From Icelandic Wood Waste to Low-Carbon Construction: Biochar Concrete for Paving and Mycelium Composites for Insulation

Neuza Valadas (University of Iceland), Jukka Heinonen (University of Iceland), Ana Mafalda Matos (FEUP, University of Porto), Stefan Werkovits (University of Nottingham)

PROBLEM

Construction must cut embodied greenhouse gas emissions. Icelandic wood waste can be turned into two potentially carbon-storing materials: biochar, used to partially replace cement in concrete (Biochar-concrete), and mycelium-based composites (MBCs) grown on wood residues.

AIM

To evaluate wood-waste-derived materials as low-carbon alternatives for two uses: pedestrian paving (Biochar-concrete) and thermal insulation (MBCs).

Objectives: (i) assess the compressive strength of Biochar concrete with 3–10% biochar and different particle sizes; (ii) characterize the thermal, fire, and microstructural performance of MBCs.

A · Biochar concrete for paving

Particle size mattered more than dosage. At 5% replacement, fine biochar (<100 µm) reached 16.5 MPa, about 2.4 times the strength with coarser biochar (about 7 MPa); 3% and 10% coarser biochar gave about 6 and 3 MPa. Fine particles likely improve packing, internal curing and bonding, while coarse particles act as weak inclusions. Biochar-concrete is too weak for trafficked layers but may suit pedestrian paving and walkways, subject to splitting strength, abrasion and freeze–thaw tests (EN 1338/EN 1339).

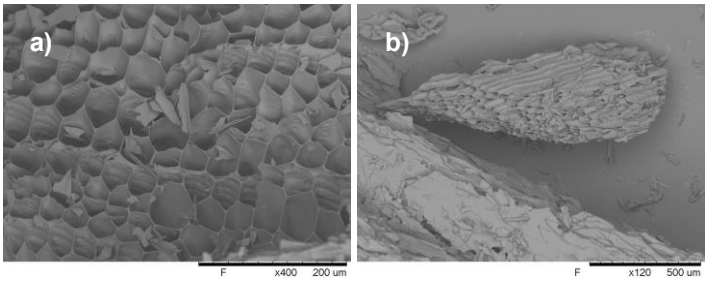


Fig. 1 – SEM images of the wood biochar (a, b).

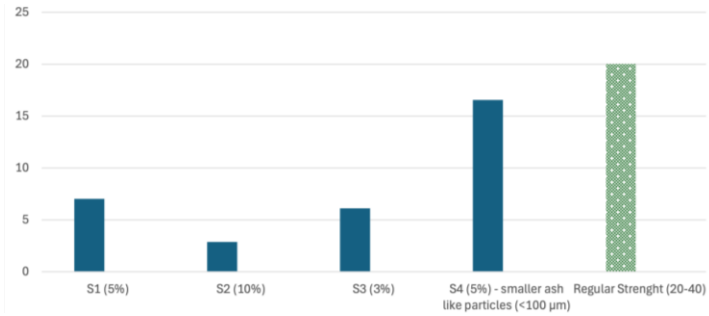


Fig. 2 – Compressive strength of the Biochar-concrete mixes (MPa).

B · Mycelium composites for insulation

MBCs grown on Icelandic wood residues form a dense hyphal network that binds the substrate (Fig. 3). Their thermal and fire performance has been reported by Valadas et al. (2026). Key values: thermal conductivity 0.05-0.06 (W/m·K), density 140-200 (Kg/m^{-3}), fireproofing results ranged from 720 s (for silica-modified specimens) to >2100 s (for those modified with wool).

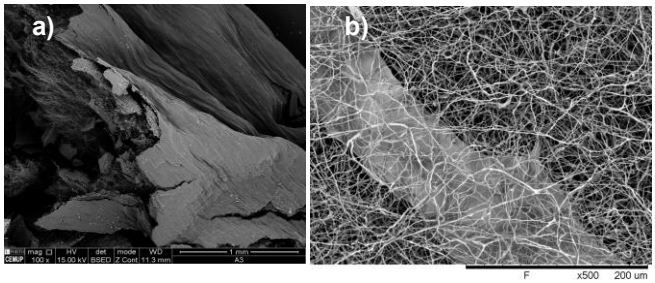


Fig. 3 – Hyphae network, substrate particles (a, b).

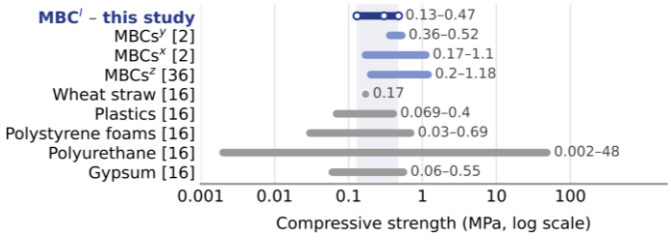


Fig. 4 – Assessment of MBCs vs. conventional materials (EPS, XPS, gypsum), from Valadas et al. (2026).

KEY TAKEAWAYS

Fine biochar (<100 µm) at 5% gave the highest biochar-concrete strength (16.5 MPa), promising for pedestrian paving pending durability tests. Mycelium composites from the same waste stream offer a bio-based insulation alternative. (Neuza I Da Silva Valadas *et al* 2026 *Environ. Res.: Infrastruct. Sustain.* **6** 025013**DOI** 10.1088/2634-4505/ae7153)