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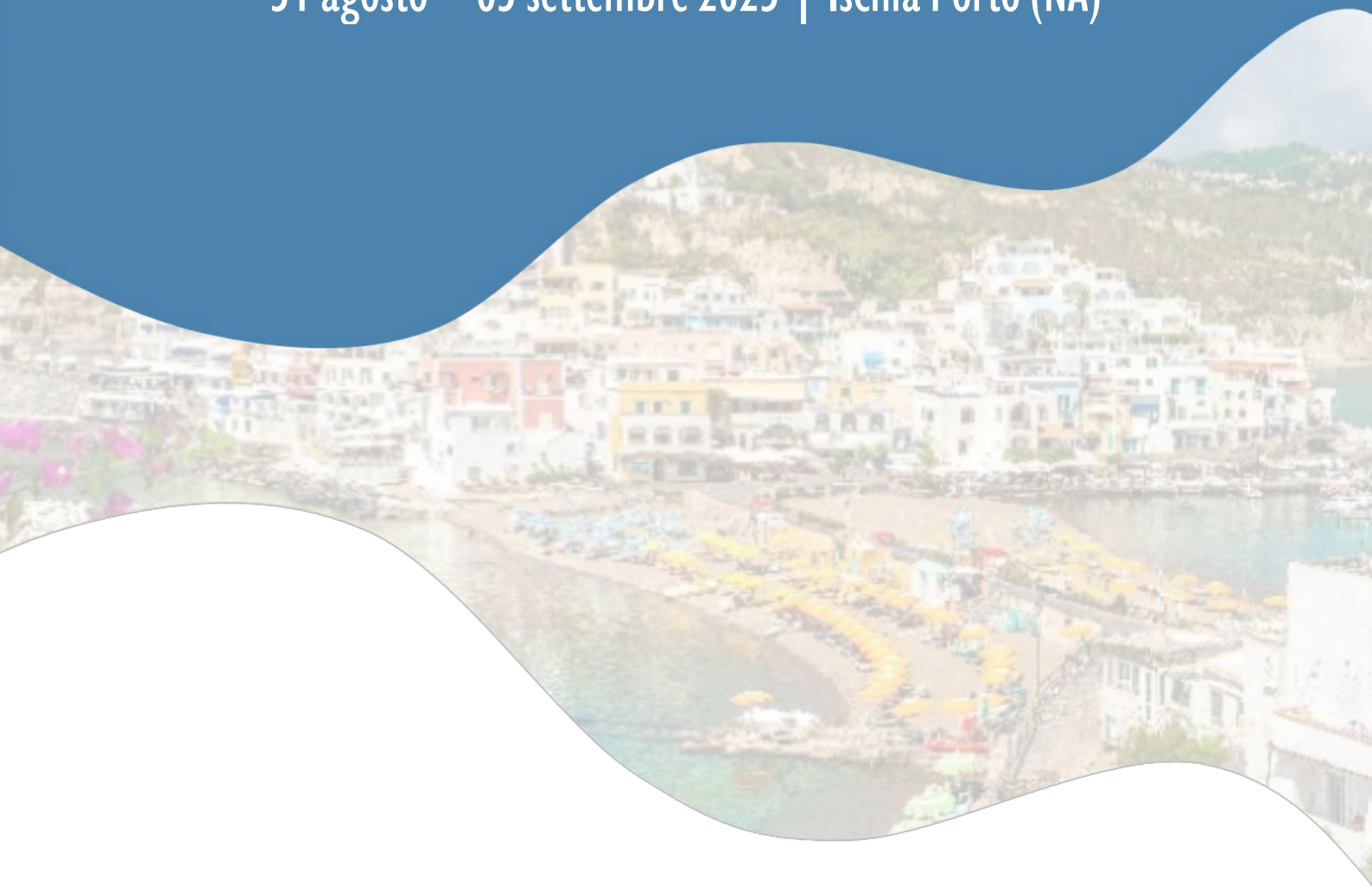

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Upcycling of leather waste to produce versatile composites for different 3D printing techniques

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Abstract

Around 80% of processed leather ends up as solid waste during production, underscoring the critical need for sustainable valorization strategies. This study explores two recycling approaches mechanical and chemical for repurposing leather waste (Muralidharan et al., 2022; Pati et al., 2014). In the mechanical recycling, we developed a fully bio-based, circular, and 3D-printable composite as an alternative to vegetable-tanned leather, incorporating leather waste particles as a filler. The composite was designed to replicate the mechanical behavior of genuine leather and to be compatible with extrusion-based 3D printing for customizable bio-leather products (Guo et al., 2022). To overcome the hygroscopic nature and hydrolysis challenges of leather waste, we established a straightforward method to produce leather hydrolysate (Matinong et al., 2022). This hydrolysate serves as a filler within a green polymer matrix suitable for both Direct Ink Writing (DIW) and LCD-based vat photopolymerization 3D printing techniques. By implementing this dual recycling strategy, the study demonstrates the conversion of leather waste into 3D-printable materials with promising tensile strength and viscoelastic performance. This approach not only supports a circular material lifecycle but also integrates sustainable recycling with advanced additive manufacturing, paving the way for innovative leather upcycling and eco-friendly material solutions.

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