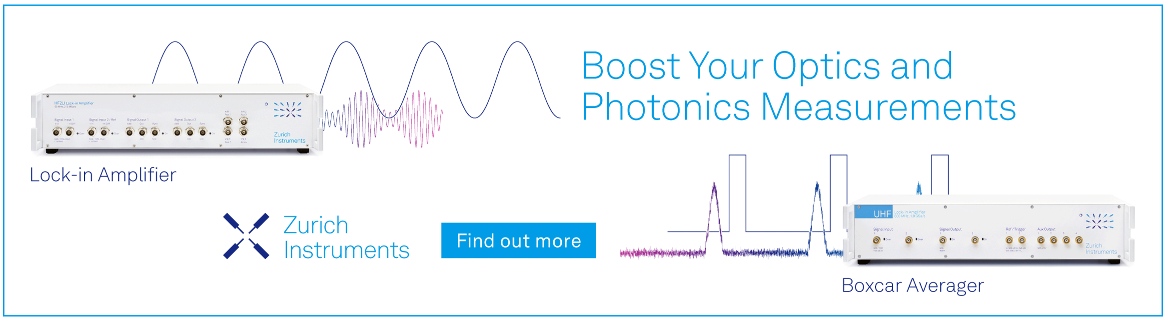
RESEARCH ARTICLE | FEBRUARY 20 2024

Tool wear context of tungsten solid carbide end milling tool on CFRP composite laminates

I. S. N. V. R. Prasanth ✉; A. Raveendra; D. V. Ravishankar; Manzoor Hussain; Uday Kiran Mudavath; Vamsi Pusam; Udaya Bhaskar

AIP Conf. Proc. 3007, 100006 (2024)
https://doi.org/10.1063/5.0193070



Tool Wear Context of Tungsten Solid Carbide End Milling Tool on CFRP Composite Laminates

ISNVR Prasanth[1, a)], A. Raveendra[1], DV. Ravishankar [2], Manzoor Hussain[3], Uday Kiran Mudavath [1], Vamsi Pusam [1], and Udaya Bhaskar[1]

[1]Department of Mechanical Engineering, Malla Reddy Engineering College, Hyderabad, India
[2]Department of Mechanical Engineering, TKRCET, Hyderabad, India
[3]Department of Mechanical Engineering, JNTUH, Hyderabad, India

[a)]Corresponding author: federicopalazzetti@yahoo.it

Abstract. Aerospace companies frequently use carbon fiber reinforced polymer (CFRP) composites because of its remarkable material properties, including their light weight, high strength-to-weight ratio, and high stiffness. Cutting tools are crucial to the achievement of quantifiable outcomes including surface quality, tool life, and cutting force. Using tungsten carbide tools, milling operations are carried out on CFRP laminates. On a computer numerical control (CNC), all trials were carried out by adjusting the feed rate, spindle speed, and depth of cut. According to the experimental findings, the tool wear of tungsten carbide (WC-6%Co) tools is characterized by abrasive wear and rounding of the tool's cutting edge. According to my observations, the spindle speed, feed rate, and cut depth all directly correlated with tool life. The experimental and regression validation results for tool wear are remarkably similar, and the error is only about 5%. Finally, the regression model accurately predicts milling CFRP tool wear.
Key words. Carbon Fiber Reinforced Polymer, Tungsten carbide end milling tool, Tool wear, Tool life.

INTRODUCTION

Industries frequently employ milling to make grooves, slots, keyholes, and remove undesirable material to keep desired products' dimensions more closely matched. FRP composites significantly differ from metals in terms of the mechanisms governing the machining process, the chip creation mechanism, and cutting characterisation. due to materials that are inhomogeneous and fail by brittle fracture. Fiber orientation, fibre volume fraction, and the kind of matrix material used in milling all have a significant impact on machining characteristics including surface roughness and delamination. The ease with which the fibre can be sheared by the sharp cutting edge of the tool utilised and the selection of cutting tool are limitations in FRP machining. The rate of tool edge wears increases gradually due to the glass fiber's abrasive properties and high hardness [1]. The complexity of composites' machinability is heavily influenced by a variety of variables, including the machining environment, tool characteristics, workpiece composition, and vibration during the process [2]. The machining forces used during machining play a significant role in the characterization of machinability in FRP composite milling. Studies on conventional machining can help to better understand this [3-6]. Due to the simplicity of the turning-related cutting mechanisms, earlier study has concentrated on machinability studies to comprehend the issues. The field of drilling FRP composites has also generated a significant amount of study. However, the issue of delamination, poor surface smoothness, and inefficient tool performance has been the main limitations in milling FRP composites. On the other hand, according to other research in the literature [1–7], changing cutting process parameters and other machining variables have a considerable impact on the surface roughness and machined surface quality of FRP composite laminates. One of the researchers used Taguchi design trials to create a machinability study. And the outcomes demonstrated that the feed rate, which has a significant impact on surface roughness, machining forces, and tool life [7], is the control parameter.

14th International Conference on Materials Processing and Characterization 2023
AIP Conf. Proc. 3007, 100006-1–100006-17; https://doi.org/10.1063/5.0193070
Published by AIP Publishing. 978-0-7354-4855-1/$30.00