

Chapter 3

Concurrent Design of Green Composites

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ABSTRACT

This chapter presents the overview of concurrent design process of green composite products with special focus on conceptual design stage of natural fiber composites product development. Design of green composites product especially during the early product development stage requires three main aspects in product design which are materials, design and manufacturing process to satisfy lower cost, high quality and fast development time requirements in order to ensure successful product launch into the market. In this chapter, the concurrent design process of green composite products are discussed involving several main stages in product development such as green composite materials selection for both natural fiber and matrix constituents, conceptual design development and concept design selection of green composite products, and green composites manufacturing process selection. In addition, discussion on life cycle assessment of green composites is also included in order to provide further insight of the sustainability design requirements to the overall product development process.

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INTRODUCTION

Concurrent design is part of the activities in the concurrent engineering (CE) approach for product development whereby it involved integration of various aspects of the product development process. Unlike traditional product development process which implemented sequential work activities, the CE approach utilized parallel process activities especially during the early design stage of the product. Also termed as Simultaneous Engineering, the CE approach removed the existing gap between design and production process in product development which has created issues regarding cost and quality due to miscommunication especially with respect to different goals and requirements between the two sequential activities (Sohlenius, 1992). Through the implementation of the CE approach, both aspects are considered in parallel as early as in the conceptual design stage which helps to produce products which able to satisfy both requirements, thus providing higher end product quality without jeopardizing the design intent, and subsequently reduced the overall product development cost due to eliminating the cost of error and repair due to the mismatch between design and production activities (Sapuan, 2005). The CE approach also helps to secure higher product development competitiveness to the market by bringing down the product development time. For green composites product developments, the CE approach is a very suitable method to be implemented considering the nature of the development process whereby green composite product designers need to consider various aspects of the product requirement such as design, materials and manufacturing process altogether during the early stage of the product development activities (Sapuan & Mansor, 2014).

Green composites products have made notable presence as substitutional materials for synthetic composites in many product applications. One of the most aggressive player using green composites is the automotive manufacturers. Driven by stringent legislations towards environmental performance for new generation of vehicles, the automotive manufacturers have applied green composites in the construction of various components such as dashboard, door trim panels, headliners and seat backs (Bismark et al., 2006). The use of green composites contributed significantly towards gaining high weight reduction, product cost and improved biodegradability of the components at the end of the life cycle (Ashori, 2008). Research in applying green composites for structural automotive components are also increasing due to similar advantages as aforementioned such as towards the development of structural frontal bonnet for buggy vehicle (Alves et al., 2010) and bumper beam (Davoodi et al., 2010).

Based on the impact and advantages of CE approach towards successful product design and development, in this chapter the concurrent design process of green composite products are discussed. Special attention is given towards the conceptual

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