Abstract

The growing demand for sustainable construction materials with reduced environmental impact has intensified interest in alternative cementitious binders and the valorization of renewable lignocellulosic resources. This study investigates the physical-mechanical performance and microstructural stability of basic magnesium sulfate cement (BMSC) particleboards reinforced with lignocellulosic agro-industrial by-products, namely oat husk and bamboo particles. The main objective is to optimize BMSC-based formulations for sustainable particleboard production while promoting the valorization of agro-industrial by-products within a circular economy framework. Particleboards were manufactured using a BMSC system with a constant molar ratio of $MgO:MgSO_4 : H_2O$ of 10 : 1: 20 and 0.5 wt.% citric acid, added to promote the formation of the characteristic 5-1-7 hydration phase. The lignocellulosic content was adjusted according to the target board density. Mechanical performance was evaluated through four-point bending tests, while the cementitious matrix and composite microstructure were characterized by X-ray diffraction (XRD) and thermogravimetric analysis (TGA). Oat husk particleboards were successfully produced with densities ranging from approximately 804 to 1057 kg/m^3, confirming the feasibility of manufacturing medium- and high-density BMSC particleboards. The mechanical behavior was strongly influenced by density and matrix-particle interactions. Microstructural analyses indicated that the smooth morphology and porous structure of oat husk can limit the adhesion between the lignocellulosic particles and the cementitious matrix. In contrast, bamboo particles promoted a more homogeneous matrix distribution and improved interfacial contact, attributed to their lower porosity and more favorable geometry or cement coating. The results demonstrate the potential of BMSC particleboards reinforced with agricultural residues as sustainable materials for non-structural building applications.