Hydro-Shape: Advancing Sustainable 3D Textile Manufacturing through High-Pressure Water-Jet Solidification

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Abstract

As the global textile industry shifts toward plastic-free and resource-saving solutions, conventional 3D forming methods-often limited to synthetic fibers and energy-intensive thermal or ultrasonic welding-face significant sustainability challenges. This paper introduces "Hydro-Shape," This technology utilizes high-pressure water jets to solidify fibers into complex, binder-free 3D structures through a unique 5-dimensional movement mechanism in a single work step.

Unlike traditional roll-good-based manufacturing, Hydro-Shape enables "close contour production" for all fiber types, including 100% natural and biodegradable fibers, without the need for chemical binders. Technical evaluations demonstrate that the process can reduce fiber waste and energy consumption . A practical application in the filtration sector shows that degradable 3D filters produced via Hydro-Shape are lighter while maintaining or exceeding the efficiency of conventional plastic products.

By allowing for variable densities, complex patterns, and the integration of diverse fiber blends, Hydro-Shape represents a significant leap in process innovation for fibres-based products. The paper discusses the current development status, including the target of a machine prototype capable of building structures up to 50 cm^3, and explores the technology's potential for industries ranging from medical to industrial filtration.

Keywords: 3D forming methods, sustainability challenges, 100% natural and biodegradable fibers, Technical evaluations, reduce fiber waste and energy consumption, process innovation

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