



## Review paper An Analysis On Hempcrete

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Date : february 2 , 2023

### Abstract

The growing concerns on the carbon emissions made the world to put efforts in this. This led to the growth of use of using vegetal building materials using biomass and biomass originating from agro -forestry industries like rice husk, staw bale, hemp(the most researched material in current times) and etc. Hemp has very low embodied carbon and embodied energy, making it ideal for a building.

### Introduction

The rapid growth of urbanization, industrialization, and is new infrastructure activity are increasing day by day which leads to the increase in the pollution. Many building materials are responsible for this , like as concrete which consist of excess of cement, generally it is prepared 25 billion ton per year, for 1 ton of cement 0.98 ton of CO<sub>2</sub> is emitted which is harmful and leads to global warming for this we have analyzed a new building material i.e hempcrete which is less pollutant and economics as compared to the concrete. Hemp is the variety and derivate of cannabis sativa plant , a hitherto marginalized crops with multitudes of application around 25000 . It is maintain by adding fibers along cement or lime in presence of water. It is also used a lime hemp concrete which is prepared by hydraulic and non hydraulic lime with shives(fibers), it is prepared by casting

process . Firstly shiv has been totally separated from fibers using mechanical grinding process, shiv size ranges from 10 to 50  $\mu\text{m}$ , then binding is done using lime(5). It is preferred of size 16+-3 with 55% humidity, cubes for testing are molded of size 100\*100\*400 . Largest dimension of hemp hurds are 40mm in their largest dimension, average hurds 15mm , maximum 55mm. It has several properties such as low carbon emission this concern made use of material like rice husk , staw bale, hemp (4). Although it is not used as load bearing material it has low strength as compared to the concrete its compressive strength is as low as 2 MPa although its strength can be increased by using admixtures such as nozahic and amziane , it imparts good thermal insulation and load bearing capacity. It has several properties as highly resistant to freezing and thawing, used as a binder, used as a low carbon emission material, by improving techniques compressive strength can be made 93.6-136.9  $\text{kg/m}^3$ , it give sound insulation also. It is also used green building material it is observed that 1 $\text{m}^2$  of hemp lime wall require 370-394 MJ of energy and is durable till 100 years, flexural strength ranges from 0.06 to 1.2 MPa. Also hemp is found less in India so a substitute extracted from balsa wood can be used as hemp provides same macro and micro structure. Also used as form packing and plastering purpose.

## Literature review

- **Sudarshan D. Core et al (2021)**-Hempcrete is maintain by adding fibres along cement or lime in presence of water. . For decreasing global warming , making binder more eco-friendly , sustainable various studies conducted on plant fibre and by products in concrete construction are wood , hemp , flax etc. Moisture locking. Hempcrete has several properties such as thermal properties , compressive strength 93.6 to 136.6 $\text{kg/m}^3$ . it is used as plastering and form packing material as well.
- **Tarun jami et al (2019)** - Hemp has very low embodied carbon and embodied energy, making it ideal for a building . The hemp stalks , normally devoid of fibrous layer ,are processed in a hammer mill to reduced to particle no longer than 40+-5 mm in their largest dimension. Past records shows usage of hemp hurds of 15mm average length, largest hurd particle of 55mm. Which make it suitable for load bearing and sound bearing material.

- **Tarun jami et al(2018)**- Cellulose aggregate concrete has benefits of low density, better thermal insulation and low embodied energy , also use of fly ash , slag etc. CAC-hemp concrete- combination of hemp and lime based binder( a creep). Ann attempt to prevent solar warming- ALBEDO MODIFICATIONS. Hemp is a plant cannabis sativa plant used for textiles, food, plastics etc. Energy 1.6 kg to 18 kg of CO<sub>2</sub>. Ellora cave lime and clay plaster hemp.
- **R Walker et all (2014)**-This paper tell us that hemp – lime concrete is a mix of lime -based concrete which can be used in place of cement -based products. Hempcrete is very helpful in trapping CO<sub>2</sub> emissions in the walls of lime. BOUTIN ET.AL (2006) determined that 1m<sup>2</sup> of hemp lime wall require 370-394 MJ of energy and sequesters 14-35 kg of CO<sub>2</sub> over its life span of 100 years. Hence hempcrete shows far better results in thaw and freeze condition and to salt exposures.
- **Pierre Tronet et al(2016)** This paper deals with Lhc which comprised of hydraulic and non hydraulic lime, with a plant- based aggregate (shiv or minor small residual fibres). The strength of lhc is very low as compared to any other building material(compressive strength less than 2 MPa), the low strength is due to high flexibility of aggregate. There are 2 methods for improving strength one- use of admixture(NOZAHIC AND AMZIANE), two- use of proper compaction in first casting process. It gives good thermal insulation and load bearing capacity. Decreasing the binder proportion can effect it tensile strength to the worst condition. Therefore applying high pressure and limiting binder quantity should be a good way of improving hempcrete blocks from both mech, and environmental point of view. Main objective is:
  - 1.To show the potential and limitation of casting lhc hollow blocks at high level of compression.
  - 2.To demonstrate the compressive strength can be improved when lime is replaced by shiv.
- **Petra Novakova et al (2019)**: The research has shown how hemp hurds may be utilised as a filler in lightweight concrete and that hempcrete can be made using hydraulic lime or cement. Nevertheless, employing cement necessitates mineralizing the shaker, which is a time-consuming and

tedious process. Such concrete has strength that is similar to lightweight concrete, which is the closest to foam concrete.[1]

- **Timea Bejat et al (2015):** The construction industry's environmental impact is growing, thus in order to meet the standards for sustainable development, new projects must recycle current building materials or utilise bio-based products with minimal environmental impact. Over the world, structural materials made of hemp are employed more frequently.[2]
- **Nigel Isaacs (2014):** Hempcrete satisfies the criteria for an eco-friendly material. It is sufficiently made of renewable materials. Producing requires less energy. It emits less greenhouse gases than it does. It offers construction that is resilient, long-lasting, and conducive to healthy living. This stuff can be recycled. Future plans call for conducting an LCA (Life Cycle Assessment) of hempcrete.[3]
- **Joao P. Manaia et al (2019):** Cannabis sativa, also known as industrial hemp, has been thoroughly studied in recent years for the creation of new materials and is gaining more interest as a potential replacement for synthetic fibres. Hemp fibres are warranted for interest because to their low density, high specific strength, and stiffness, as well as the fact that they are 100% biodegradable, relatively inexpensive, and made from renewable resources.[4]
- **Joseph Updike (2015):** Hempcrete is a beneficial material for minimising the negative environmental effects of the construction industry while maintaining high economic value. Hemp's potential as a sustainable building material will be greatly increased by improving mechanical properties and reducing water absorption.[5]
- **Arjun tomar et al (2021) -** In the analysis of “Making building material from hempcrete” we came to know that the hempcrete has a high porosity and the vapour permeability, medium-low thermal conductivity, Young's modulus and compressive strength hempcrete is a light weight insulating material which is ideal for most of the climates as it combines with the thermal mass .It was also found that the density is little bit affected by water content for the sample as the strength is more for the less density because it has good impact on compressive strength.

- **Ismail Demir et al (2020)** - In this paper of “Physical and mechanical properties of hempcrete” are relatively low thermal conductivity, medium low density and very high specific heat, strong thermal insulation and thermal mass, which provide building comfort and also prevent sudden heat changes. Considering the result in the study hempcrete has not only a positive influence on the environment but on global warming and climate changes also. Hempcrete is ensuring a building envelope, which can be used in wall, roof and floor. Hemp is a suitable plant for growing in an environment other than extreme desert climate and high mountain regions.
- **Alaa chateaneuf et al (2015)** - The statistical analysis has been performed for the considered properties, namely the density, the compressive strength and the Young’s modulus by taking into account four parameters: testing laboratory, batch type, hemp shiv type and specimen size. The results obtained by different laboratories show that there is an accurate repeatability for the compressive strength and the dry density. However, the results for the Young's modulus are of a large variability, with results varying from excellent to poor quality. The results also showed that there is some variability between different batches, and therefore the mixing procedure must be done with an utmost care
- **R . walker et al (2014)** – In the research of “ Moisture transfer and thermal properties of hemp-lime concretes” we found that the Analysis showed that microstructural differences related to the amount of hydrates in the binder of concrete at 6 months, the commercial binder included abundant needle-shaped hydrates filling pores while the builder’s mix showed a smaller amount of hydrates which indicated that the commercial binder has significant hydraulic solutions. The binder type did not have a statistically significant Effect on heat conductivity.
- **Michal Golebiewski (2017)** – In the analysis of “ Hemp-lime composites in architectural design” Hempcrete, the material discussed in the paper has significant potential for aiding in advances in the development of sustainable architecture. Its properties help create a healthy and comfortable indoor microclimate and lead to high potential energy savings . The use of the material does not cause significant limitations to architectural design.

## • Conclusion

~Compaction is the good measure to improve strength.

Shiv will contribute to the strength when reduction of volume by 2% is seen.

Stiffness also depends on compactness , but ill be reduced by a high shiv content because wall of shiv particle are one order more flexible than binding particle.

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