iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 5 **Issue:** II **Month of publication:** February 2017

DOI: http://doi.org/10.22214/ijraset.2017.2092

Volume 5 Issue II, February 2017
ISSN: 2321-9653
International Journal for Research in Applied Science & Engineering Technology (IJRASET)

Overview and Recent Advancements in Composite Materials

N. Ashok kumar[1], A. Sivakumar[2], R.Tamilarasan[3]
[1,2,3] *Faculty of Mechanical Engineering, Varuvan Vadivelan Institute of Technology, Dharmapuri, Tamil Nadu, India.*

Abstract : A continuing trend in material development is the evolution of composite materials. The composite materials being very strong and stiff, yet light in weight provide high strength to weight and stiffness to weight ratios. The designers have found the composites to have unmatched design potential, so new and better materials could be developed resulting in weight reduction, improved efficiency and overall cost reduction. Recent developments in composites include Bio composites, green composites, self-healing polymer composites, thermoplastic composites and carbon Nano tube composites. The improved material properties, like stiffness, high strength, low weight & corrosion resistance has made the composites to find vast application in industries like space craft , dentistry, pressure vessels mining, abrasive materials and cutting tools.
Keywords: Composite materials, Bio composite, dentistry, nano tubes.

I. INTRODUCTION

Composite materials (also called as composition materials or composites) are materials composed of two or more materials to form a new useful material. The combination of existing materials is done by physical means. There are two categories of constituent materials, one is the stronger material (reinforcement) and the other is the weaker material (matrix or binder). Matrix helps to maintain the position and orientation of the reinforcement. The two constituents may be of different physical and chemical properties , but when amalgamated into a single material, it emerges into a new material with entirely different composition from the individual constituents. There are various types of composites namely, particulate composites, Flake composites, Fiber composites, Nano composites. According to their matrix phase the composites are classified as , Polymer matrix composites, Ceramic matrix composites, Metal matrix composites. There are various techniques for the fabrication of composites, namely Advanced fiber placement (automated fiber placement), Tailored fiber placement, Fiber glass spray lay-up process, filament winding, lanxide process, Tuffing , z-pinning.

II. OVERVIEW AND HISTORICAL PERSPECTIVE OF COMPOSITES

The earliest man-made composite materials were straw and mud combined to form bricks. Wood is a naturally occurring composite comprising cellulose fibers in a lignin and hemi-cellulose matrix. Wattle and daleb is one of the man- made artificial composite. Concrete is also a man-made artificial composite (a mixture of cement and aggregate giving a strong material). Bakelite was the first artificial fiber reinforced plastic and one of the most common and familiar composite is fiber glass. Shape memory polymer composites are high performance composites using fiber and shape memory polymer resin matrix. High strain composites are another form to perform in high deformation setting. Composites can also use metal fibers reinforcing other metals.

III. RECENT ADVANCEMENTS OF COMPOSITE MATERIALS

A. Light Weight Composites

In alternate to steel, magnesium and aluminum alloys have been used for in automobiles for their light weight. Emerging trends in polymers and fiber-based hybrid composite has led to the development of light weight vehicles. The other class of lightweight materials in automobile industry are natural fiber reinforced composites. Many automotive industries are using the natural fiber reinforced composites (density 1.5 g/cc) as an alternate to glass fiber (2.5 g/cc).In industries producing high-end products , carbon fiber is being used as an alternate to glass fiber. Hybrid design of carbon and glass fiber have resulted in optimum performance. Recycling of carbon fibers and incorporating nano fibers in the carbon fibers enhances the performance of automobiles. CBBP, university of Toronto, Canada, in association with automotive partners have developed a light weight hybrid prototypes which is currently under study. Recent advances in utilization of cellulose and carbon fiber- enabled composite structures has increased the ergonomics design of vehicles.[1]

B. Composite Resins

Composite resins have been implemented in field of dentistry which replaced the former acrylic resins and silicate cement. Composite resins are used as restorative adhesives in dentistry and silica is used as a filler material. Flowable composite resin is used as a liner, to block small undercuts, build up cavity and direct or indirect pulp cap. It is used as a stress breaker. The first generation of Indirect resin composites developed by Touati & Mormann had a composition identical to direct resin composites ,which led to the development of second generation composites. The second generation composites had a filler with diameter ranging from 0.04 – 1 micron. Advancement in the field of nanotechnology provided a interface between the tooth and restorative biomaterials. Another advancement in the field of composites is the self-healing composites. The self-healing characteristics was reported in epoxy resin composite. If a crack occurs in the composites, the microcapsules get destroyed and release the resins which fill the crack and reacts with Grubbs catalyst dispersed in the epoxy composite , resulting in self-healing.[2][4]

C. Improvement of Composite Materials

The improvement of composite materials especially glass fiber reinforced plastic (GFRP) in pulstration manufacturing industry was accomplished by processes like Re-engineering, Re-designing and Re-cycling. This improvement was aimed for eco-efficiency performance. The term ‘eco-efficiency’ means doing more with less resources. It was observed that eco efficiency improvement can be achieved by reducing the consumption of energy, material and waste. In the Re-engineering approach, the temperature profile of the die was verified experimentally by Thermography technique and analyzed by FEM, which showed the reduction of energy consumption by 17 % and warm up time by 50 %` In re-cycling approach, the non-conformities, by-products of thermoplastic products and carbon fiber reinforced plastic (CFRP) were taken into observation and found to be effective by 15 %`replacement.[3]

D. Modeling for Composites

Due to advancements in newer materials, the composite materials require modeling and simulation. FEM is the numerical method of structural analysis in which the data for the required for structure analysis such as stresses, deformations, displacements can be obtained. FEM implies dividing the structures into small dimensions and shapes and then creating a Mesh and analysing it. Catia, pro-E , solid works, `CFD are some of the softwares available for modeling and analyzing the heat transfer , fluid flows in various structures.[5]

E. Green Composites

The strength of any composite can be determined by its fiber properties, resin properties and the fiber-resin interface. Mostly all the available fiber and resin are derivatives of petroleum which do not degrade or decompose for several years. These composites can also not be recycled very easily leaving toxic gases. This led to the development of Green composites which are easily degradable and eco-friendly. Green composites combine plant fibers and natural resins to create natural composite materials. These composites are now emerging as an alternate to glass reinforced composites. Green composites find application where moderate strength is required. [6]

IV. CONCLUSION

The improved mechanical and physical properties of composite materials has made it being used in industries like automobile, aerospace, naval, electronics and medicine. Continuous improvements in composite materials has led to the evolution of newer materials like self-healing composites, Green-composites, carbon nano-tubes, carbon fiber reinforced plastics, Bio-composites etc. The future promises an substantial progress of composite materials.

REFERENCES

[1] Perviaz, M., Panthapulakkal, S., Birat KC ,Sain, M. and Tjong, j. (2016)Emerging Trends in Automotive Light-Weighting through Novel Composite Materials. Materials sciences and Applications , 7, 26-38
[2] P.Benly et al/j. Pharm. Sci.& Res. Vol. 8(8), 2016,881-883.
[3] M.C.S. Ribeiro , A.Fiuza, A.C.MCastro, F.J.G. Silva, J.P. Meixedo , M.L.Dinis and M.R. Alvim , PAPER REF :5789, Recent Advance in Mechanics and Materials in Design
[4] Prachi Singh , Nitesh Kumar , Richa Singh, Kamini Kiran , Shailesh Kumar DOI:10. 17354/ijss/2015/578
[5] Subhash S , A.N. Hari Rao, Department of Mechanical Engineeing, S J C E , Mysore, Karnataka, India.
[6] B.C. Mitra ,Defence science journal, Vol . 64, No .3, May 2014, pp. 244-261, DOI: 10.14429/dsj.64.7323.