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Review

A review on the machining of polymer composites reinforced with carbon (CFRP), glass (GFRP), and natural fibers (NFRP)

Mohamed Slamani[1,2] · Jean-François Chatelain[1]

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Abstract
Composite material consumption is booming and is expected to increase exponentially in many industrial applications such as aerospace, automotive, marine and defense. However, in most cases, composite products require further processing before they can be used or assembled. Machining of composite materials is extremely difficult due to their anisotropic and non-homogeneous structure. This paper provides a comprehensive review of the literature on composite materials and their machining processes, such as turning, milling and drilling. Damage related to these processes is also discussed. The paper is divided into seven main parts; the first, second and third parts give a brief overview of composite materials, reinforcements used in composite materials and composite manufacturing methods, respectively. The fourth part deals with post-processing machining operations, while the fifth, sixth and seventh parts are devoted to the machining of carbon fiber reinforced polymer composite, glass fiber reinforced polymer and natural fiber reinforced polymer composites, respectively. An analysis of the factors that influence the machining and the machinability criteria used for these materials is also presented, with particular emphasis on cutting forces, tool wear, delamination and surface finish. Non-traditional manufacturing methods are not discussed in this paper.

Keywords Composite materials · CFRP · GFRP · NFRP · Machining · Tool wear · Surface damage

1 Introduction

The composite materials sector is booming to the point that it is currently difficult to find an industry that does not leverage the benefits provided by the materials, which means that the sector must meet the demands of a constantly changing market. In these composites, several immiscible materials are arranged together, with the qualities of each constituent complementing those of the other to form materials with increased properties. They thus have many advantages, which allow them to compete directly with so-called conventional materials such as metals or alloys [1, 2]. They are used in many industrial applications thanks to their excellent mechanical and electrical properties and to their low density as compared to those of metallic structures [3].

Aerospace is a perfect example of a sector witnessing the emergence of composite materials [4, 5]. The success of FRP composites in this sector is mainly due to their very high strength-to-weight ratio [6, 7], allowing to significantly reduce the weight of aircraft components, and fuel consumption by extension, while maintaining similar resistance properties.

✉ Jean-François Chatelain, jean-francois.chatelain@etsmtl.ca; Mohamed Slamani, mohamed.slamani@univ-msila.dz | [1]Mechanical Engineering Department, École de Technologie Supérieure, Montreal, Canada. [2]MMS Lab, Faculty of Technology, University of M'sila, M'sila, Algeria.