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Recent Advances in Fiber-Reinforced Biopolymers Derived from Rice Husk Waste for Sustainable Construction Materials

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INTRODUCTION & AIM

The increasing demand for sustainable and environmentally friendly construction materials has spurred interest in biopolymer composites reinforced with agricultural waste. Rice husk (RH), a byproduct of rice milling, is abundant and rich in lignocellulosic fibers and silica, making it an excellent for use in fiber-reinforced biopolymers. This study investigates recent developments in RH-reinforced biopolymer composites and evaluates their potential in construction applications due to their mechanical, thermal, and ecological advantages.

METHOD

Rice husk was subjected to alkaline treatment using 5% NaOH to remove surface impurities and enhance fiber–matrix interaction. The treated fibers were incorporated into various polymer matrices including low-density polyethylene (LDPE), polylactic acid (PLA), epoxy resin, and unsaturated polyester. The composites were fabricated through melt blending and compression molding techniques.

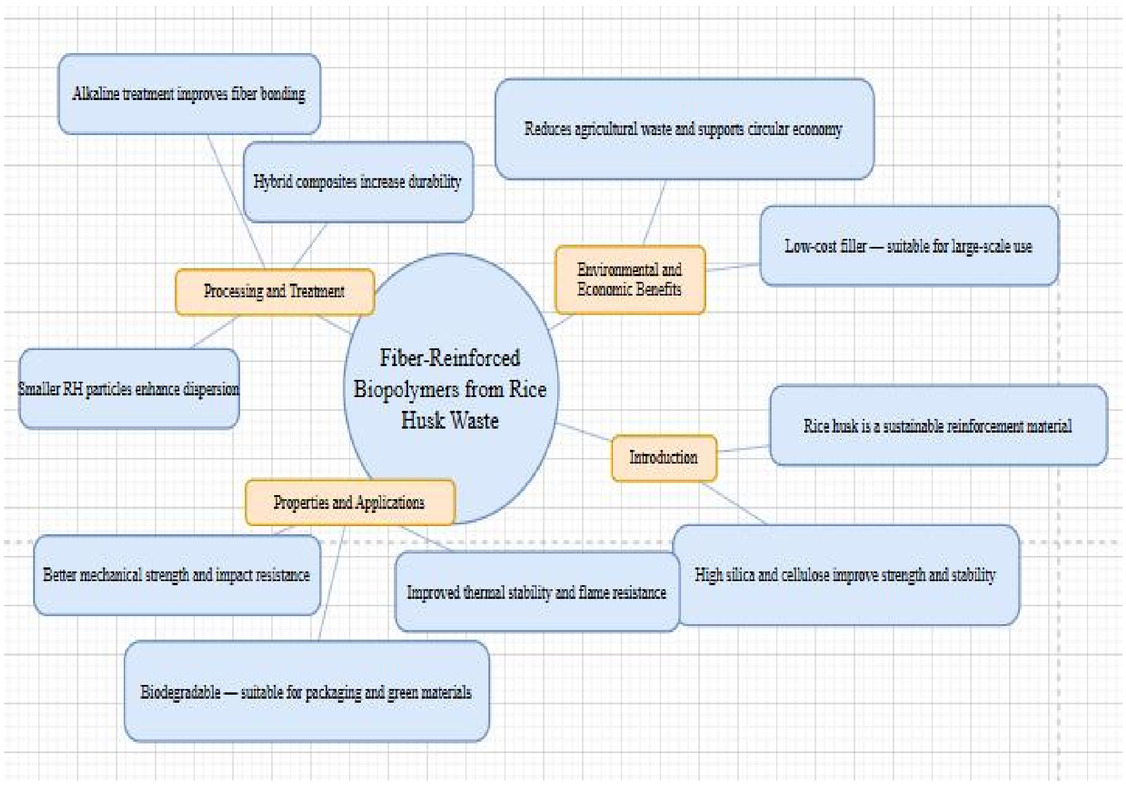

Figure 1: Fiber-Reinforced Biopolymers from Rice Husk Waste

RESULTS & DISCUSSION

Overall improvement: Incorporation of RH enhanced the mechanical performance of all tested polymer systems.
Tensile strength: LDPE/RH composites showed a 25% increase, rising from 13.2 MPa to 16.5 MPa.
Flexural strength: Epoxy/RH composites demonstrated a 32% improvement compared to pure epoxy.
Hardness: Surface-treated RH composites exhibited an 18% increase in hardness.
Compressive strength: RH ash addition enhanced the compressive strength of cementitious composites by 15%.
Biodegradability: Composites containing RH particles <250 μm achieved 60% degradation after 90 days.
Soil reinforcement: RH biochar and chitosan-treated soils showed a 22% increase in shear strength.

CONCLUSION

Sustainable alternative: Rice husk fiber-reinforced biopolymers are promising eco-friendly substitutes for conventional construction materials.
Enhanced performance: They exhibit improved mechanical strength, thermal stability, and biodegradability.
Versatile applications: Suitable for panels, insulation materials, cementitious composites, and soil reinforcement.
Environmental benefit: Promote circular economy practices and reduce construction-related waste.
Future focus: Research should emphasize large-scale implementation, cost-effectiveness, and long-term durability assessment.

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