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Study on Polymer Composite

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ABSTRACT:

A polymer composite is a blend of more than two polymers with different properties, which at a certain proportion allow synergizing features (such as physicochemical, thermal and separation properties) in the resulting material. Herein, individual components in the composite remain together by physical or chemical interactions but retaining their physical or chemical identities and exhibit superiority over the individual pristine state. Polymer composites are produced in different shapes and sizes according to the application demand by various methods. To date, polymer composites can be manufactured in a different structure, such as flat sheet, thin-film, microsphere/microparticle, hollow fibre, nanofibre, nanoparticle, gel, sponge and foams. It cloud-word showing the well-reported morphologies of polymer composites observed from literature.

Key Words: polycarbonate, polyhexamethylene sebacic, polyether sulfone, polyether ether ketone, polyether ketone ketone, polyether imide, polyethylene terephthalate, phenoplasts, epoxy resin and polyurethane

INTRODUCTION

Polymer composites are a kind of high-performance and versatile material formed from a combination of different phases of materials, at least one of which, normally the matrix, is a polymer [1]. The combination of these components results in unique mechanical and thermal properties that are infeasible to be achieved with a single material. Matrix and reinforcement are the two main phases that are essential in developing polymer composites. These two phases are usually composed of organic polymers as the matrix and fiber as the reinforcement. Generally, the strength and stiffness of the fiber materials are much higher than those of the matrix material, and thus make the fiber the major load-bearing component in polymer composites. On the other hand, the matrix serves as a load distributor by uniformly transferring the applied force to the fiber. Therefore, the matrix needs to hold the fiber firmly to establish an efficient load transfer, which in turn increases the mechanical properties of the polymer composites.

The performance of polymer composites is generally determined by:

1the properties of the fiber,

2the properties of the polymer matrix,

3the ratio of the fiber to the polymer matrix in the composite (fiber volume fraction), and

4the geometry and orientation of the fiber in the composite.

The performance is usually referred to as the mechanical properties of the polymer composites. It is considered to be the most important of the physical and chemical properties of the polymer composites. To determine the mechanical properties of polymer composites, there are numerous mechanical tests and testing instruments with standardized and nonstandardized testing methods [2]. One of the most important criteria in determining the performance of polymer composites materials is the tensile properties.

The concept of formulation is very broad since it concerns all industries which develop intermediaries or finished products by mixing several raw materials [1], [2], [3], [4], [5]. More precisely, the formulation can be defined as all of the knowledge and operations implemented when mixing, combining or shaping ingredients of natural or synthetic origin, often incompatible with each other, of so as to obtain a commercial product characterized by its function of use and its ability to satisfy a predetermined specification [6], [7], [8], [9], [10]. Among the constituents of formula, a distinction must be made between the active ingredients which fulfill the main function sought and the formulation aids which play accessory roles. The formulated product consists of a fine dispersion of several immiscible phases which appears homogeneous on the macroscopic scale and heterogeneous on the microscopic scale (paints, cosmetic creams, mayonnaise and composite materials); to the previous requirements are added those of the preparation and the stability of the mixture [6]. Composite material can be defined as the assembly of two or more materials, the final assembly having properties superior to the properties of each of the constituent materials. Composite materials are now commonly called reinforcement arrangements (also called fillers) which are embedded in a matrix. The matrix ensures cohesion and orientation of the load. Also, it possible to transmit to the load the stresses to which the composite is subjected. The materials thus obtained are very heterogeneous and often anisotropic. The nature of the matrix and the charge, the shape and proportion of charge, the quality of the interface and the production process used are all parameters that can influence the properties of the composite material. The matrix and the reinforcement can be metallic, ceramic or plastic, which makes it possible to envisage a multitude of combinations [8]. The composite material is composed in the general case of one or more discontinuous phases distributed in a continuous phases. In the case of several discontinuous phases of different natures, the composite is said to be hybrid. The continuous phase is called the matrix and the discontinuous phase is called the reinforcement or reinforcing material. In composite materials components with complementary physical and mechanical properties are combined. The insertion of reinforcements of good tensile strength, of very high modules in a polymer matrix, makes it possible to improve the mechanical and thermal qualities. The advantage of composites with a polymer matrix, compared to metals, is the manufacturing process which allows the production of parts of complex shape including their lower density, hence a lower fuel consumption (for aviation and automobile), higher speed in competitive sport or longer range for missiles and higher payload (in transport). The composite materials are classified according to the type of matrix into three categories, namely organic, mineral and metallic. Among the organic composites, there are cardboard (resins and cellulose fibers), laminated tires (rubber, steel, organic resins, glass fibers, carbon and boron) and reinforced plastics (resins and short fibers). Amongst the mineral composites we find concrete (cement, sand and additives), carbon–carbon composites (carbon and carbon fibers) and ceramic composites (ceramics and ceramic fibers). And also, the last are the metallic composites (aluminum/boron fibers and aluminum/carbon fibers). These composite materials affect several fields of application, namely packaging, automotive, light structures, civil engineering, aviation, sports, biomedicine, thermomechanical components and aerospace.

Different composite materials types

Polymer composites are considered as one of the most important materials used for high performance applications, and are replaced many of the conventional metallic components in the recent past because of their lightweight and efficient strength and amenable processing characteristics. The major advantages of polymer composites are their ease of fabrication into complex structural shapes, replacement of traditional materials with considerable weight reduction, improved reliability and increased fuel economy in the case of vehicles. Modern technological development wants consistent high performance composite materials that are light-weight and have outstanding electrical insulation, thermal, mechanical and environmental properties. The usage of polymer composites in transportation industries has gradually improved over the past few eras fetching a breakthrough argument in the method vehicles are intended and fabricated. Considering at the aeronautics sectors, which continuously attempts to decrease its influence on the environment, according to the Advisory Council for Aviation Research and Innovation in Europe (ACARE) intentions for 75% reduction in CO_2 releases per traveler kilometer compared to 2000. In this regard, at present, aerospace sector uses the polymer composite materials in the primary and secondary structures of aerospace components to replace the current metals to reduce the weight of aircraft and to increase the fuel efficiency. Currently, 50%–53% of polymer composite materials are used in aerospace structure (Airbus A350 (2007) and Boeing B787 (2013)). The present article presents an outline of thermoplastic and thermosetting polymers, reinforcements used in aerospace sector, including their properties and applications. To access the description of the composite material, it will be necessary to specify three natures such as the nature of the constituents and their properties, the geometry of the reinforcement and its distribution and the nature of the matrix-reinforcement interface. The composite material is therefore a system formed of a relatively large number of constituents [1]. The number of possible realizations from this range of fundamental elements is therefore practically infinite. The nature of

Composite materials formulation

Polymer composites are one of the most important applications of polymers, whether natural or synthetic. A polymer composite is a multiphase solid material, where one of the phases has one, two, or three dimensions in different polymer matrices. Polymer composites are suitable for applications as high-performance composites, where the properties of the reinforcements are substantially different or better than those of the matrix [8]. Polymer matrix composites are most advanced composites; these composites have different types of fibers (natural and synthetic) as reinforced material in different types of polymers such as thermoplastic or thermoset polymers, which can mold in different shapes and sizes, and make different types of fashioned materials [9]. The polymer composites have very good mechanical strength and stiffness, along with resistance to corrosion. Polymer materials have advantages over conventional materials that are used in different aerospace components [5]. One of the key properties is being light weight while providing specific strength at the same time, thereby reducing overall weight by up to 40%. The other properties include the potential for rapid process cycles, ability to meet stringent dimensional stability, lower thermal expansion properties, and excellent fatigue and fracture resistance [9]. The reason for these being most common is their low cost, high-strength, simple manufacturing principles, and design flexibility [5]. Synthetic fibers such as carbon, glass, and kevlar used in polymer composites for aerospace application are replacing the secondary structure with fiber–polymer composites [2]. Aerospace applications require specific design material characteristics with high-performance and capacity from polymeric materials. Polymer composites can be altered and provide high-strength with low weight, corrosion resistance to most chemicals, and provide highly durable materials under most environmentally severe conditions. The main components of the composite materials formulation are matrices, fibers and additives or fillers (Scheme 1), respectively.

Matrix

The matrix can be of the thermoplastic, thermosetting and/or elastomer type. The role of the matrix is to linked the reinforcing fibers, distribute the constraints, provide the chemical resistance of the structure and give the desired shape to the final product [40], [68]. The choice of matrix depends on the use for which the composite material is intended. Composite materials, as defined in the context of this study, have been deliberately limited to those formed by organic matrices.

Reinforcement

The reinforcement constitutes the reinforcement or the skeleton which provides the mechanical strength (tensile strength and rigidity). It is, by definition, of filamentary nature (organic or inorganic fiber) going from the elongated particle to the continuous fiber [9], [5]. The most used is E glass fiber which represents more than 95% of applications. In addition, aramid fiber (Kevlar) is also of great interest [1], [2]. In general, in a composite structure (anisotropic), the fibers

Filler

Under the general name of filler is designated any inert substance which, added to the base polymer, makes it possible to appreciably modify the mechanical, electrical or thermal properties, to improve the surface appearance or else, simply, to reduce the price of the transformed material [4], [5], [8]. Thermosetting materials are always contained fillers of various kinds and shapes, at often high rates of up to 60% by mass. For a given polymer, the choice of filler is determined according

Conclusion

After studying a large number of literatures on thermoplastic polymers, elastomer polymers and thermosetting polymers reinforced by fibers and formulated by fillers we have recommended and concluded the following points:

•Composite materials thermosetting showed exceptional mechanical and thermal resistance at high temperature.

•Technological composite materials reinforced by glass fibers and carbon fibers present excellent high tensile and compressive strength

REFERENCES

[1] H. Corrêa, and D.G. Corrêa, Frontiers in Materials 7, 283 (2020).
[2] D.K. Rajak, et al., Polymers 11, 1667 (2019).
[3] R.R. Nagavally, Int J Mech Prod Eng 5, 82 (2017).
[4] G.-W. Lee, et al., Composites Part A: Applied science and manufacturing 37, 727 (2006).
[5] G. Liang, et al., Dielectric Polymer Materials for High-Density Energy Storage (Elsevier 2018), pp.383.
[6] C. Tuakta, Use of fiber reinforced polymer composite in bridge structures (Massachusetts Institute of Technology: Master of Engineering Thesis 2005).
[7] B.P. Singh, et al., Surface and Coatings Technology 232, 475 (2013) .
[8] K. Nam, et al., Bulletin of Materials Science 34 , 1289 (2011).
[9] T. Selvin, et al., in International Conference Polymeric Materials (2004), pp.49.
[10] S. Fu, et al., Nano Materials Science 1, 2 (2019).
[11] M. Albdiry, et al., Journal of composite materials 47, 1093 (2013).

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