Study of the One-Shot Drilling of CFRP/Ti6Al4V Stacks with a Double Tip Angle Cutting-Tool Geometry

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Abstract. Dissimilar materials are commonly used by the aerospace industry in form of hybrid structures in order to achieve better mechanical properties, with an important weight reduction. An example of this is the joining of lightweight metal alloys such as Ti6Al4V, with carbon fiber reinforced polymer (CFRP) materials. These stacks must be drilled previous to be riveted in the assembly stages. However, due to their dissimilar machinability these materials can show some issues, like high tool wear, delamination and burr formation. In this sense, a way to obtain a better cutting-tool behavior is the use of One Shot Drilling (OSD) strategies, by changing the cutting parameters for each material at the interface.

In this research, a study of the One-Shot drilling of CFRP/Ti6Al4V stacks was performed using internal MQL, drilling a full thickness of 10.25 mm (5.25 CFRP, 5.00 Ti6Al4V) with a 6.4 mm diameter cutting-tool, with double tip angle of 116º and 52º. Tool life were tested up to 200 bores using the cutting parameters shown in **Table 1**.

Table 1. Drilling parameters

Material	Cutting Speed, S (m/min)	Feed rate, f (mm/rev)
CFRP	100	0.250
Ti6Al4V	13	0.021

Macro and micro geometrical defects have been evaluated every 10 holes, involving the evaluation of diameter deviation, surface quality (in terms of roughness average, Ra), delamination and burr height at the interface. Also cutting tool wear has been evaluated by using Stereoscopic Optical Microscopy (SOM), while thrust force were acquired during the drilling process by using a dynamometric table.

The cutting geometry employed allows to obtain satisfactory results in surface quality and diameter in most of cases. However, the burr generated shows high values, associated to a high tip angle. The main wear mechanisms detected have been identified as adhesion and abrasion, being their evolution directly related with the behavior of the thrust force.