3D PRINTING OF BIO-BASED BUILDING MATERIALS

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Abstract
The construction industry is one of the largest emitters of CO2 because the production of traditional building materials is highly energy-intensive and uses considerable amounts of raw materials. This research aims to decrease the negative environmental impact of the construction industry by providing biocomposites with a low environmental impact due to their bio-based components and efficient use of the materials through 3D printing. Agricultural waste products—hemp shives—are used in these materials as a filler together with three different types of fast-setting binders—magnesium, calcium sulphoaluminate (CSA) and those that are gypsum-based. The study determines the setting time and compressive strength of these binders, as well as the formation of biocomposites of different densities for different applications; extrusion tests and preliminary life cycle assessment (LCA) are also performed. Results show that biocomposites with hemp shives and fast setting binders have a possible application in 3D printing due to their shape stability and buildability, as well as relatively high compressive strength, which allows for load-bearing use at high densities and thermal insulation use at low densities, although printability at low binder content remains a significant challenge. Preliminary LCA results show that CSA and gypsum binders have the lowest environmental impact from the binders considered.

Keywords:
3D printing, LCA, CSA, gypsum