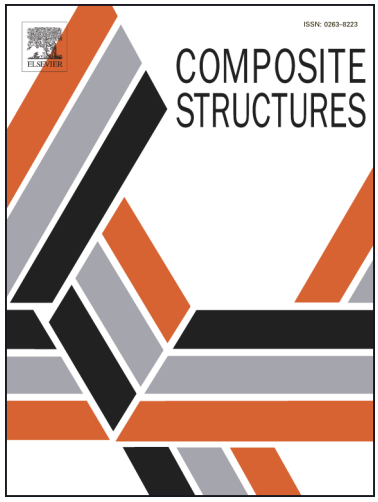

A new approach for forming polymeric composite structures

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A new approach for forming polymeric composite structures

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Abstract. The use of composite structures is increasing constantly in the last years, pushed by advantages of reduced weight and high strength. Moreover, the recent scenario points out a great attention on thermoplastic matrix composites due to their intrinsic recyclability as well for their possibility to re-use and re-manufacturing. However, the adoption of these materials can be further appreciated considering the secondary material workability as far as by demonstrating the possibility to re-manufacture the thermoplastic composite.

The proposed work presents an experimental analysis carried out to investigate the downstream workability of a thermoplastic composite by one of the most versatile and flexible process. Glass fiber reinforced Polyamide 6 is the investigated material and the Single Point Incremental Forming is the implemented manufacturing approach. Since the composite matrix is characterized by a glass transition temperature higher than 50 °C, an external heating source has been necessary to perform the process in "*hot*" conditions. The process feasibility was fully demonstrated as well as the same was optimized in order to derive proper guidelines that can drive the process designer in the method star-up.

Keywords: thermoplastic composite, short glass-fibers, downstream process, SPIF

1. Introduction

Composite materials are gaining great interest for their application in several sectors, such as in the aircraft and naval ship industry, where there is the need of producing different parts in small batches [1,2]. Composites are well known for their excellent properties in terms of mechanical strength, reduced weight and stiffness, corrosion resistance, non-magnetic properties. They have been using for replacing both no-structural and structural components, that may also be subjected to impacts. Composite materials are usually shaped through primary manufacturing processes, such as autoclave molding, compression molding, pultrusion and filament winding processes, where temperature, pressure, and process time affect the mechanical properties of the produced components [3]. Researchers in the last decades have been investigating downstream processes for forming composites and for understanding the influence of process parameters and material properties on the outcomes.

Machining operations, such as drilling, orthogonal cutting, turning, belong to the downstream process category and are necessary for meeting dimensional and functional requirements of the composite parts [4]. These post machining operations allow to improve the parts by appropriately setting the tool geometry, the cutting speed, the