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A analytical review on composite materials in manufacturing sector in various industries

Glory T[1], Naveen Kishore P[2]
[1](Mechanical Engineering, Neil Gogte Institute of Technology, OU, Hyderabad, INDIA)
[2](Mechanical Engineering, Matrusri Engineering College, OU, Hyderabad, INDIA)

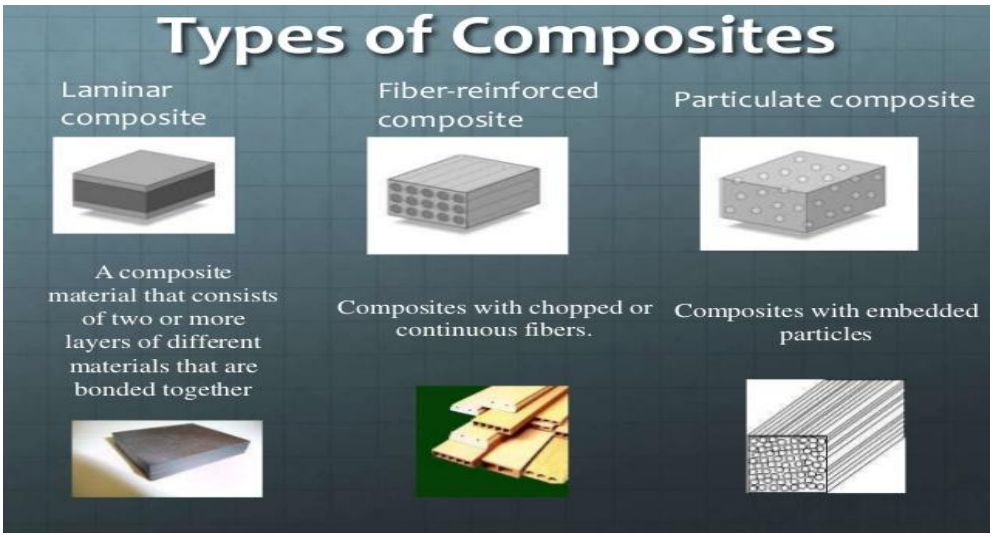
Abstract: In the human civilization and country infrastructure, materials play a major role. Compositional materials have limitless application in engineering, where the strength to weight, low cost and manufacturing ease are important. In addition, the use of composite materials as opposed to metals has led to reductions in weight and cost for many applications. Examples include cascades for engines, leaf springs, curved filets and bandages, tubes, pipes, conduits, bladder closure bands, medical devices, computer equipment, sports equipments etc. Around 50 percent of the airframe in aerospace is made of composites because of its high specific strength, light weight and rigidity. This paper aims at presenting the existing script for applications of composites in manufacturing, with their benefits, drawbacks and applications in industrial equipment, and at the approach of composite materials in the future. The features, threats, opportunities and potential demand of composites in the industrial environment are also shown in this paper.

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

I. INTRODUCTION

Composite materials are now being used in large quantities in various engineering systems, including spacecraft, aircraft, vehicles, boats, sport equipment, bridges and houses. Composite materials in the industry are widely used due to the good features of their strength to density and their hardness to density. This has increased the likelihood that these characteristics can be improved by means of state-of-the-art innovations and different manufacturing methods. Composite materials were commonly only used in the aerospace industry in the 1970s, but are today being used in almost all industries after just three decades. Meanwhile, each country's automotive industry has taken advantage of these advanced materials' abilities and properties. In addition to technical advancement, composites replace metallic vehicle parts. In the last decade, the effects of damage on damage tolerance of composite systems have been investigated by researchers and several design problems were identified. According to their fundamental characteristics, composites are more effective in their efficiency than metals. Various distinct characteristics of composite materials make them important in aerospace and automotive industries, for example; strong damping properties Damage to composites can occur as cracking matrix, debonding fibre / fiber pullout fracture and delamination. To improve the composite design structure and choose a method that minimizes costs for all operations, it is also important to understand the damage mechanism. Harm caused by impact events is one of the essential behaviors of composite structure. For thousands of years, composite materials have been in use, for example, using clay, which is a thousand-year-old technique to make bricks. Today, in certain aspects of our lives, we all rely on composite materials. Composite material described as a two or more material mixture (reinforcement).Often named or shortened to composites based materials. Composite materials consist of two or more materials that have significantly different physical and chemical properties and that, in combination, create materials with different appearances than the individual components. Material is known as reinforcing composites, and weaker materials are referred to as the matrix. Sustainability and strength provide support for structural load. Reinforcement provides Composite materials do not lose its identity but still have to do with the product caused by their mixture. The benefits of engineered structures are very robust and strong. Strengthening is in certain situations heavier, faster, quicker and more stable than the matrix. It may be found in the areas of automotive, aircraft, electrical devices, sporting equipment, industrial appliances and packaging industries. Composite products are chosen for their outstanding chemical tolerance to other types of degradation as an construction tool. This characteristic of conventionally appropriate composite material is hardly the only useful aspect. There are a number of significant and useful characteristics, low bulk, low weight, unmatched manufacturing and distribution opportunities, simple produce of complicated materials, ideal for very small items and very big goods, very low tooling costs and a good surface finish can be an essential feature[1,2]. Composites have tensile power four to six times over steel or aluminum (depending on the armor). At running point, composites have reduced pressure and propagation of friction than metals. The torsional stiffness and impact properties of composite materials are present. Composites provide strong strength to fatigue, effects, environmental resistance and decrease repair, higher toughness fatigue (up to 60% of the ultimate strength of the tensile). Composites have a good fire and corrosion

tolerance. The variations in surface properties are also properties of the composites, weak electrical conductivity and higher thermal expansion. Composite components may replace joints and simplify and build the assembly compared with non metallic components. Composite materials have high manufacturing prices, extended processing period, production difficulties, poor ductility, temperature limits, solvent or moister attack, secret harm and vulnerability to injury. Matrix used in composite materials is subject to environmental deterioration and analyzes are challenging, heat curing is also required that requires time to add special equipment. Materials must be transported and stored refrigerated and have limited shelf lives.



1.1. Composite material

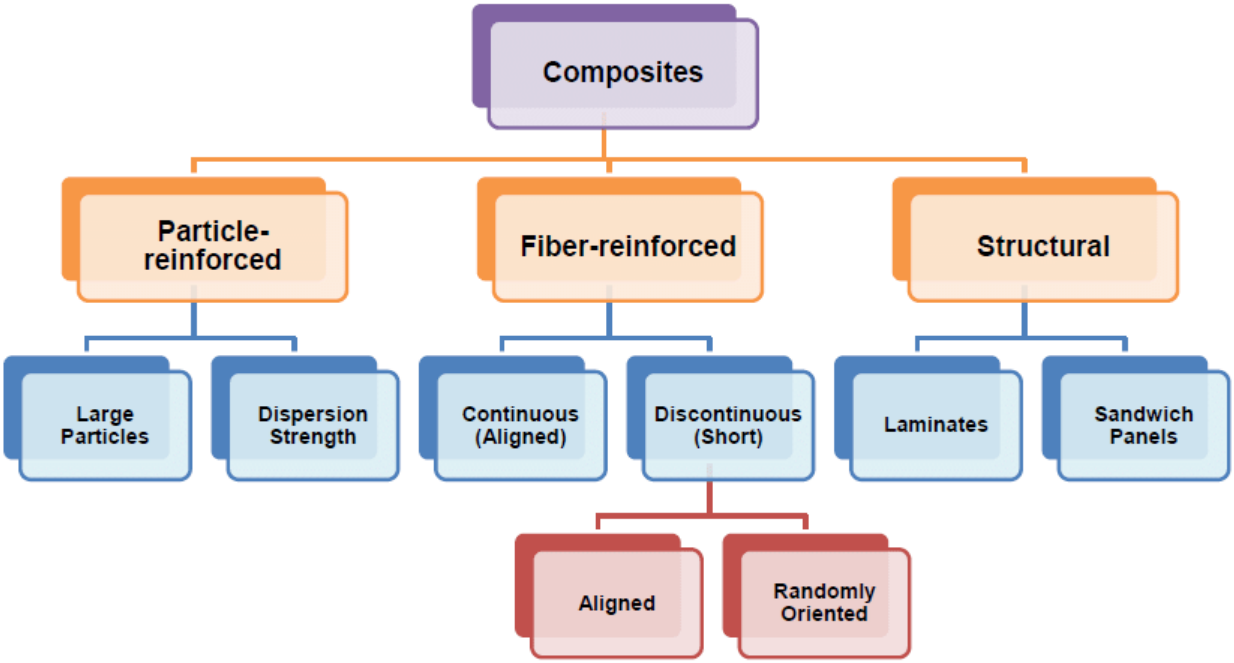


Fig 2: classifications of composite materials

Due to their specific properties which bypass conventional limitations due to the physical and mechanical performance of monolithic materials, composite matter is used extensively as advanced multiple materials in different fields through the rapid evolution of the modern manufacturing industry, including electronics, aeronautics, pharmacy, cars and machining machine [4, 5]. Tungsten carbide (WC) has strong toughness and resistance to wear but is poor in strength and strength [6, 7], whereas tungsten carbide has an outstanding strength and tightness though its wear tolerance is weak [8-10]. A coated structure of wc with a high strength

steel may be used in multiple manufacturing applications to incorporate their advantages. A composite material can be described as the material made from two or more blended materials with significantly different physical and chemical qualities, creating a material which, when combined, has different characteristics from each part. The individual composites remain independent and distinct from mixtures and solid solutions throughout the completed system [11, 12]. Every composite material has two key components, by nature, a matrix, i.e. A process of constant stimulation, i.e. a period of discontinuity. If three or more constituents are usable, the composite is classified as a hybrid composite [13, 14]. Among us in nature composites, e.g. wood, bone, tissue etc., are usable. Mainly metals, ceramics and polymers are the foundation for most composites in industry[3]. In various forms, composites may be graded. A useful classification based on matrix and reinforcement can be made based on this as shown in Table 2. The reinforcing MMCs, e.g. These days, glass fragments, whiskers and fibers acquire considerable significance. The newest developments in the area are known to be CMCs [15]. The micro-fabrication of metal and ceramic-based composites.fig.1 composites and composite materials is a subject of this review.

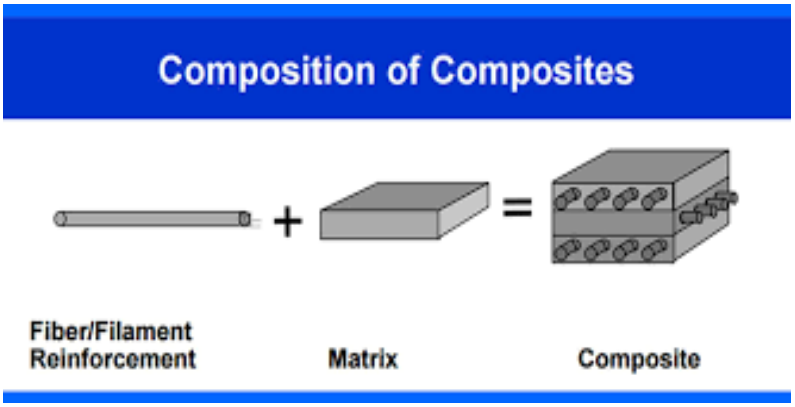


Fig 1: Composition of composites materisla

1.2. Metal matrix composites:

For manufacturing sectors the need for new products is constantly important. The main considerations in designing new products are stronger mechanical qualities, weight loss and lower costs[16]. Because established bulk materials eventually hit their maximum, engineers try composites to attain additional strength, rigidity and durability [17]. Metals and their alloys are mostly produced and formed in bulk form; however, they may also be closely mixed with another substance in order to enhance their efficiency. MMCs [18] are the resulting materials. Over the last few decades, substantial progress was made in its implementation in major industrial applications in the production of MMCs. Those groundbreaking materials have opened for present material science and development unlimited possibilities [19]. The properties of MMCs may be tailored and application-dependent on the content [19]. MMCs give better material properties relative to polymer matrix composites. Metal matrices provide, for example , a higher tensile and shear molding characteristic, greater melting temperature, a lower thermal expansion coefficient, greater dimensional stability, better join ability, high ductility and toughness, and a fully dense ability compared with resin[20, 21]. MMCs consist primarily of a metal or alloy as a composite matrix and reinforcement in different shapes and types. Presents a comprehensive MMC description, including the usual descriptions, design and production methods, of the products used.

1.3. Ceramic matrix composites:

Metal and metal composites have been widely used in industry; however, they have reached a limit of their capacity for further growth in some applications, especially with high temperatures. At the other side, ceramics provide the advantage of operating at extremely elevated operation temperatures. Low density, high stiffness, and high inertness in addition to those faced by metallic materials increase inherent shortcomings of ceramic efficiency. However, ceramic products have intrinsic limitations of fragility and strength. Major progress has been made over the past two decades to address these disadvantages. Composites, i.e., became the most significant inventions. Combination of ideal microstructures with many constituent phases to obtain the required characteristics. In addition, two or more distinct ceramic phases may not be accomplished by monolithic materials in conjunction with ceramic composites [23, 24]. CMCs with excellent properties and possible uses are deemed the most recent entrants in the world of composite materials [25]. As the market constantly increasing demand was met by the improvements produced, different forms of CMC were hired. The four major classes of CMC can be categorized into: (1) hardened CMCs, (2) composites graded and coated, (4)

refractory composites and (4) nanostructured composites. Similarly, different techniques for CMCs are graded depending on the materials used, the form of composites,

1.4. APPLICATION OF COMPOSITE MATERIAL:

Fig 4: Different application of composite materials

- Aeronautic elements are constructed of composites for about 50 percent of the airspace. The key benefits of composites are weight loss and simplification of assembly. The extensive usage of composites in modern plane, war combat, small and large commercial transport planes, spacecraft, vehicles and missiles production programmes. Composites are manufactured by different components of aircraft, e.g. Coltors, spoils, airbrakes, raises, LG doorways, cowlings motor, quilting board, bulkhead back, wing braces, main wings, fan engines, propellers, internal sections, etc[26-29].

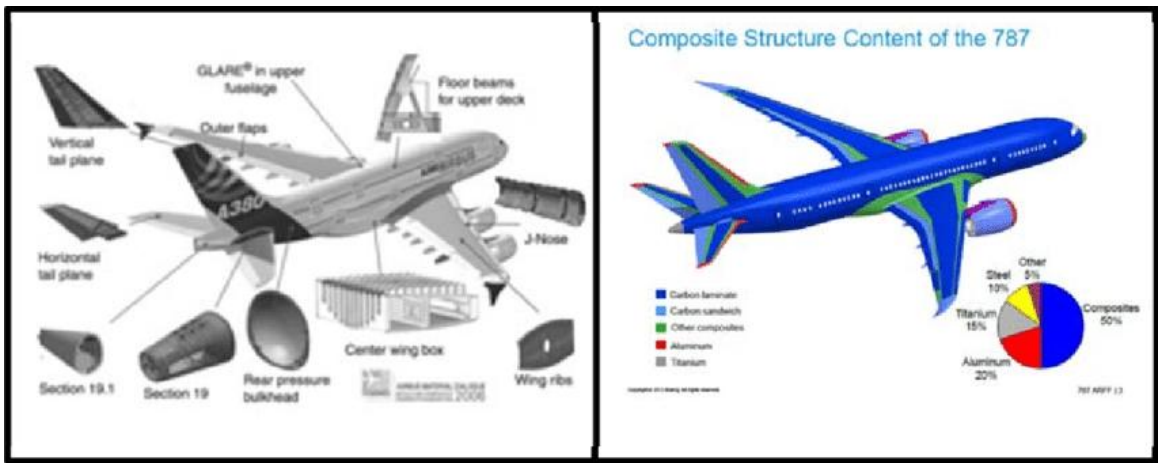


Fig 5: applications of composite materials in aerospace

- Composites are known to manufacture cars of lower weight, cleaner and fuel-efficient. A composite consists of a high strength fiber (carbon or glass) in a matrix material (epoxy polymer), which provides magnifying properties in conjunction with each material. Many of the parts are rendered from composite materials: steering wheel, dash board, sitting top, doors, floors, power source, inside and external instrument panel, tires, tyres, engine covers, etc. [29-31].
- A composite in a medical device is non-viable material that interacts with a biological system and is used in a medical device. Over the centuries developments have allowed the usage of composite material, surgical procedures and sterilization processes. A significant range of instruments and implants are used in medical practice today. Composites in suture shape, bone and joint replacements, artery grafts, heart tubes, intraocular lenses, bridge dentures, pacemakers, biosensors, mechanical cardiac's, etc. Used extensively to bypass or repair the perturbed or degenerated tissue or organ function, improve the output, help heal anomalies and thus improve patient quality of life [44-45].
- In electrical area, composites have a high power, strong frame, and strong thermal conductivity, low thermal expansion, low dielectric constant and low electric conductivity are stressed by electronic composite materials based on the individual electro purposes. Composites of electronics may use expensive fillers including silver particles that give strong conductivity. Composites in electronics are added to

interconnections, circuit boards, dielectric interlayer's, fasteners, panels, thermal control fabrics, contacts electronically, cables, heat sinks, housings etc.[32].

- Plastic components in athletic equipment are used because of the simplicity of transportation, resistance, light weight, low maintenance and reliability they give. Natural products, including wood, were originally used because of their excellent shock resistance, but they had a few disadvantages. Due to the anisotropic nature the properties and moisture absorption vary, and different deformations are allocated. The composite material has characteristics such as fatigue resistance break resistance, superior thermal resilience, tolerance to friction, abrasion resistance and reduction of vibration.
- Efficiently designed and formed, and suitable for sports equipment. There are numerous plastic items such as vessels for boating, sailboats, tennis rackets for sailboards, baseball bat stands, bats of softball, ice hockey sticks, bows, arrows etc. [46, 47].
- In Chemical Manufacturing-The products used in the chemical industry has the benefits of fire-fighting, lightweight, mould resistant and corrosion strength composites. Composites are commonly used for commercial scrubber, pipes, exhaust bags, pumps & blowers, supplies, containers, columns, reactors, etc. For the conditions alkaline and acidic. Any uses include drive shaft, fan blades, tubing, containers, bins, tubes, composite vessels etc. Internationally, in contrast to the overall usage of composites, composite products in the industrial chemistry are a comparatively low segment [48].
- The design of structural pillars, houses, long-dimensional roof frames, reservoirs, bridge parts and full bridge systems have long been utilized using other composites. Composites with outstanding aquatic climate tolerance. With composite, for domestic and construction purposes, we create light weight doors, windows, furniture, building, bridge, etc [49].

II. LITERATURE REVIEW

C. Pathania et al.[33] research found that dielectric constant and dielectric dissipation decreased at frequency and increased by temperature factor but dielectric loss at fixed temperature decreased and increased at lower frequencies. It is therefore assumed that with chemical preparation, the dielectric loss factor decreases. It is also noted that there will be strong potential and a promising future with systematic and ongoing work in the case of polymer reinforced composites for different electrical applications, including terminals, connectors, switches, circuit boards etc.

Kumar S. et al. [34] the commercial and domestic usage of rice husks and rice husk ash was discussed. It is used for the manufacture of high quality stainless steel, owing to the excellent isolating properties of rice husk, such as low thermal conductivity, low weight, strong melting point and low bulk porosity. Mixed cement is manufactured using rice husk ash to satisfy the increasing demand for building materials. Silicium production is economical because of the strong silica content in the rice husk powder. Silica is used as a binding agent in the rubber sector, cosmetics, toothpaste and food industry.

A. Balaji et al [35] Discussed on and implementation of potential biocomposites. Strong, eco-friendly and well-designed synthetic fabrics, biocomposites produced from nature materials that will replace the potential domination of petroleum-based goods. The usage of biocomposites bagasse fibers and the application of emerging materials changes the potential of next century. The development of biocomposites, common to ordinary people, whether they're home-made furniture, house, closed fence, fence, deck, design, flooring or light weight automotive components or sports equipment, will be an alternative way. Their low expense, simple distribution and elegant designs would be the key advantages to turn the depending current to prosperous future.

T. Subash et al [36] Discussed on bast fibers for indoor aircraft construction uses, natural composites strengthened. Such fabrics provide the benefit of producing board panels such as cushions for beds, cabin linings, package racks etc. Natural fibers like jute, kenaf, bagasse, bamboo, coir, sisal have been found to be high-strength fabrics in the aerospace and automotive industries. Similar to the conventional mineral composites, these materials have a lower density and a tremendous ability to manufacture lightweight and robust finished goods that can minimize big energy usage in aerospace.

Alen John et al. [37] Study the construction structure in passenger cars for car bumper. It is really necessary to decide the right content in the collection process. The chosen content would satisfy the engineer's standards. The content must be physically practical and cost-effective. Besides the manufacture of bumpers, the composite materials provide a broad variety of other vehicle uses such as body plates, braking structures, steering systems, brakes and other parts. In addition to body panels, bumpers assembly, leaf springs, drive

shafts, fuel tanks, instrument panels, cross Wheel Bridge, intake supplier are generally limited to the use of automotive composites.

Gururaja M N et al. [38] Study latest developments and hybrid composite framework for the potential. This paper provides a regular analysis of the hybrids composite material technologies with regard to accessible materials and characteristics and a general summary of some simple, developments and hypothesis, highlighting specific uses, including descriptions of intelligent hybrids. In the area of automobile, aircraft, maritime, wind power etc; the author has concluded the submission.

Prof. N.V. Hargude et al. [39] Discussed mono-leaf spring composite material. In this paper we understand that a leaf spring can be easily created by using E glass epoxy fiber. As a matter of fact, composite material can be used to reduce weight. Composite Leaf Springs' driving comfort and life are also greater than steel leaf fountains.

Obilade, I.O. et al. [40] Usage of rice husk ash as a partial replacement for concrete cement analysis. The Author has determined that the cement replacement is partly acceptable in the range of 0-20 percent RHA. The concrete compacting factor values decrease as the RHA percentage increases. The bulk concrete densities decreased as the RHA replacement percentage rose. Concrete compressive strengths decline as the RHA substitution percentage rises.

Md Iqbal Ahmad et al. [41] the current scenario, future trends & their applications focusing on earthqake-resistant structures, future trends & the use of earthquake-resistant constructions. Composite material can, it is concluded, be used as a viable alternative of conventional reinforced concrete frames in earthquake-proposed areas. In the construction of the masonry framework, fiber reinforced cement composites are found to be reliable.

Piyoosh Thori et al. [42] Giving an introduction to large machinery composite material. Hybrid laminates are produced as required for different industries such as civil engineering, shipping, naval, industrial, aeronautical, shipbuilding, automotive and electronic parts industries. Major attempts were made to further explain the anomalies correlated with state-of-the art developments in the applications of mixed composites.

S. Prabhakaran et al. [43] Design the composite fan blade of glass fiber enhanced polymer. The composite blade was manufactured in this plant. Composite blade is heavier than the fan blade present. The new weight of the fan blade is about 295 g, with a weight of 215 grams composite fan blade that is 28% smaller than the existing model. Compared to composite blades (0.037 units), the new blade absorbs more strength (0.052units). Composite blade limit is Rs. 279/-, 44% below the current blade of aluminum. Compared to an aluminum blade, the strength of the composite blade is also strong. The study concludes that fiber-reinforced plastic is best suited for the composite ceiling fan blade output.

III. CONCLUSION

A large range of composite materials are available in the automobile, aero-space, water , power, recreational, domestic, military, medical and chemical industries, etc. In systems subject mainly to compressive forces, composite materials have tremendous application potential. Composite materials are desirable for their compressive power, excellent adaptability in the manufacture of dense composite covers, light weight, low density and resistance to corrosion. Composite products are physically strong, electrically and chemically strong, which ensures that in many sectors we will use composite content. Specific vehicle and aeronautical components are made with strong properties in conjunction with composite content. Composite items such as beds, walls, doors, mattresses, civil building etc. are used for domestic purposes. We may use composite material in the maritime, pharmaceutical, and sports industries to boost product efficiency. By analyzing them, we infer that composites have tremendous advantages & usage in different industries; by using composite material we can change life style.

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