

Preface

The idea for writing a book on machining fiber-reinforced polymer (FRP) composites came about during the time I taught a graduate course on the subject at Wichita State University. Preparing lecture notes and material for the course was and still is a laborious and painstaking task because of the lack of complete books and references on the subject. The machining of FRP composites is a relatively new practice, and unlike the well-established practices of metal machining, it is still in the development stages. Despite the fact that ample research work has been published in the past three decades, there exists no single source that provides a comprehensive treatment of the subject from fundamental and practical points of view. Therefore, a need for such a book exists, and this current book is perhaps the first compilation of its kind on the subject.

This book addresses both the theoretical foundation and practical aspects of machining FRP composites. A brief introduction to composite materials is provided in Chap. 1. This is necessary to familiarize readers who are new to the subject with the terminology, technology, and manufacturing aspects of polymer composites. The section on properties of composites at the end of this chapter is very brief and by no means is a fair treatment of this very complicated subject. Its inclusion is necessary for completeness, so that the reader would appreciate the complexity of the subject. Chapter 2 provides a brief synopsis of machining kinematics. This treatment is necessary for anyone who intends to engage in machining studies, whether it is for metals or composites. Chapter 3 covers the fundamental concept of mechanics of chip formation from the experimental and analytical perspectives. Much of the techniques discussed in this chapter have been imported from established metal machining tradition. A case in point is the application of single shear plane theory to the orthogonal machining of fiber-reinforced composites. Therefore, great effort is spent in explaining the similarities and contrasts between machining metals and composites and the limitations of metal machining theories in this regard. Chapter 4 discusses the phenomena of tool wear and provides analysis of tool materials and tool wear mechanisms in machining FRP composites. Once again the differences in tooling requirements for composites and metals machining are considered. Chapters 5 and 6 discuss the machinability of FRP composites by traditional and

nontraditional methods, respectively. These include turning, milling, drilling, abrasive, abrasive waterjet, and laser machining. Recommended industrial practices and tips are highlighted whenever possible. Finally, Chap. 7 discusses the important issue of health and safety in machining FRP composites. This chapter familiarizes the readers with the health hazards involved in machining and some of the current standards set by appropriate authorities to deal with these hazards.

This book should serve as a valuable reference for those engaged in research and for manufacturing and design engineers who are engaged in process selection and design of cutting tools for machining FRP composites. It also serves as a complete and comprehensive textbook for one semester course on the subject at the graduate and upper undergraduate levels in manufacturing, mechanical, or materials engineering.

It is my pleasure to acknowledge many of my graduate students at Wichita State University who contributed directly or indirectly to this book. Many of the references I have used in preparing the Chaps. 3–6 were collected and reviewed by my students as a part of their research work or as a required assignment for the course on machining composites. Several students, whose names appear in the references lists, have provided necessary experimental results included in the book. My appreciation is also extended to several colleagues from academia and industry who reviewed parts of the manuscript and provided valuable feedback. Finally, a special note of thanks is due to my editors Steve Elliot and Angela DePina for their indispensable assistance in preparing the manuscript.

Abu Dhabi, UAE

Jamal Y. Sheikh-Ahmad



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Ahmad, J.

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