Chapter 20
Processing Technologies for Green Composites Production

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ABSTRACT

Green composites became a most important and adaptable theme of research. This area/theme not only harness the agricultural wastes such as bagasse fibres, banana fibres, etc. but also provides a new material manufactured from these wastes which are reduced weight, have low cost, and have high mechanical strength. Currently, there are various methods available for the processing or fabrication of green composites. Some of these methods are hand layup method, injection molding method, spray-up method, compression molding, Resin-Transfer Molding (RTM), etc. In this chapter, we are discussing about the fabrication method of green composite and their important parameters. Various properties and characterization of composite materials made by these methods have also been discussed and reported here.

INTRODUCTION

Green composites are a combination of bioplastics and natural fibers, which have arisen as propitious alternatives to conventional polyolefin/glass fiber composites because they offer a wide variety of advantages, such as less expensive, reduced weight, increased flexibility, renewable resource and sound insulation a certain required performance. Natural fibres are subdivided based on their origins, from plants, animals or minerals. All plant fibres are composed of cellulose while animal fibres consist of proteins. Plant fibres include bast (or stem or soft sclerenchyma) fibres found in phloem of dicotyledonous stems, leaf, seed, fruit, wood, and other grass fibres. The use of these fibers in composites has increased due to their relative cost, their ability to recycle and for the fact that they can compete well in terms of strength

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per weight with other material. Natural fibres can also be considered as naturally occurring composites consisting mainly of cellulose fibrils embedded in lignin matrix they are aligned along the length of the fibre, which render maximum tensile and flexural strengths, in addition to providing rigidity. The reinforcing efficiency of natural fibre is associated with the nature of cellulose and its crystallinity. The main components of natural fibres are cellulose, hemicellulose, pectins, lignin, and waxes. Currently due to increasing interest in eco-friendly, sustainability, eco-efficiency and industrial ecology materials, studies on natural fiber have been actively focused to the area of composite. In an appropriate way, it can be applied as very advantageous composite when an appropriate resin has been selected.

METHODS OF FABRICATION

There are various methods for fabricating composite components to meet specific design or manufacturing challenges. The selection of appropriate method for a particular component, therefore, will depend on the part design, materials and application. Composite fabrication molding processes is used to shape the resin and reinforcement as per design. For an overview of methods used to make mold tools.

Open Molding

Open mold processes include, hand lay-up and spray-up (chopping) (Verma, Deepak, et.al, 2015). In this process, a single-sided mold is used that acts as the form and cosmetic surface of the part. Gel coatis applied to the prepared mold surface and then reinforcements are applied either by hand and then wet-out with resin, or by the spray-up process where resin and chopped fiberglass are sprayed onto the gel coated surface. The additional laminate layer is added to build thickness and strength as desired. Air is then rolled out of the laminate by hand and the part is left to cure. In addition to reinforcements, low density core materials such as balsa wood, foam, or honeycomb can be added to stiffen the laminate without adding significant weight.

Open molding is the most flexible of all composite fabrication processes as part size and design options are virtually limitless. Typically, the open molding process is used for a large size range of products that cannot be produced in more automated processes, or for parts that are produced in low volumes that cannot justify the higher mold costs of automated processes.

Hand Layup Process

Hand layup fabrication is very simple method and used for the thermoset composites, which typically consists of laying dry fabric layers, by hand onto a tool to form a laminate stack (Figure 1). As a part requirement for the hand lay-up process a mold must be used. The mold should be as simple as possible and can be a flat sheet or have infinite curves and edges. For few typical shapes, molds should be joined in sections/ parts so that after curing they can be taken apart for the taking away of the parts.

Resin is applied to the dry plies after layup is complete (e.g., by means of resin infusion). In a variation known as wet layup, each ply is coated with resin and “debulked” or compacted after it is placed. When heat is required for cure, the part temperature is “ramped up” in small increments, maintained at

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