Comparison of three Additive Manufacturing (AM) techniques for manufacturing complex hollow composite parts

C. Tosto[1,*], E. Pergolizzi[1] and G. Cicala[1]

[1] *University of Catania, Department of Civil Engineering and Architecture, V.le Andrea Doria, 6 – 95125 Catania, Italy, gianluca.cicala@unict.it*

Keywords. composites, additive manufacturing, tooling, fff, lcd

Abstract.
Additive manufacturing (AM) is well known for supporting the manufacturing of composites through the 3D printing of lay-up tools, sacrificial mandrels, trim molds etc [1].
The FDM (Fused Deposition Modeling) was a pioneer in composite tooling. This technique is advantageous in many scenarios [2] in which it is convenient to obtain hollow composite parts by dissolving sacrificial mandrels, removing the use of expensive and heavy metal molds. However, the effects that the removal process has on the thermomechanical properties of the composite must be considered. The convenience of another AM technique, liquid crystal display (LCD) printing, has also recently been demonstrated [3].
The present work aims to compare three different techniques, FDM, FFF (Fused Filament Fabrication) and LCD, each using different materials and, therefore, different mandrel removal processes. DMA analyses have highlighted the impact of some dissolution processes on thermomechanical properties. Further mechanical analysis were conducted to support what was found in the thermomechanical characterization tests.
Finally, an economic analyses highlighted the time and cost savings of some AM technologies compared to the conventional method for manufacturing composite parts.

References
[1] M. Luši´ca et al. Proc. CIRP. 2016, 50, 390.
[2] C. Tosto et al. Macromol. Symp. 2020, 389, 1900069.
[3] G. Cicala et al. Macromol. Symp. 2021, 395, 2000256.