A Review on Recent Application and Future Scope of Composite Material

Amber Nigam[1] Deepak Pandey[2] Harshit Gupta[3] Shilesh Dwivedi[4]
[1,2,3]B.E. Student [4]Assistant Professor
[1,2,3,4]VITS Satna

Abstract— On this modern age the composite materials are become the primary material for any engineering production because composite materials have several specific properties such as high strength to weight ratio, low cost and easy of fabrication, tensile strength, compressive strength, Impact strength, which does not realize in pure material or non composite material. Composite materials are usually used when numbers of mechanical properties are required in single material. This paper presents a review of current status of composite material technology and various applications of composite material including some detail of composition of composite material.

Key words: Composite, Aerospace Application, Marin Application, Civil Application, Automobile Application

I. INTRODUCTION

The material can broadly classified into following categories i.e. Metal, polymer, ceramics & inorganic glasses, and composite. Metals starts losing their strength at very high temperature .high- polymeric material generally can withstand at still lower temperature. And ceramic material ability to withstand at elevated temperature in their favorable melting points, but due to their brittleness they are often unsatisfactory as a structural material. Here now the composite material is introduced which can withstand at very high temperature without any failure.

The composite material can be define as a material or material system which consist of mixture or combination of two or more micro constituent mutually insoluble and differing in form and/or material composition, as shown in fig.1.

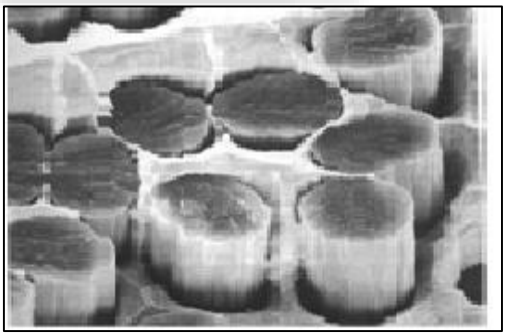

Fig. 1: A composite Laminate Cross Section

Examples of composite material are steel reinforced concrete (metal+ ceramic), vinyl-coated steel (metal+ polymer), fiber reinforced plastic (ceramic +polymer).

From their construction point of view composite material may be define as a material which is composed of two or more distinct phase (matrix phase and dispersed phase) and having bulk properties significantly different from those of any of constituents.

- Matrix phase - It is the primary phase, having a continuous character, is termed as matrix. Matrix is usually more ductile and less hard phase. It holds the dispersed phase and shares a load with it.
- Dispersed (reinforcing) phase – it is embedded in the matrix in a discontinuous form. This secondary phase is called dispersed phase. Dispersed phase is usually stronger than the matrix, therefore it is sometimes called as reinforcing phase.

II. CLASSIFICATION OF COMPOSITE MATERIAL [1]

A. Based on Matrix Material

1) Metal Matrix Composites (MMC)

Metal matrix composites are composed of a metallic matrix (Aluminum, Magnesium, iron, copper, and cobalt) and dispersed ceramic (oxides, carbides) or metallic (lead, tungsten, molybdenum) phase.

2) Ceramic Metal Composites (CMC)

Ceramic Metal composites are composed of a ceramic matrix and embedded fibers of other ceramic material (dispersed phase).

3) Polymer Matrix Composites (PMC)

Polymer matrix are composed of a matrix from thermo set (Unsaturated polyester, polyvinylchloride, nylon) and embedded glass, carbon steel or Kevlar fiber (Dispersed phase).

B. Based on Reinforcing Material

1) Particulate Composites

It consists of a matrix reinforced by a dispersed phase in form of particles.

- Composite with random orientation of particles.
- Composite with preferred orientation of particles.

a) Fibrous Composite

1) Short Fiber Reinforced Composite: it consist of a matrix reinforced by a dispersed phase in form of discontinuous fiber (length<100* diameter).
- Composite with random orientation of fibers.
- Composites with preferred orientation of fibers.

2) Long-fiber reinforced composites- it consist of a matrix reinforced by dispersed phase in form of continuous fibers.
- Unidirectional orientation of fibers.
- Bidirectional orientation of fibers.

2) Laminated Composites

When a fiber reinforced composite of several layers with different fiber orientation, it is called multi layer composite.

Why composite?

- Composites are used to produce vast design with having less weight compare to tradition material. Its tensile strength is greater than that of steel or aluminum
- Its show higher fatigue and endurance limit.
- Composite are more versatile than metals it means lighter in weight and having better strength
- They are long lastic and prevent the structure from corrosion and erosion.
- Less noise while in operation
- It requires less Maintenance.

- They resist sudden load.
- Its fire retardancy is higher
- Structure of composite can be assemble and dismantle easily.

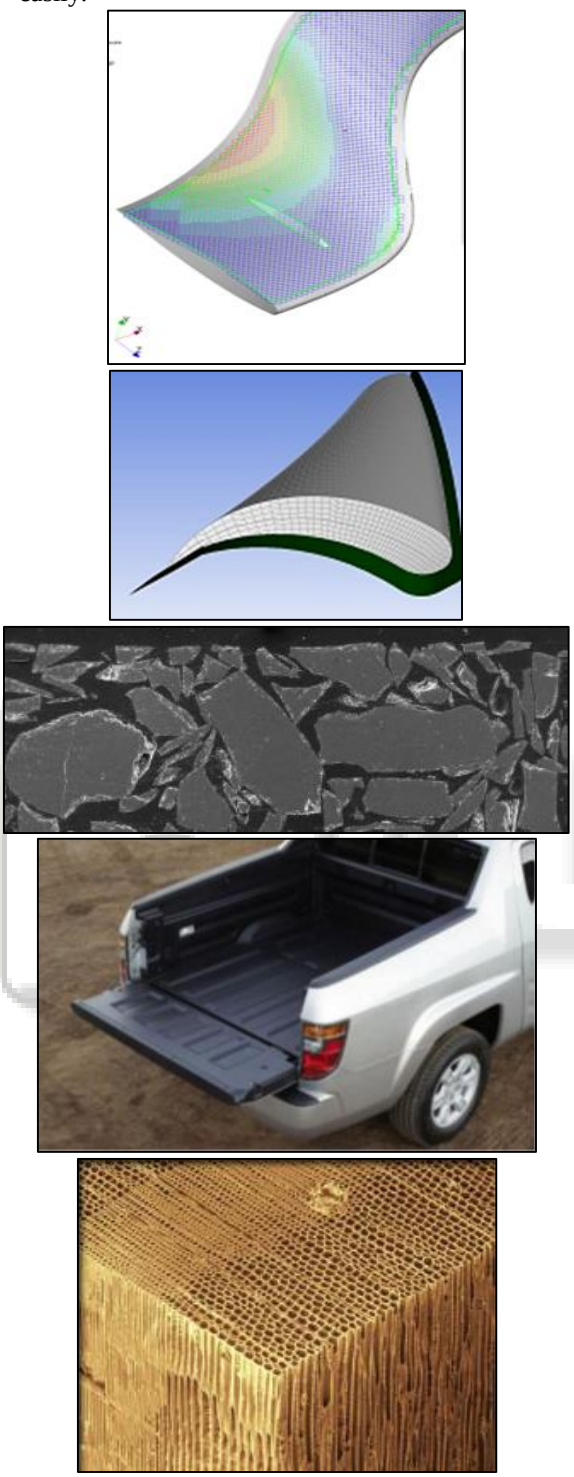

Fig. 2: Composite Material

III. Application of Composite Material in Various Field

A. Marin Application

The first marine application of composite material that is fiber reinforced polymer (FRP) in construction of boat nearly after World War II. Boat manufactures began to use FRP composite in place of timber, or steel and aluminum alloy because wooden boats were easily degraded by sea water and marine organism and metal used in fabrication of boat is get corrode therefore required ongoing maintenance and repairs that can be expensive. Most maritime craft are made of glass reinforced polyester (GRP) composite and advanced FRP materials that consist of carbon and aramid fibers with vinyl ester or epoxy resin matrices. They are used for high performance structural applications.

FRP composite is used for maritime craft because it provide high strength, light weight, corrosion resistance and durable naval boats. Another reason for using composite in maritime craft was to reduce weight of ship, particularly the top side weight of ship. Composite material also provides high acoustic transparency property which helps the result of rodomes on ship and sonar on submarine. Naval patrol boats are being built with an aluminum super structure. The growing popularity of FRP patrol boat is due to their excellent corrosion resistance, this reduces maintenance costs, and light weight, this result in better speed and fuel economy.

Fig. 3: Marin Application

B. Aerospace Application

Composite materials are the vast the vast combination to increase global marketing in aerospace industries, because it is replacing the heavier material with some other better strength and resisting power. By the use of composite material we are able to reduce the fuel consumption which is very important for any aerospace industry. Now days, the interior of aerospace are made of composite material which gives the better look as well as plays very vital role to make it efficient and long lastic.

Here weight becomes the main the main factor, when it comes to the heavier air machines and engineers are continuously working for the improvement of the same. We mostly used carbon fiber glass and aramid and reinforced epoxy.

High tech remote control planes are also made of composite material. Now a day's helicopter rotor is made of composite material like carbon fiber, woven glass epoxy, nomex epoxy, honey comb, foam etc. because they give higher strength, toughness and better resistivity with very less weight. These are also used for construction of wings of airplane.

This modern era of technology it become the challenge for the scientist to produce such satellite vehicle which consume very less fuel and this is depend upon the weight of material that we use in today's satellite vehicles. Satellites have four stages where fuels and motor varies when it attains third stage its casing of motor is made up of Kevlar composite. Uses a flux nozzle control system. By using these materials we are able to save about 1/6th of total expense. Component like frame, solar panel, wings, solar booms, antenna, optical structures, thermal shields, fairings, motor case and nozzle, and propellant tank, pressure vessel etc.

Fig. 4: Pressure Vessel

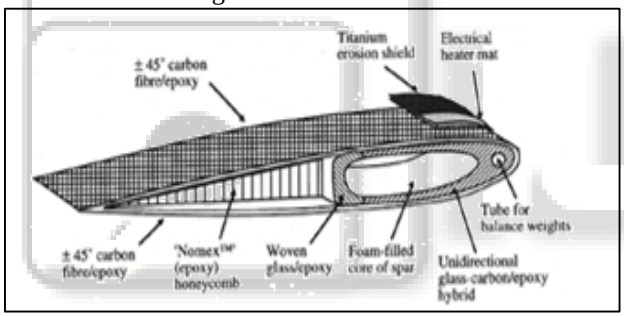

Fig. 5: Schematic section through a typical composite construction for a helicopter rotor blade

Fig. 6: Aerospace Application

C. Automobile Application

It has become the main aim of engineers to reduce the mass of vehicle just to improve performance of vehicles. There is a relation between mass and speed of the vehicle, In auto racing, less mass means greater speed, So engineers have found the way to reduce the mass by changing the material. So the engineers replace the traditional materials from different composite material. In this age of new era of car designing, automobile companies use the carbon fiber to manufacture high performance vehicle.

Various parts of automobile are made-up with the composite material. Such as seats, body parts, steering wheel, valve mechanism parts, fuel tanks, bumpers, carpeting, lighting, insulation, roof assembly, wipers, seat belts, air bags, etc.

Most of these are made up with the carbon fiber. It provides the strength to the vehicle, reduces the weight up to 50%, improves the fuel efficiency up to 35%, and it accelerates the innovations with a fluid grace now a day.

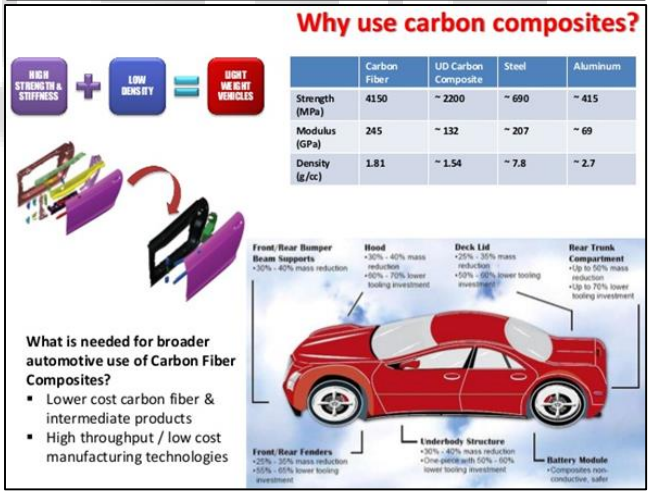

Fig. 7: Automobile Application

D. Building Construction [2]

Composite materials have been used in construction for centuries. One of the first was the use of straw as reinforcement in mud and clay bricks by the ancient Egyptians.

The combination of reinforcing steel and concrete has been the basis for a number of structural systems used for construction for the last century. The new class of composite materials, gradually gaining acceptance from civil engineers, both for the rehabilitation of existing structures and for the construction of new facilities, are Fibre Reinforced Polymer composites, primarily developed for the aerospace and defense structures.

Reinforced Polymer composites are the combination of polymeric resins, acting as matrices or binders, with strong and stiff fibre assemblies which act as thereinforcing phase. The combination of the matrix phase with a reinforcing phase Fiber reinforcing fractions vary considerably (i.e., reinforced concrete in general rarely contains more than 5% reinforcement, where produces a new material system, analogous to steel reinforced concrete, although the eas in FRP composites, according to various sources, reinforcing volume fraction ranges from 30-70%).

E. Areas of application [2]

1) Repair and Retrofitting of Existing Bridge Structures

Strengthening and retrofitting of existing structures using externally bonded FRP composites are one of the first applications of FRP introduced in civil engineering. The technique is simple, rapid, and effective. FRP used for strengthening and retrofitting can be in the forms of FRP sheet or strip, depending on their application. Externally bonded FRP composites have been used for increasing both flexural and shear capacity of concrete elements, including girders, beams and slabs.

2) Reinforcement of concrete

Although the steel reinforcement in concrete structure is protected by concrete, aggressive environmental condition can stimulate the carbonation of concrete and the formation of hydrated ferrous oxide in steel, resulting in spalling of concrete cover. The primary cause of deterioration of concrete bridge is the corrosion of steel reinforcement. Since FRP composite exercises high corrosion resistance.

3) Hybrid Bridge Structures

Hybrid bridges are understood as structures created by combining elements made of traditional materials (usually girders) with elements made of FRP composites (usually decks or cables/tendons). The pillars are usually made of traditional materials.

Bridge design concepts are still mostly oriented towards the use of traditional materials such as concrete or steel, which often prevents the full exploitation of the new materials The most common example of a hybrid bridge is a construction composed of steel or concrete girders to which FRP bridge deck is affixed. FRP bridge deck was introduced as a solution providing easy installation, light weight and potential resistance.

Fig. 8: Design Concept

4) Future scope of composite material-

Where the composite material is replacing traditional material due its weight saving property and economic cost due to which most of the industries work with composite material it is very obvious that efficient only efficient manufacturing is not enough to reduce the cost ,main thing is that design ,material, process ,tooling must also taken to the consideration .composite materials will be widely used

in aerospace, marin, civil, automobile, sports, chemical industries, nano composite, natural fiber composite, consumer and sport good etc. because of best construction capability and also resist the vibration and absorb the shok.

IV. CONCLUSION

From this paper finally we conclude that in this modern era of technology where compactness, less weight, easy workability and economic is main factor. Composite material is widely accepted most of the era of technology like- marine, automobile, civil work and aerospace technology. FRP composite material is widely used for structural and non- structural. And recycbility of the composite is very easy. High performance becomes the main key of the composite.

REFERENCES

[1] Www. Subtech.com/ composite classification
[2] Use of fiber reinforced polymer composite in bridge construction.by pawel Bernard potyrala
[3] Composite material in Aerospace Applications by Nikhil V nayak.[International Journal of Scientific and Research Publications, Volume 4, Issue 9, September 2014 1 ISSN 2250-3153
[4] The advantages of composite material in marine renewable energy structures by M Mohan, Gurit, UK .Paper presented at RINA Marine Renewable Energy Conference 2008
[5] http://indianspaceworld.blogspot.in/2012/02/polar-satellite-launch-vehicle-pslv.html?m=1
[6] http://www.ae.iitkgp.ermet.in/ebooks/chapter1.html
[7] http://composite.about.com/od/applications/a/composites-in-aerospace.htm
[8] www.Materialstoday.com
[9] www.jeccomposites.com
[10] www.compositeworld.com/articles/composite-engine-valves

