Mycelium-Based Binders and Packaging Materials: High-Performance, Circular Alternatives for Hygiene and Spill-Control Applications

Abstract

Mycelium-based binders and packaging materials are emerging as scalable, biodegradable alternatives to fossil-derived foams and synthetic absorbent components, offering a rare combination of functional performance, circularity, and waste-to-value potential. This presentation examines recent advances in fungal biotechnology, substrate engineering, and modular manufacturing, with a specific focus on valorizing cellulose-rich residues from the pulp and paper industry as low-carbon feedstocks.

Comparative performance and lifecycle data against expanded polystyrene (EPS), polyurethane (PU), and bio-based foams (PLA, PHA) demonstrate mycelium's advantages in key sustainability metrics—including substantially lower greenhouse gas emissions, reduced embodied energy, inherent microplastic-free end-of-life, and rapid compostability—while achieving application-relevant mechanical strength, cushioning behavior, and absorbency.

Use cases relevant to the hygiene and spill-control sectors—including absorbent cores, industrial spill management media, and protective packaging for sensitive products—are explored alongside commercial and pilot-scale case studies. These examples highlight both near-term opportunities and scale-up challenges, such as growth-cycle variability, material standardization, moisture sensitivity, and cold-chain requirements for spawn viability.

The session further outlines priority research and development pathways in strain optimization, substrate formulation, hybrid mycelium-fiber composites, and Industry-4.0-enabled process monitoring and control. Regulatory and market drivers—including plastic bans, green public procurement, and extended producer responsibility (EPR) frameworks—are discussed as accelerating forces for adoption.

By integrating material science, industrial ecology, and market insights, this presentation positions mycelium-based systems as a credible, high-impact pathway for delivering sustainable performance in hygiene, absorbent, and protective material applications—supporting Europe's circular-economy and decarbonization objectives.