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Characteristic Analysis of Mechanical Properties on Carbon Fiber Reinforced Plastic

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Abstract - Composite materials are extending the horizons of designers in all branches of engineering, and yet the degree to which this is happening can easily pass unperceived. In composites, materials are combined in such a way as to enable us to make better use of their virtues while minimizing to some extent the effects of their deficiencies. This process of optimization can release a designer from the constraints associated with the selection and manufacture of conventional materials. He can make use of tougher and lighter materials, with properties that can be tailored to suit particular design requirements. And because of the ease with which complex shapes can be manufactured, the complete rethinking of an established design in terms of composites can often lead to both cheaper and better solutions.

Keywords: Composite material, carbon fiber, resin, reinforced material.

I. INTRODUCTION

Composite materials are extending the horizons of designers in all branches of engineering, and yet the degree to which this is happening can easily pass unperceived. In composites, materials are combined in such a way as to enable us to make better use of their virtues while minimizing to some extent the effects of their deficiencies. This process of optimization can release a designer from the constraints associated with the selection and manufacture of conventional materials. He can make use of tougher and lighter materials, with properties that can be tailored to suit particular design requirements. And because of the ease with which complex shapes can be manufactured, the complete rethinking of an established design in terms of composites can often lead to both cheaper and better solutions. The 'composites' concept is not a human invention. Wood is a natural composite material consisting of one species of polymer cellulose fibres with good strength and stiffness in a resinous matrix of another polymer, the polysaccharide lignin. Nature makes a much better job of design and manufacture than we do, although Man was able to recognize that the way of overcoming two major disadvantages of natural wood that of size and that of anisotropy was to make the composite material that we call plywood. Bone, teeth and mollusc shells are other natural composites, combining hard ceramic reinforcing phases in natural organic polymer matrices. Man was aware, even from the earliest times, of the concept that combining materials could be advantageous, and the down-to-earth procedures of wattle-and-daub and 'pide' building construction, still in use today, pre-date the use of reinforced concrete by the Romans which foreshadowed the pre-tensioned and post-tensioned reinforced concretes of our own era. But it is only in the last half century that the science and technology of composite materials have developed to provide the engineer with a novel class of materials and the necessary tools to enable him to use them advantageously. The simple term 'composites' gives little indication of the vast range of individual combinations that are included in this class of materials. We have mentioned some of the more familiar ones, the scope for ingenuity which is available to the Materials Scientist and his customer, the Design Engineer. First, within each group of materials metallic, ceramic and polymeric there are already certain familiar materials which can be described as composites. Many members of the commonest and largest group of engineering materials, the family of steels, consist of combinations of particles of hard ceramic compounds in a softer metallic matrix. These particles are sometimes plate-like, sometimes needle-shaped, and sometimes spherical or polygonal. Polymers, too, are often two-phased, consisting of a matrix of one polymer with distributions of harder or softer particles contained within it; wood is a perfect example of this, as we have seen. And concrete is a classic example of a ceramic/ceramic composite, with particles of sand and aggregate of graded sizes in a matrix of hydrated Portland cement. These materials have been well known for many years, and

Materials Scientists have learned to control their properties by controlling their microstructures; that is to say, the quantity, the form, and the distribution of what we might refer to as the 'reinforcing phase'.

The appropriate performance of these composite during use is mainly related to their mechanical properties and thermal resistance as a result of the adequate combination of reinforcement, polymeric matrix and processing technique Composite materials are extending the horizons of designers in all branches of engineering, and yet the degree to which this is happening can easily pass unperceived. In composites, materials are combined in such a way as to enable us to make better use of their virtues while minimizing to some extent the effects of their deficiencies. This process of optimization can release a designer from the constraints associated with the selection and manufacture of conventional materials. He can make use of tougher and lighter materials, with properties that can be tailored to suit particular design requirements. And because of the ease with which complex shapes can be manufactured, the complete rethinking of an established design in terms of composites can often lead to both cheaper and better solutions. The 'composites' concept is not a human invention. Wood is a natural composite material consisting of one species of polymer cellulose fibres with good strength and stiffness in a resinous matrix of another polymer, the polysaccharide lignin. Nature makes a much better job of design and manufacture than we do, although Man was able to recognize that the way of overcoming two major disadvantages of natural wood that of size and that of anisotropy was to make the composite material that we call plywood. Bone, teeth and mollusc shells are other natural composites, combining hard ceramic reinforcing phases in natural organic polymer matrices. Man was aware, even from the earliest times, of the concept that combining materials could be advantageous, and the down-to-earth procedures of wattle-and-daub and 'pide' building construction, still in use today, pre-date the use of reinforced concrete by the Romans which foreshadowed the pre-tensioned and post-tensioned reinforced concretes of our own era. But it is only in the last half century that the science and technology of composite materials have developed to provide the engineer with a novel class of materials and the necessary tools to enable him to use them advantageously. The simple term 'composites' gives little indication of the vast range of individual combinations that are included in this class of materials. We have mentioned some of the more familiar ones, the scope for ingenuity which is available to the Materials Scientist and his customer, the Design Engineer. First, within each group of materials metallic, ceramic and polymeric there are already certain familiar materials which can be described as composites. Many members of the commonest and largest group of engineering materials, the family of steels, consist of combinations of particles of hard ceramic compounds in a softer metallic matrix. These particles are sometimes plate-like, sometimes needle-shaped, and sometimes spherical or polygonal. Polymers, too, are often two-phased, consisting of a matrix of one polymer with distributions of harder or softer particles contained within it; wood is a perfect example of this, as we have seen. And concrete is a classic example of a ceramic/ceramic composite, with particles of sand and aggregate of graded sizes in a matrix of hydrated Portland cement. These materials have been well known for many years, and Materials Scientists have learned to control their properties by controlling their microstructures; that is to say, the quantity, the form, and the distribution of what we might refer to as the 'reinforcing phase'. Carbon fibre reinforced polymeric composite are very used for manufacturing flaps, landing-gear, golf shafts,snowboards,doors and other additionaly,the composite can be used in other areas like home constructions and navy. In general aeronautical polymeric composites are classified as advanced and present continuous fibre reinforcement of high strength embedded in a thermoset or thermoplastic polymeric matrix.

These properties are again related to manufacturing processes with specified parameters, resulting in well defined products. The material quality is controlled and tested regularly and for all component types manufactured. This result in well defined properties with low standard deviation.

II. SYSTEM MODEL

Material Collection

CARBON FIBER

Carbon fiber–reinforced polymer, carbon fiber–reinforced plastic or carbon fiber–reinforced thermoplastic (CFRP, CRP, CFRTP or often simply carbon fiber, or even carbon), is an extremely strong and light fiber-reinforced polymer which contains carbon fibers.

CFRPs can be expensive to produce but are commonly used wherever high strength-to-weight ratio and rigidity are required, such as aerospace, automotive and civil engineering, sports goods and an increasing number of other consumer and technical applications.

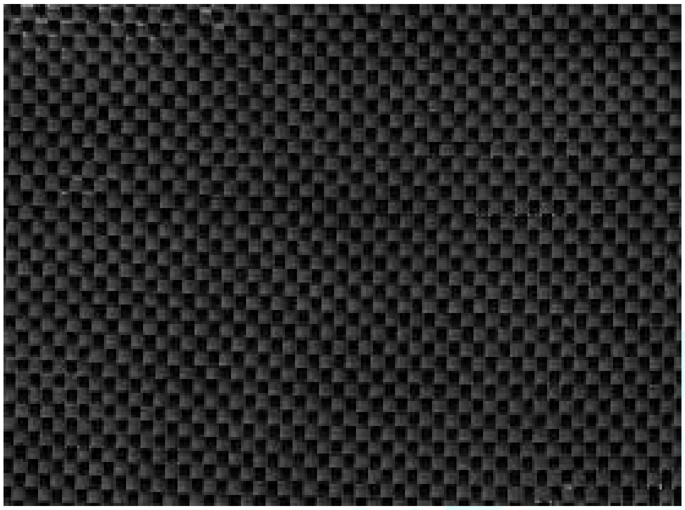

Fig. 1. Carbon fibre

BISPHENOL

Bisphenol is a carbon-based synthetic compound with the chemical formula $(CH_3)_2C(C_6H_4OH)_2$ belonging to the group of diphenylmethane derivatives and bisphenols, with two hydroxyphenyl groups. It is a colorless solid that is soluble in organic solvents, but poorly soluble in water and has been in commercial use since 1957.

BPA is employed to make certain plastics and epoxy resins. BPA-based plastic is clear and tough, and is made into a variety of common consumer goods, such as water bottles, sports equipment, CDs, and DVDs. Epoxy resins containing BPA are used to line water pipes, as coatings on the inside of many food and beverage cans and in making thermal paper such as that used in sales receipts.

Fig 2: Bisphenol

III. PROPOSED METHODOLOGY

Carbon Fibre Reinforced Plastics laminates are fabricated using hand lay-up technique. Resins are impregnated by hand into fibres which are in the form of woven, knitted, stitched or bonded fabrics. This is usually accomplished by rollers or brushes, with an increasing use of nip-roller type impregnators for forcing resin into the fabrics by means of rotating rollers and a bath of resin. Laminates are left to cure under standard atmospheric conditions.

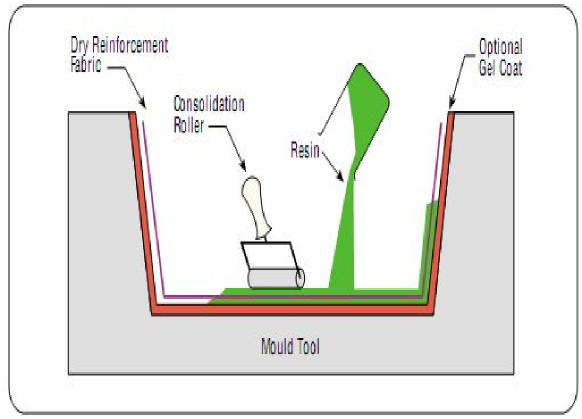

Fig. 3:Handlay up process

IV. SIMULATION/EXPERIMENTAL RESULTS

Using the Handlay up process preparing the specimen of one layer carbon fibre and bisphenol to four layer carbon fibre and bisphenol for composition of ratio 44:60 (carbon fibre and bisphenol) we obtain.

SPECIMEN

One layer carbon fibre and bisphenol resin

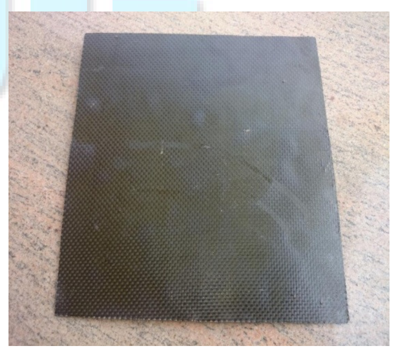

Fig 4: One layer composite

Fig 5: Four layer composite

V. CONCLUSION

The compatibility between resin and fibre is important in order to reach good mechanical properties. Expensive resin and fibre does not guaranty for optimal performance/properties, as the compatibility has to be tested.

Polymeric laminated composites present high strength-to-weight and stiffness-to-weight ratios when compared with metallic materials.

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