

Application and Future of Composite Materials: A Review

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ABSTRACT

Materials play a significant role in the blooming of human civilization and country's infrastructure. Composite materials have boundless engineering application where strength to weight ratio, low cost and ease of fabrication are required. For certain applications, the use of composite materials as compare to metals has in fact resulted in savings of both weight and cost. Some examples are cascades for engines, leaf spring, curved fairing and fillets, replacements for welded metallic parts, tubes, cylinders, ducts, blade containment bands, medical devices, electronic devices, sports goods, etc. In aerospace, approximately 50% of the airframe is made from composites due to their high specific strength, light weight and stiffness. The aim of this paper is to present the current scenario of application composites in industries and go towards the approach of composite material in future direction with its advantages, disadvantages and applications in industrial machinery. This paper also shows the properties, characteristics, challenges, opportunities and future demand of composite material towards industrial environment.

Keywords: aerospace, composite materials, high specific strength, medical devices

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INTRODUCTION

Composite materials have been using for thousands of years, e.g., they have manufactured bricks with the help of mud which is thousand-year-old technology. Now days, we all depend on composite materials at some aspects of our lives. Composite material defined as a mixture of two or more than two materials (reinforcement, fillers and binder) different in composition [1]. Composite materials also called composition materials or shortened to composites. Composite materials are materials made from two or more than two materials with considerably differ in physical and chemical properties, that when combined, make a material with appearances different from the individual components. Composites comprise strong load carrying material is known as reinforcement and weaker materials is

known as matrix. Reinforcement provides stiffness and strength which helps to support structural load [2]. Composite materials do not lose their respective identities but still relate their properties to the product causing from their mixture. The benefits of composite materials have their great stiffness and strength. There are in many cases, the reinforcement is stronger, tougher, harder and stiffer than the matrix. It finds application in automotive, aerospace, electronic equipment, sport goods, furniture, medical equipment and packaging Industry. Composite materials used as an industrial material for their outstanding resistance to chemicals and most forms of corrosion. This property of composite material conventionally important is hardly the only useful property [3]. There are many important and useful properties are, low

mass, low weight unequalled manufacturing and processing possibilities, complex material body are easily produced, appropriate to very small products and very large product, tooling cost is very low, satisfactory surface finish can be an integral feature [1, 2]. Composites have four to six times tensile strength as compare to steel or aluminum (depending on the reinforcements). Composites have less noise and lower vibration transmission than metals at the time of operations. Composite materials have torsional stiffness and impact properties. Composites have high fatigue strength, impact, environmental resistance and reduce maintenance, higher fatigue endurance limit (up to 60% of ultimate tensile strength). Composites exhibit fire retardancy and good corrosion resistance [4]. Composites have improved surfaces properties and readily incorporable integral decorative melamine is other characteristics of composites, low electrical conductivity and thermal expansion. Composite parts can eliminate joints and providing simplification and assembly design compared to non-composite metallic parts. Composite materials have high cost of material, long development time, manufacturing difficulties, low ductility, temperature limits, solvent or moisture attack, hidden damages and damage susceptibility. Matrix used in composite materials is subject to environmental degradation and analysis is difficult, hot curing is necessary in many cases requiring special tooling, hot or cold curing takes time. Materials require refrigerated transport and storage and have limited shelf life [5].

APPLICATION OF COMPOSITE MATERIAL

Aerospace

Approximately 50% component of the airspace is made from composites. The primary benefits that composite components are reduced weight and assembly simplification. The large-scale

use of composites in current program of development of helicopters, military fighter aircraft, small and big civil transport aircraft, satellites, launch vehicles and missiles. Various components of aircraft are fabricated by composites, e.g. rudder, spoilers, airbrakes, elevators, LG doors, engine cowlings, keel beam, rear bulkhead, wing ribs, main wings, turbine engine fan blades, propellers, Interior components, *etc.* [6].

Automotive

Composites are being considered to make low weight, safer and more fuel-efficient vehicles. A composite is composed of a high strength fiber (carbon or glass) in a matrix material (epoxy polymer) that when combined provides magnify properties compared with the individual materials by themselves. Many components like steering wheel, dashboard, seat, roof, hatch, mats, energy absorber, instrument cluster, interior and exterior panel, leaf spring, wheels, engine cover, *etc.* fabricated by composite materials [7].

Medical

A composite is a nonviable material used in a medical device and intended to interact with biological system. Over the centuries, advancement in synthetic materials, surgical technique and sterilization methods have permitted the use of composite material in many ways. Medical practice today utilizes a large number of devices and implants. Composites in the form of sutures, bone and joint replacements, vascular grafts, heart valves, intraocular lenses, dental implants, pacemakers, biosensors, artificial hearts, *etc.* widely used to replace and/or restore the function of disturbed or degenerated tissues or organs, to improve function, to assist in healing, to correct abnormalities and thus improve the quality of life of the patients [8].

Electrical Field

Composite materials have strength, high modulus; electronic composites emphasize high thermal conductivity, low thermal expansion, low dielectric constant and high/low electrical conductivity depending on the particular electronic applications. Electronics composites can use expensive fillers, such as silver particles, which serve to provide high electrical conductivity. The application of composites in electronics include interconnections, printed circuit boards, interlayer dielectrics, die attach, lids, thermal interface materials, electrical contacts, connectors, heat sinks, housings, *etc.* [9].

Sports

Composite materials are used in sports equipment because they offer ease of transport, resistance, low weight, low maintenance and durability. Initially, natural materials, like wood, were used due to its good shock absorption, but these materials had some drawbacks. The anisotropic nature resulted in low resistance and the variation in properties and high moisture absorption allocate various deformations. The composite material has characteristics of fatigue resistance break resistance, superior thermostability, friction resistance, abrasion resistance and vibration attenuation, and it has light weight, high strength and high design freedom, and can be processed and shaped easily, so it is widely used in sports equipment. There are various goods made of composite materials, including the planning boats, sailing boats, sailboards tennis rackets, badminton rackets, softball bats, ice hockey sticks, bows and arrows, *etc.* [10].

Chemical Industry

Advantages of composites of fire resistance properties, lightweight, mold ability, and resistance to chemicals has made the material used in the chemical industry. Composites are extensively used

in industrial gratings, scrubbers, ducting, piping, exhaust stacks, pumps and blowers, structural supports, storage tanks, columns, reactors, *etc.* for alkaline and acidic environments. Some applications are drive shaft, fan blades, ducts, stacks, underground storage tanks, casings, composite vessels, *etc.* Internationally, composites applications in chemical industry are a relatively small segment in relation to the total usage of composites [11].

Other

Composites have long been used in the construction for industrial supports, buildings, long span roof structures, tanks, bridge components and complete bridge systems. With composites exhibiting excellent resistance to the marine environment. With the help of composite we make light weight doors, window, furniture, building, bridge, *etc.* for domestic and construction purpose [12].

CONCLUSION AND FUTURE SCOPE

There is a wide scope of composite material in automotive, aerospace, wind energy, electrical, sports, domestic purpose, civil construction, medical chemical industries, *etc.* Composite materials have a great potentiality of application in structures subjected primarily to compressive loads. Composite materials have attractive aspects like the relatively high compressive strength, good adaptability in fabricating thick composite shells, low weight, low density and corrosion resistance. Composite materials have good mechanical, electrical, chemical properties, due to which we can use composite material in many various industries. Various parts of automobile and aerospace are manufactured by composite material due to good properties. Composite materials are used for domestic purpose like furniture, window, door, mating, civil construction, *etc.* In the marine, chemical industries, sports, we can

use composite material for better performance of the parts. With the help of review, we conclude that composite materials have wide advantages and application in various industries; we can make better life style with the help of composite material.

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