Chapter 7
Composites as TRIBO Materials in Engineering Systems: Significance and Applications

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ABSTRACT

This chapter starts with the importance of composite materials over single-phase materials and further explores the importance of natural fiber reinforced composites over synthetic fiber reinforced composites followed by chemical and physical modifications of the fiber surface to enhance the adhesion between the fiber and the matrix. The chapter also focuses on the different types of wear mechanisms that lead to shutting down the industries and types of different wear test rings to measure the wear rate of a material. Current work also represents a comprehensive literature study on tribological characterisation of composite materials. In addition, it focuses composites as TRIBO material in engineering systems. The effect of tribological operating parameters like load, sliding velocity, sliding distance, temperature, and other influential parameters like fiber length, fiber volume fraction, fiber orientation, and surface treatment on friction and wear rate of composites are also described. Over the past few years composites have been dominant in the emerging materials. The applications areas of composite materials have grown steadily in the various systems of Mechanical Engineering, Civil Engineering, Electrical Engineering, Medical Engineering, and Automobile Engineering. In engineering systems, failure of parts may occur due to different types of wear mechanisms. The availability of a range of fiber reinforcements, fillers, matrices, and processing techniques offers ample scope for tailoring properties in composites as required for specific applications.

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1. INTRODUCTION

Today with the fast growth of automotive industries and large scale of housing construction forests are dwindling and natural resources are washed out considerably. Metals are drawn out from the natural resources with extensive processes. For the industrial growth conservation of metals is a major issue, so focus has been made on some other suitable alternatives which can substitute metals and alloys. Composites are in boom now a days, due to its intrinsic characteristics like light weight, high strength, corrosion resistance, high fatigue strength, less noisy in operation condition etc.

Composite materials consist of two or more constituents with physically separable phases. Composites are materials that consist of well-built load carrying material (known as reinforcement) embedded in softer strength material (known as matrix) Reinforcement gives rigidity and strength, help to support structural load. The matrix (organic or inorganic) helps in maintaining the orientation of the reinforcement (Srinivas & Chandramohan, 2012).

1.1 Importance of Composites

(Chandramohan & Marimuthu, 2011) has revealed the advantages of composites materials over their conventional counterparts. Composites provide very good strength to the weight ratio so it is favourable in most of the design needs. Some advantages of composite materials over conventional materials are listed below:

- Composites are provides very good tensile strength over the conventional material.
- It suppresses the vibration and provides quite performance for the machine elements compared to the conventional materials.
- It gives less life cycle cost compared to the conventional one.
- It gives good corrosion resistance.
- It provides good esthetical view and can be used for decorative purpose.
- It has less amount of wear rate so can be used as better medical material to replace knee joint.
- Ii has long fatigue life, good impact strength and less maintenance.

(Chandramohan & Marimuthu, 2011) classified composites in four main groups, such as polymer matrix composites (PMCs), metal matrix composites (MMCs), ceramic matrix composites (CMCs) and carbon-carbon composites (CCCs) and each group is having its unique mechanical and tribological properties.

Among the four groups of tribo-materials PMCs have shown immense potential, mainly because of its self-lubrication properties, lightweight, resistance to wear, corrosion and organic solvents. In PMCs, the polymer matrices are generally used as binders and their role is to transfer the stress to the fillers/fibrous reinforcement (Chand & Dwivedi, 2008).

Various inorganic (glass) and organic (carbon, graphite, aramid, polymer) synthetic fibers can be used to develop high strength, high modulus polymer composites. Glass fibers are the most widely used to reinforce plastics due to their low cost (compared to aramid and carbon) and fairly good mechanical properties. However, these fibers have serious drawback weight to strength ratio and its brittleness. Compare to glass fiber natural fiber have less density and good weight to strength ratio so the interest in natural fiber-reinforced polymer composite materials is growing with reference to their industrial applications and elementary research.

1.2 Natural Fibers Reinforced Composites (NFRC)

Natural fiber reinforced composites material are attractive over the conventional material like glass fiber because of its accessibility, renewability, low

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