile strength of the samples after the maximum time \( t \) is calculated in the following way: \( f_{c t} = \frac{F \cdot l}{(h^3)} \) where:

- \( f_{c t} \) is the bending tensile strength, expressed in Newtons per square millimeter (MPa)
- \( F \) is the maximum load, expressed in Newtons (N)
- \( l \) is the distance between lower supports, expressed in millimeters (mm) (\( l \geq 3 \cdot h \))
- \( h \) is the dimension of the transversal section of the sample at the location of the break, expressed in millimeters (mm).

Together with tests according to the Young module, extensive tests such as for water-permeability and thermal properties have also been conducted.

Results of tests, theses and reports can be viewed at Hempcrete Australia’s head office.

### 3.1.4 Water

The water used for the mix should be clean as per AS1379.2.4

### 3.2 MIXING

Mixing is preferably undertaken in pan mixers, however standard drum mixers can be used with great care to avoid formation of ‘pellets’ or ‘balls’, or a mix that is too wet.

In all cases the aim is to obtain a homogeneous mixture in order to produce an aerated concrete in which the particles of hemp are well covered by the binder.

The mixing is an essential part of the hempcrete building process and should at all times be executed as close as possible to the guidelines in this manual.

Experience in mixing will result in a consistent mix that is adapted to the local environmental circumstances at the time.

Weather conditions can influence the required humidity ratio of the hemp hurd.

All work with powders and dust should be performed in accordance with safety regulations:

- Avoid contact with the eyes and skin from both wet and dry product as there is a risk of serious damage to eyes.
- Avoid breathing dust.
- Wear protective clothing, gloves (AS 2161) and eye protection (AS/NZS 1337)
- In dusty conditions wear respirator (AS/ANZS 1715,1716)
3. Hempcrete Installation: General

3.2.1 Pan Mixer

Hempcrete Australia rents out and sells reliable pan mixers.

The mixer is loaded from the top and mixes with 3 rotary pedals. See Method below.

A slow speed is recommended.

Mixers are available in 120, 300, 360, 500, 650 and 850 Ltr. Bigger mixers are more efficient.

Power is supplied by: 220 Volt; 3 phase; petrol; hydraulic or a universal joint.

**Method For Pan Mixing**

- Prepare your mix ratio. Consider the amount of wall infill in advance.
- Introduce the hemp in the mixer, breaking any hemp clumps into fine particles.
- While turning, spray the hemp with water mist until damp (color change).
- Introduce up to 10% waste material if applicable.
- Add the INSULIME.
- Add remaining water until a homogeneous mix, with hemp particles covered equally by the lime binder, is obtained.

Total mixing time is about 5 minutes.

A hempcrete mix is described as a ‘dry porridge’. Mix should never be too wet. A homogenous mixture is essential.

It is very important to create the correct consistency. Hemp is measured with scales, and water with meters on the hose.

To ensure the consistency of the mix, it is recommended that the same mixing operator is employed.

3.2.2 Drum mixer

This method is not recommended for larger projects.

**Method For Drum Mixing**

All work with powders and dust should be performed with safety regulations as stated above.

- Introduce 25 litres of water.
- Add the INSULIME.
- Mix for 3-5 minutes to obtain a smooth milky paste with no lumps.
- Spray the correct quantity of hemp with water mist until damp (color change).
- Add the hemp and mix for about 5 minutes to obtain the required mix.
- Add the remaining water.

Total mixing time is about 8-10 minutes.

A hempcrete mix is described as a ‘dry porridge’. Mix should never be too wet. A homogenous mixture is essential.

Add water as recommended, and adapt according to humidity of the hemp wood and weather conditions.

There is a risk that balls may form in the bell of the mixer with this method.

3.2.3 Tools

The following tools are required after mixing:

- Wheelbarrows - plastic wheelbarrows are robust, will not rust and are easy to clean. Larger barrows can be used as the hempcrete is relatively light.
This is a preview from the Hempcrete Australia Installation Manual 3rd Edition.

For the full version please contact Hempcrete Australia to register for the training course, or to gain further information and technical support.