Characterizing Sargassum polyphyllum for Use in Biodegradable 3D-Printing Supports

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Additive manufacturing relies heavily on disposable plastic supports, which contribute to long-term environmental waste. This project investigated Sargassum polyphyllum, an invasive brown algae found in Hawai‘i, as a local and biodegradable alternative to petroleum-based 3D printing supports. Sodium alginate was extracted from Sargassum and processed into hydrogels using a coaxial extrusion system that combined alginate with calcium chloride for controlled crosslinking. Mechanical and shape retention tests were conducted on samples ranging from 1.0g to 5.5g per 100mL to identify a concentration suitable for structural stability. Results showed that 4.0-5.0g alginate concentrations achieved optimal mechanical strength and shape retention (96-99%), maintaining integrity during extrusion while remaining water-soluble for easy removal. A custom-built CoreXY 3D printer with a dual-extrusion system was successfully assembled and calibrated for hydrogel deposition, producing two-dimensional alginate grids with reliable adhesion. Although full-length print trials are ongoing, preliminary findings confirmed that alginate-based supports dissolve cleanly and minimize plastic waste. This work demonstrates that Sargassum polyphyllum can be converted into a functional, biodegradable support medium for sustainable additive manufacturing. The system establishes a foundation for further optimization of crosslinking chemistry, nozzle precision, and large-scale production. Broader implications include reducing local plastic waste, enabling eco-friendly material sourcing, and supporting Hawai‘i’s transition toward circular, bio-based engineering materials.

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