

Preface

This book is a culmination of efforts and experience that I have gathered over the past 15 years from teaching the course of manufacturing of composites at Concordia University, from training engineers at local aircraft companies, and from research activities on analysis, design and manufacturing of composites over the past three decades.

I came to work on composites from a mechanical engineering background. This may be similar to many other people in the late 1970s and 1980s. I began work on mechanics of composites. For mechanics problems, we assumed that resin and fibers possess certain properties and that most resins would behave similarly as long as they are of the same category (for example, epoxies). As I got to know more about the field, I came into contact with people in various industries from which I found that there exists a world of knowledge and experience for composites manufacturing: in order to have sufficient expertise in composites, one must know not only the mechanics of the materials/structures, but also the intricacies of their manufacturing processes.

When I listened to presentations or attended industrial shows on composites manufacturing, the discussions and/or exhibits of composite parts were impressive. However, the question that always came to my mind was: what is the principle behind the manufacturing of these parts? How can one grasp the concepts and the principles behind them?

There are a few books on composites manufacturing that exist in the literature. One well-known book is that of George Lubin (*Handbook of Composites*), which is a comprehensive presentation of many aspects of composites and composites manufacturing. Another book is that of Brent Strong (*Fundamentals of Composites Manufacturing*). This book presents the principles of composite manufacturing, describing the ingredients: matrix, fibers, interface and the main processes for composite manufactur-

ing. It deals more with the practical aspects of composites manufacturing. In 1997, T. G. Gutowski's *Manufacturing of Composites* was published. This book is a collection of works of well-known scientists in the field and focuses on the scientific aspects of composites manufacturing. Also in 1997, there was a book on processes entitled *Composite Materials, Processing, Fabrication and Applications*, by Mel M. Schwartz. In 2000, a book by Sanjay Mazumdar on practical aspects of composites manufacturing came out. These are excellent books in Composites Manufacturing and provide essential knowledge for the field.

However, during my 15 years of teaching I have always found that the existing literature presents composites manufacturing either from the practical point of view (Brent Strong), the collection of opinion of scientific experts (Gutowski), or the collection of different processes (Mazumdar). The existing literature describes more of *what* has been done, with little attention paid to *why* these processes have been done. As its name implies, composites is a field that requires knowledge from many fields. Manufacturing of composites involves a significant amount of knowledge in materials and chemistry. For mechanics people, trying to grasp the chemical aspects of composites manufacturing can be daunting. From the point of view of the learner (students), if they understand the "why," then it may be easier for them to grasp the essentials of composite manufacturing.

The objective of this book is to present composites manufacturing from the rationale of why things are done in a certain way. The book is intended for students from different backgrounds such as mechanical engineering, aerospace engineering, civil engineering, materials engineering, and chemical engineering. It covers the main principles governing manufacturing using composites.

The book is divided into two parts. The first part deals with the fundamental elements for composites manufacturing. This includes the discussion on the essential principles behind composites manufacturing in Chapter 1. This is followed by a discussion on matrix material in Chapter 2, and a discussion on reinforcements in Chapter 3. The second part presents the five most common techniques for composites manufacturing. These are: manufacturing using autoclave in Chapter 4, filament winding in Chapter 5, pultrusion in Chapter 6, liquid composite molding in Chapter 7 and, finally, thermoplastic composites in Chapter 8.

This book is a written version of the instructional materials that I have used in my manufacturing of composites course over the last 15 years. I hope that it will be of help to future students and also to future instructors.

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