Mycelium-based composites using biomass residues: opportunities to advance regional and resilient supply-chains

Radika Bhaskar (Assistant Professor)
Department of Engineering, Thomas Jefferson University
4201 Henry Avenue
Philadelphia, PA, 19129 United States
Radika.bhaskar@jefferson.edu

Mycelium-based composites (MBCs) are formed from lignocellulosic materials and a biopolymer matrix derived from fungal mycelium. Due to their low fossil energy demand, MBCs represent a versatile and sustainable material suitable for a range of applications spanning packaging, insulation, construction, and furniture.

Pennsylvania's established and burgeoning agricultural industries related to mushroom and industrial hemp cultivation create opportunities to advance a regional circular economy centered on transformation of sustainably-sourced biomass residues to bio-based products. Hemp fibers are an example of natural fibers with great promise to improve mechanical properties of bio-composites, yet minimally processed hemp stalks have not yet been evaluated as an effective substrate for MBCs.

Partnering with local industries, we screened the potential of three different locally grown mushroom strains combined with local hemp residues to serve as an alternative to environmentally harmful expanded polystyrene (EPS, or Styrofoam). Some aspects of mechanical performance were met or exceeded, and we discuss the promising implications of the work. However, MBCs are challenging to produce at scale, due to lead-times, strict environmental conditions, and inherent variability of living organisms impacting critical material characteristics. Further refinement is aimed at reducing production time and variability, and imparting water repellency to facilitate scalability. Ongoing research directions to further regional circularity includes evaluation of spent mushroom substrate and engagement with a local sawmill to explore potential of forestry sector residues in MBCs.