Chapter 7
Textile–Reinforced Composites for the Automotive Industry

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ABSTRACT

In the last decades, automotive industry has especially focused on developing and applying new materials and technologies for enhancing the comfort and security levels in the vehicles, but on the other hand for reducing the weight of the means of transportation in order to decrease the energy consumption. In this concept, textile-reinforced composite structures come in possession of one of the most favored materials in the automotive industry by satisfying these demands. In this chapter, usage of textile-reinforced composites in the automotive industry has been elucidated under three main sections: textile reinforced composites for 1) automobiles, 2) mass transportation vehicles, and 3) trucks. The aim of this chapter is to discuss the subject in detail by giving technical information about particular vehicle parts and composite structures utilized in the automotive industry and academia.
INTRODUCTION

The composites are gathering of two or more different materials that enable to acquire a material whose properties are greater than that of the constituent components (Sivakandhan & Prabhu, 2014). Composite structures can be classified into three categories according to their matrix system. These are; metal matrix composites, ceramic matrix composites and polymer matrix composites (Tucker & Lindsey, 2002). Polymer matrix composites are mostly reinforced with textile structures. These structures can be in different forms such as; discontinuous chopped fibers, continuous filament yarns, simple fabrics (2D) or advanced fabrics (3-D) (Misnon, Islam, Epaarachchi, & Lau, 2013). The first example of a fiber reinforced composite was developed after World War II by embedding glass fibers in polymeric resin for petrochemical industry (Bakis et al., 2002).

By using low-cost, light-weight polymers with high strength and high modulus fibers provides good combination of mechanical and technological properties to composites and these properties enables them to find numerous application areas in many sectors such as; automotive, marine, aerospace industry and so on (Bakis et al., 2002; Bindal, Singh, Batra, & Khanna, 2013; Murugan, Ramesh, Padmanabhan, Jeyaraam, & Krishna, 2014; Sezgin & Berkalp, 2016; Shalin, 2012).

Figure 1 shows the relative effect of matrix and reinforcement material on several properties of the composites. It is seen that while the properties such as corrosion, temperature and chemical resistance of composite materials are directly related to the properties of the matrix material, strength and stiffness of the composite is mostly associated with the reinforcement material. However, most of the mechanical properties of the composites are governed by both the reinforcement and the matrix material. By raising the amount of work that is needed to fracture the composite, the synergy of the matrix and the reinforcement material strengthen and toughen the composite material (Friedrich & Almajid, 2013).

The growth of the automotive industry has begun by means of the economic growth that occurred in the early 20th century (Kamath, Bhat, Parikh, & Mueller, 2005). Ever-rising population in the world is the key factor that drives the increment of the global automotive production year by year. The number of passenger cars and commercial vehicles in use worldwide is given in Table 1 (Statista, 2017). On the other hand, while the number of passenger cars and commercial vehicles that were manufactured in the year 2000 was 41.22 and 17.17 million respectively, it has increased to 72.11 and 22.53 million in 2016 (Statista, 2016).

This great expansion in the automotive industry has led the engineers to hunt for new materials (Kamath et al., 2005). All vehicles are subjected to loads which result in stress, vibration and noise and the components of a vehicle should possess required properties to withstand these loads (Harshit, Kumar, & Verma, 2016). In the
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