

Characteristics of Composite materials and their Uses

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ABSTRACT

Materials play a huge role in the blooming of human progress and nation's infrastructure. Composite materials have endless designing application where solidarity to weight proportion, ease and simplicity of creation are required. For specific applications, the utilization of composite materials as contrast with metals has in actuality brought about reserve funds of both weight and cost. A few models are falls for motors, leaf spring, bended fairing and filets, trades for welded metallic parts, tubes, chambers, conduits, cutting edge control groups, restorative gadgets, electronic gadgets, sports merchandise and so on. In aviation around half of the airframe is produced using composites because of their high explicit quality, light weight and solidness. The point of this paper is to introduce the present situation of use composites in enterprises and go towards the methodology of composite material future way with its favourable circumstances, detriments and applications in modern hardware. This paper additionally shows the Properties, Characteristics, Challenges, Opportunities and Future interest of Composite material towards mechanical condition.

Keywords: Composite materials, Aerospace, Medical devices, High specific strength.

INTRODUCTION

The earliest synthetic composite materials were straw and mud combined to form bricks for building construction. Old block making was reported by Egyptian tomb artistic creations.

Wattle and smear is one of the most established manufactured composite materials, at more than 6000 years old.[1] Concrete is likewise a composite material, and is utilized more than some other engineered material on the planet. Starting at 2006, about 7.5 billion cubic meters of cement are made every year—more than one cubic meter for each individual on Earth.

Woody plants, both genuine wood from trees and such plants as palms and bamboo, yield characteristic composites that were utilized anciently by humanity are as yet utilized broadly in development and framework.

Pressed wood 3400 BC [2] by the Ancient Mesopotamians; sticking wood at various edges gives preferable properties over characteristic wood.

Cartonnage layers of cloth or papyrus absorbed mortar dates to the First Intermediate Period of Egypt c. 2181–2055 BC [3] and was utilized for death covers.

Cob mud blocks, or mud dividers, (utilizing mud (earth) with straw or rock as a folio) have been utilized for a huge number of years.

Concrete was portrayed by Vitruvius, composing around 25 BC in his Ten Books on Architecture, recognized kinds of total suitable for the arrangement of lime mortars. For auxiliary mortars, he prescribed pozzolana, which were volcanic sands from the sandlike beds of Pozzuoli tanish yellow-dark in shading close to Naples and rosy darker at Rome. Vitruvius determines a proportion of 1 section lime to 3 sections pozzolana for concretes utilized in structures and a 1:2 proportion of

1st International Conference on Multidisciplinary Research (ICMR-2018)



NIILM University, Kaithal, Haryana, (India)



4th-5th August 2018

www.conferenceworld.in

ISBN:978-93-87793-38-5

lime to pulvis Puteolanus for submerged work, basically a similar proportion blended today for concrete utilized at sea.[4] Natural concrete stones, in the wake of consuming, delivered concretes utilized in cements from post-Roman occasions into the twentieth century, with certain properties better than produced Portland concrete.

Papier-mâché, a composite of paper and paste, has been utilized for a long time.

The principal fake fiber fortified plastic was bakelite which dates to 1907, albeit characteristic polymers, for example, shellac originate before it.

One of the most widely recognized and natural composite is fiberglass, in which little glass fiber are installed inside a polymeric material (typically an epoxy or polyester). The glass fiber is generally solid and firm (yet in addition fragile), though the polymer is pliable (yet additionally feeble and adaptable). Hence the subsequent fiberglass is generally firm, solid, adaptable, and malleable [5].

LITERATURE REVIEW

D. Pathania et al. [10] study and indicated that dielectric consistent and dielectric dispersal diminished with recurrence and expanded with temperature however dielectric misfortune factor diminished with the expansion of recurrence at fixed temperature and expanded with temperature at lower frequencies. It is additionally inferred that the dielectric misfortune factor decline with compound treatment. It is likewise seen that with precise and tenacious research there will be great degree and splendid future for polymer fortified composites for different electrical applications, for example, terminals, connectors, switches, circuit sheets and so on.

Kumar S. et al. [11] talked about modern and local utilization of rice husk and rice husk debris. Because of fine protecting properties of rice husk like low warm conductivity, low weight, high softening point, low mass thickness high porosity, it utilized for the generation of top notch steel. Mixed concrete is created by utilizing rice husk debris for satisfying the expanding requirement for building material. Because of enormous silica content in rice husk debris, extraction of silica is prudent. Silica are utilized in elastic ventures as a fortifying specialist, in beautifiers, in toothpastes, in nourishment enterprises as an anticaking operator.

A. Balaji et al [12] examined about the future biocomposites material and their application. Characteristic filaments and biocomposites produced using regular sources, eco-accommodating and all around structured mechanical items which can be supplant predominance of oil based items in future. The use of bagasse filaments for manufacture of biocomposites by utilizing new innovation changes fate of coming age. It will be an elective method to build up the biocomposites which can be broadly utilized for day by day necessities of average folks whether it is house hold furniture, house, fencing, window, decking, planning, ground surface, and light weight vehicle segments or sports types of gear. Their minimal effort, simple accessibility and tasteful plans will be the principle preferences to change the depended present to maintainable future.

T. Subash et al [13] examined about bast filaments fortified green composites for flying machine indoor structures applications. These materials gives the advantages in creation of the body boards, for example, in seat pads, lodge linings, bundle racks and so forth., The common strands, for example, jute, kenaf, bagasse, bamboo, coir, sisal have demonstrated to be a materials with the high quality in aviation and car industry. These composites show a lower thickness when contrasted with conventional mineral composites and have an extraordinary potential to make lightweight economical completed items that can lessen huge measure of vitality utilization in the airplane business.

Alen John et al. [4] give an audit on the composite materials utilized for car guard in traveler vehicles. Deciding the correct material during the choice procedure is significant. The material chose should meet the desire for the specialist. The material ought to be precisely attainable and ought to have minimal effort. Other than the assembling of guards, the composite materials have a wide scope of other potential car applications, for example, body boards, suspension, guiding, brakes and different pieces of the car. Aside from body boards, the current, constrained car utilization of composites incorporate guard frameworks, leaf springs, drive shafts, fuel tanks, instrument boards, cross wheel bar, consumption complex.

Gururaja M N et al. [5] give a survey on ongoing applications and future extent of cross breed composites. This paper displays an audit of the cross breed composite materials innovation now daily, as far as materials accessible and properties, and a blueprint of a portion of the self-evident, patterns and theoretical, with accentuation on different applications including a few subtleties of keen crossover composites. Creator closed the utilization of cross breed composite in car, aviation, marine, wind control and so forth. Prof. N.V.

Hargude et al. [6] talked about composite material mono leaf spring. In this paper we have comprehend it is conceivable to simple assembling a leaf spring utilizing E glass epoxy glass fiber. According to the point of weight decrease it is conceivable by utilizing composite material. Ride solace and life of Composite Leaf Springs are additionally more when contrasted with steel leaf springs.

Obilade, I.O. et al. [7] learn about utilization of rice husk debris as incomplete swap for concrete in concrete. Creator finished up the trade for concrete is in the range 0-20% ideal expansion of RHA as halfway. The compacting factor estimations of the solid decline as the level of RHA expanded. The Bulk Densities of cement decreased as the rate RHA substitution expanded. The Compressive Strengths of solid decline as the rate RHA substitution expanded.

COMPOSITE MATERIALS

Concrete is the most widely recognized fake composite material of all and commonly comprises of free stones (total) held with a network of concrete. Concrete is a reasonable material, and won't pack or break significantly under a significant huge compressive force.[10] However, concrete can't endure ductile loading[11] (i.e., whenever extended it will rapidly break separated). In this manner, to enable cement to oppose being extended, steel bars, which can oppose high extending powers, are frequently added to cement to shape strengthened cement.

Fiber-strengthened polymers (FRP)s incorporate carbon-fiber-fortified polymer (CFRP) and glass-fortified plastic (GRP). Whenever grouped by framework then there are thermoplastic composites, short fiber thermoplastics, long fiber thermoplastics or long fiber-fortified thermoplastics. There are various thermoset composites, including paper composite boards. Many progressed thermoset polymer lattice frameworks normally consolidate aramid fiber and carbon fiber in an epoxy pitch grid [8].

Shape memory polymer composites are superior composites, planned utilizing fiber or texture support and shape memory polymer gum as the network. Since a shape memory polymer gum is utilized as the network, these composites can be effectively controlled into different arrangements when they are warmed over their enactment temperatures and will show high quality and firmness at lower temperatures. They can likewise be warmed and reshaped over and again without losing their material properties. These composites are perfect for applications, for example, lightweight, unbending, deployable structures; quick assembling; and dynamic fortification [9].

High strain composites are another kind of elite composites that are intended to act in a high disfigurement setting and are frequently utilized in deployable frameworks where basic flexing is beneficial. Albeit high strain composites display numerous similitudes to shape memory polymers, their exhibition is commonly reliant on the fiber design instead of the tar substance of the network [10].

Composites can likewise utilize metal filaments fortifying different metals, as in metal framework composites (MMC) or earthenware network composites (CMC), which incorporates bone (hydroxyapatite fortified with collagen strands), cermet (fired and metal) and cement. Clay grid composites are fabricated basically for break durability, not for quality. Another class of composite materials include woven texture composite comprising of longitudinal and transverse bound yarns. Woven texture composites are adaptable as they are in type of texture [11].

Natural network/clay total composites incorporate black-top solid, polymer solid, mastic black-top, mastic asphalt, mastic roller hybrid, dental composite, syntactic foam and mother of pearl. Chobham armour is a special type of composite armour used in military applications.



Fig. 1: Concrete is a mixture of cement and aggregate, giving a robust, strong material that is very widely used.

Additionally, thermoplastic composite materials can be planned with explicit metal powders bringing about materials with a thickness go from 2 g/cm³ to 11 g/cm³ (same thickness as lead). The most well-known name for this sort of material is "high gravity compound" (HGC), despite the fact that "lead substitution" is additionally utilized. These materials can be utilized instead of customary materials, for example, aluminum, tempered steel, metal, bronze, copper, lead, and even tungsten in weighting, adjusting (for instance, altering the focal point of gravity of a tennis racquet), vibration damping, and radiation protecting applications. High thickness composites are a financially feasible alternative when certain materials are considered unsafe and are prohibited, (for example, lead) or when auxiliary tasks costs, (for example, machining, completing, or covering) are a factor [2].

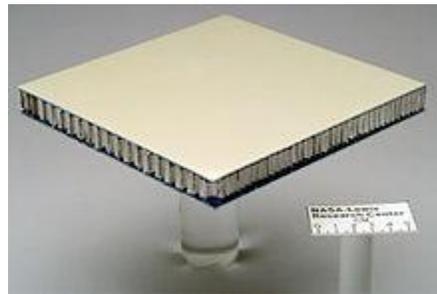


Fig. 2: Composite sandwich structure panel used for testing at NASA

A sandwich- organized composite is an uncommon class of composite material that is created by joining two dainty however firm skins to a lightweight yet thick center. The center material is ordinarily low quality material, yet its higher thickness furnishes the sandwich composite with high twisting firmness with in general low thickness.

Wood is a normally happening composite including cellulose filaments in a lignin and hemicellulose framework. Designed wood incorporates a wide range of items, for example, wood fiber board, compressed wood, arranged strand board, wood plastic composite (reused wood fiber in polyethylene network), Pykrete (sawdust in ice lattice), Plastic-impregnated or overlaid paper or materials, Arborite, Formica (plastic) and Micarta. Other designed cover composites, for example, Mallite, utilize a focal center of end grain balsa wood, clung to surface skins of light amalgam or GRP. These produce low-weight, high inflexibility materials [5].

Particulate composites have molecule as filler material scattered in network, which might be nonmetal, for example, glass, epoxy. Car tire is a case of particulate composite. Propelled precious stone like carbon (DLC) covered polymer composites have been reported[12] where the covering builds the surface hydrophobicity, hardness and wear opposition.

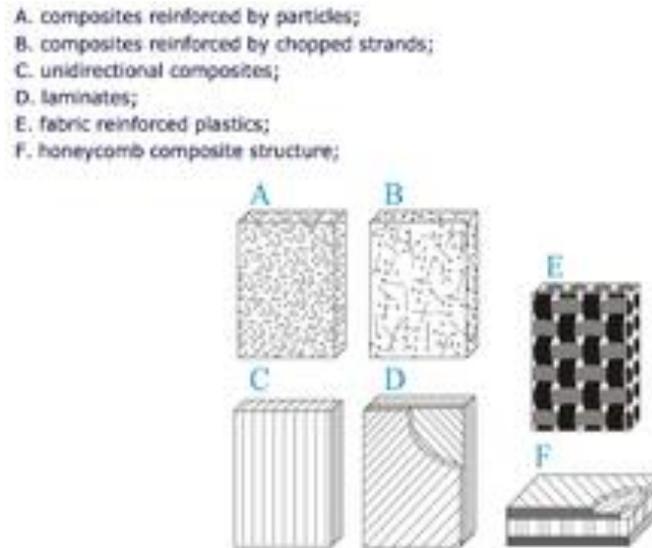


Fig. 3: Composite materials are widely used in aerospace structures

CHARACTERISTICS OF COMPOSITE MATERIALS

Composites are made up of individual materials referred to as constituent materials. There are two primary classifications of constituent materials: lattice (folio) and fortification. At any rate one segment of each sort is required. The lattice material encompasses and supports the fortification materials by keeping up their relative positions. The fortifications grant their extraordinary mechanical and physical properties to improve the network properties. A synergism produces material properties inaccessible from the individual constituent materials, while the wide assortment of lattice and reinforcing materials permits the fashioner of the item or structure to pick an ideal blend [4].

Built composite materials must be framed to shape. The framework material can be acquainted with the support previously or after the fortification material is set into the form pit or onto the shape surface. The framework material encounters a merging occasion, after which the part shape is basically set. Contingent on the idea of the network material, this merging occasion can happen in different manners, for example, compound polymerization for a thermoset polymer lattice, or cementing from the dissolved state for a thermoplastic polymer grid composite.

An assortment of trim techniques can be utilized by the end-thing plan necessities. The chief elements affecting the system are the natures of the picked lattice and fortification materials. Another significant factor is the gross amount of material to be created. Huge amounts can be utilized to legitimize high capital uses for quick and mechanized assembling innovation. Little creation amounts are suited with lower capital consumptions yet higher work and tooling costs at a correspondingly more slow rate [6].

Numerous industrially created composites utilize a polymer framework material regularly called a sap arrangement. There are various polymers accessible relying on the beginning crude fixings. There are a few general classes, each with various varieties. The most widely recognized are known as polyester, vinyl ester, epoxy, phenolic, polyimide, polyamide, polypropylene, PEEK, and others. The support materials are regularly strands yet in addition usually ground minerals. The different techniques depicted underneath have been created to decrease the sap substance of the last item, or the fiber content is expanded. As a dependable guideline, lay up brings about an item containing 60% tar and 40% fiber, while vacuum implantation gives a last item with 40% pitch and 60% fiber content. The quality of the item is enormously subject to this proportion [8].

1st International Conference on Multidisciplinary Research (ICMR-2018)



NIILM University, Kaithal, Haryana, (India)



4th -5th August 2018

www.conferenceworld.in

ISBN:978-93-87793-38-5

PRODUCTS AND USES OF COMPOSITE MATERIALS

Fiber-fortified composite materials have picked up ubiquity (in spite of their for the most part significant expense) in elite items that should be lightweight, yet sufficiently able to take brutal stacking conditions, for example, aviation segments (tails, wings, fuselages, propellers), pontoon and scull structures, bike edges and hustling vehicle bodies. Different uses incorporate angling poles, stockpiling tanks, pool boards, and slugging sticks. The Boeing 787 and Airbus A350 structures including the wings and fuselage are made to a great extent out of composites. Composite materials are likewise getting progressively normal in the domain of orthopedic medical procedure, and it is the most widely recognized hockey stick material [9].

Carbon composite is a key material in the present dispatch vehicles and warmth shields for the reemergence period of rocket. It is generally utilized in sunlight based board substrates, radio wire reflectors and burdens of rocket. It is likewise utilized in payload connectors, between organize structures and warmth shields of dispatch vehicles. Moreover, plate slowing mechanisms of planes and dashing autos are utilizing carbon/carbon material, and the composite material with carbon filaments and silicon carbide framework has been presented in extravagance vehicles and sports vehicles [10].

In 2006, a fiber-strengthened composite pool board was presented for in-ground pools, private just as business, as a non-destructive option to stirred steel. In 2007, an all-composite military Humvee was presented by TPI Composites Inc and Armor Holdings Inc, the primary all-composite military vehicle. By utilizing composites the vehicle is lighter, permitting higher payloads. In 2008, carbon fiber and DuPont Kevlar (multiple times more grounded than steel) were joined with upgraded thermoset pitches to make military travel cases by ECS Composites making 30-percent lighter cases with high quality [11].

Channels and fittings for different reason like transportation of consumable water, putting out fires, water system, seawater, desalinated water, compound and modern waste, and sewage are presently fabricated in glass strengthened plastics. Composite materials utilized in malleable structures for exterior application gives the upside of being translucent. The woven base material joined with the suitable covering permits better light transmission. This gives an entirely agreeable degree of brightening contrasted with the full brilliance of outside. [13]

The wings of wind turbines, in developing sizes in the request for 50 m length are created in composites since quite a long while. Two-lower-leg-amputees run on carbon-composite spring-like fake feet as speedy as solid sportsmen. High weight gas chambers normally around 7–9 liter volume x 300 bar pressure for fire fighters are these days developed from carbon composite. Type-4-chambers incorporate metal just as supervisor that conveys the string to sink the valve.

CONCLUSIONS

There is a wide scope of composite material in automotive, aerospace, wind energy, electrical, sports, residential reason, common development, restorative synthetic ventures and so on. Composite materials have an extraordinary probability of utilization in structures oppressed principally to compressive burdens. Composite materials have alluring angles like the moderately high compressive quality, great versatility in manufacturing thick composite shells, low weight, low thickness and erosion obstruction. Composite materials have great mechanical, electrical, concoction properties, because of which we can utilize composite material in numerous different businesses. Different pieces of vehicle and aviation are produced by composite material because of good properties. Composite materials are utilized for residential reason like furnishings, window, entryway, mating, and common development and so on. In the marine, compound businesses, sports, we can utilize composite material for better execution of the parts. With the assistance of audit, we presume that composite materials have wide points of interest and application in different businesses; we can improve way of life with the assistance of composite material.

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4th-5th August 2018

www.conferenceworld.in

ISBN:978-93-87793-38-5

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