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A Literature Review On The Optimization Of Hemp Building Block Material

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ABSTRACT

Given that a significant portion of the world's total carbon emissions originates from the construction sector, there is a growing need to develop and promote the use of sustainable building materials. Hemp-based building materials are among the most promising sustainable options due to their superior thermal performance, zero carbon footprint, good fire resistance, and biodegradability. However, hemp-based building blocks have some drawbacks, including low mechanical strength, high water absorption, and a lack of production standards, so they require further development.

This article is a literature review prepared to shed light on future optimization studies of hemp-based building blocks. This review includes scientific sources that have conducted experimental research on hemp-based building blocks. Based on the sources examined, the effects of different binder types, binder-aggregate ratios, binder-water ratios, different pretreatment applications, particle sizes, and different additives on the physical properties of the material, such as mechanical strength, thermal performance, porosity, and density, have been investigated.

This literature review revealed that the compressive strength of hemp-reinforced building blocks ranged from 0.067 MPa to 17.7 MPa, while their thermal conductivity ranged from 0.047 W/Mk to 0.16 W/mK. According to the studies examined, the mechanical performance of the building block was found to be directly proportional to its density and inversely proportional to its thermal performance. This is because the air voids within the low-density material reduce thermal conductivity but make the material more susceptible to mechanical stress. For example, increasing the binder ratio or reducing the hemp particle size increases density and mechanical performance while negatively impacting thermal performance. However, some applications improve the mechanical performance while preserving the thermal properties of the material. For example, pretreatment applications that reduce the porosity of hemp particles or improve their adhesion to the binder, the addition of flax fiber, and the use of calcium aluminate cement or magnesium cement as binders are some of these. The most important variables affecting mechanical performance are the type of binder, particle size and ratio, and the applied pretreatments. In addition, additives such as Arabic gum, metakaolin, silica, and pozzolan have also been shown to improve mechanical performance.

This article examines the parameters that positively and negatively affect the physical properties of hemp building blocks, highlighting the need to balance mechanical strength, thermal insulation, and environmental performance for material optimization.

KEY WORDS:
hemp, sustainability, building, material, optimization