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A review on recent applications and future prospectus of hybrid composites in various engineering applications

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ABSTRACT

Hybrid composite Materials have extensive engineering application where strength to weight ratio, low cost and ease of fabrication are required. Hybrid composites provide combination of properties such as tensile modulus, compressive strength and impact strength which cannot be realized in composite materials. In recent times hybrid composites have been established as highly efficient, high performance structural materials and their use is increasing rapidly. Hybrid composites are usually used when a combination of properties of different types of fibres have to be achieved, or when longitudinal as well as lateral mechanical performances are required. The investigation of the novel applications of hybrid composites has been of deep interest to the researchers for many years as evident from reports. This paper presents a review of the current status of hybrid composite materials technology, in terms of materials available and properties, and an outline of some of the trends, obvious and speculative, with emphasis on various applications including some details of smart hybrid composites.

KEYWORDS

Hybrid composites;
Strength;
Stiffness;
Tensile modulus;
Smart hybrid composites.

INTRODUCTION

There is a steady increase both in the number of applications being found for fiber reinforced plastics and, concurrently, in the variety of fiber/resin systems that are available to designers. Some of these systems are useful, however, only in highly specialized situations where limitations such as high cost and brittle fracture behavior are considered secondary to such qualities as low density, high rigidity and high strength. By mixing two or more types of fiber in a resin to form a hybrid composite it may be possible to create a material possessing the combined advantages of the individual components and simultaneously mitigating their less desirable qualities. It should, in addition, be possible to tailor the properties of such materials to suit specific requirements. There are many situations in which, for example, a high modulus material is required but in which the catastrophic brittle failure usually associated with such a material would be unacceptable. In the case of a strut member, a high initial modulus followed by limited yielding of the material and accompanied by the smallest possible reduction of load carrying capacity is usually desirable.

Aeronautical applications

Commercial aircraft applications are the most important uses of hybrid composites. Aircraft, unlike other

Review

vehicles, need to lay greater stress on safety and weight. They are achieved by using materials with high specific properties. A modern civil aircraft must be so designed as to meet the numerous criteria of power and safety. Glass & carbon reinforced hybrid composites are the most desired materials as a result of advanced technology that has gone beyond the design and application. In cases where high moduli of elasticity values are less important, hybrid is the natural option because of the low cost of material. The matrix material used with fiber glass & carbon fibers however, limits its use to low temperatures, usually below 121°C, although it is not a debilitating limitation for the fiber, as its properties can still be used and maintained at temperatures beyond 426 to 482°C. Fiber epoxy composites have been used in aircraft engine to enhance the performance of the system.

Marine applications

Ships are under constant attack, both from the elements of nature and the enemy. The vast majority of ship hulls are constructed from common carbon steels, which are obviously susceptible to corrosion, but they also create distinct thermal and electromagnetic signatures easily detectable from long distances. Nonetheless, even methods which are staples of the industry have shortfalls. First, the construction process is very labor intensive, involving the welding of thousands of steel plates. Second, all the welding creates numerous heat affected zones, resulting in areas of stress concentrations. especially these heat-affected zones, are highly susceptible to corrosion and reduced fatigue life. Lastly, extensive coatings[8] are required to shield the structure from the elements. All of these factors and more ultimately translate into higher build and maintenance costs for ships. For the next generation of ships, the Navy is looking to stealthier hull technologies, specifically those which create lower magnetic, acoustic, hydrodynamic, radar, and thermal signatures. One way to accomplish this is by constructing hulls out of reinforced polymer hybrid composite materials. Hybrid composites have many advantages over carbon steel[9], including a much higher strength to-weight ratio, lower maintenance requirement,

Hybrid composites for telecom applications

Need of telecommunication industries of power transmission along with data transmission is increasing,which felt the need to explore the innovative product category called Hybrid Cable. Hybrid aerial, underground A Review on Recent Applications and Future Prospectus of Hybrid Composites 355cable is very innovative and versatile cabling solution within built power transmission required for network equipments with OFC cables. Hybrid Composite Cable is need of a day, firstly to support for Power transmission for always ON (Interrupt free) telecom needs. The telecom network elements & terminations are powered with help of this copper pair. Secondly, the Copper pair also used for critical signaling needs for railway signaling & fiber optic element for Telecom application.

CHALLENGES, OPPORTUNITIES AND FUTURE TRENDS

Several challenges must be overcome in order to intensify he engineering usage of Hybrid composites. Design, research and product development efforts and business development skills are required to overcome these challenges. In this pursuit there is an imperative need to address the following issues

- Science of primary processing of hybrids need to be understood more thoroughly, especially factorsaffecting the microstructural integrity.? There is need to improve the damage tolerant properties particularly fracture toughness and ductility in Hybrid Composites.
- Work should be done to produce high quality and lowcost reinforcements from industrial wastes and byproducts.
- Efforts should be made on the development of Hybrids based on non-standard fibers & matrices.

CONCLUSION

The following conclusions can be drawn with regard to the various applications of Hybrid Composites: Firstly, the details of manufacturing process of hybrid laminates is provided as applicable to various industries such as transportation industry, aeronautics, naval, automotive industries and components for the electronic industry. Considerable efforts have been focused on the applications of Hybrid composites for better un-

derstanding of the phenomena associated to the cutting edge technology. As far as the material is concerned, glass and carbon fibre reinforced composites have been equally investigated; however, epoxy resin is preferred as the matrix material. An effort towards this literature on hybrid composites will throw some light on researchers and scientists pursuing work on hybrid composite technology.

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