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A Review on Use of Soft Computing in Hybrid Composite Materials

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ABSTRACT:*This paper review the use of artificial intelligence in hybrid composite materials for mechanical optimization. In recent years there have been a lot of focus on utilizing the fibers of plants in effective and economic manner. This is because of their abundance in nature. The soft computing is taken to include the tools of artificial intelligence methods and techniques to solve the problem of manufacturer. The four main issues of production which are Design, planning, production and system level activities when optimized with the tools of artificial intelligence improves the performance of production industry. This paper deals with the various works of researchers which has application of new AI paradigms in manufacturing.*

Keywords:*Composite, Fiber, Mechanical properties, Soft Computing*

I.INTRODUCTION

Astructural material which consists of two or more constituents of material is called as composite material. It is a multiphase material which has significant proportion of properties of both constituent phase to realize the better properties of material. In recent years synthetic fiber based composite materials have been used in various application which includes industrial, appliances, sports, electrical ,automobile aeronautical etc.

They have good mechanical properties such as low heat conductivity, hardness, strength, low water absorption and resistance to abrasion. Natural resource have played vital role in manufacturing industry. Composite material which use natural fiber as raw material is produced at low cost. So use of natural fiber as reinforce in materials have been an important area of research. This article gives a brief review of intelligent computing method and its use in manufacturing industry.

II. APPLICATIONS OF HYBRID COMPOSITES

The advanced composite materials such as graphite, Carbon, Kevlar and Glass with suitable resins are widely used because of their high specific strength (strength/density) and high specific modulus (modulus/density) [1].

In principle several different types of fiber can be incorporated into a hybrid system [2] but in practice it is likely that a combination of only two types of fiber would be of most use.

Fiber epoxy composites have been used in aircraft engine to enhance the performance of the system[3]. The pilot's cabin door of aircrafts has also been made with hybrid resin composites and these are now used in other transport systems. Increasing demands on the performance of materials used in engineering applications necessitate the development of so-called adaptive, multifunctional, smart, or intelligent materials[4].All the structural elements have been made with Hybrid Fiber Reinforcement Plastics(GFRP & CFRP)[4,5]. The all HFRP solution was chosen for this bridge due to its heavily corrosive environment where the bridge is surrounded by the ocean.

Currently, the US Army uses helmets of a different design. These helmets, called PASGT helmets which are made using a composite comprising aramid fabric in a thermoset matrix. One overarching goal of the FFW helmet is to reduce weight compared to the PASGT helmet [6].

Conventionally railway use quad cables for communication as well as signaling. Due to change in technology & increase in applications of communications for data transmission optical fiber cables are now become backbone of communication. New hybrid cable design is made such that it reduces cost of installation & total cost of twoseparate cables. TheCopper conductor and types of fiber cable reinforcement & protection are provided based on requirement of the field[4,7].

Material selection is an interdisciplinary effort and it often requires different fields of study such as material science and engineering, mechanical engineering, industrial engineering and other experts in the field of application[8].

The current trend is to reduce the price of high-performance fibers and develop the reinforcing fibers with special function. Composite materials have characteristics of multi-component, so they will certainly develop into the multi-functional composite materials. Wecouldsaythatthe development direction to multi-function is an inevitable trend to play the advantages of composite materials.

III. ADVANCEMENTS IN FIBER HYBRID COMPOSITES

Manufacturing industry isexploiting composite material technology for structural components in order to obtain the reduction of the weight without decrease in machine quality and reliability[9].

Before selecting raw materials for composite manufacturing, it is mandatory to determine the appropriate manufacturing techniques.[11] This is important as it reduces the wastage of money, labor and time.

In practice, most composites consist of a bulk material (the matrix) and a reinforcement of some kind, added primarily to increase the strength and stiffness of the matrix[14].

The major improvement in the mechanical properties of composite material includes Stiffness, Dimensional stability, Corrosion Resistance, Specific strength, Failure strain Fatigue life design and optimum cost effectiveness[11,17].

Usual resins are polyesters, phenolic, melamine, silicone, polyurethane and epoxy. Mineral matrices, like silicon, carbide or carbon, are capable to withstand high temperatures[18].

The influences of strength of reinforcing ceramic particles as well as the mechanical and geometric properties of interphase boundaries on the peculiarities of mechanical response of TiC- reinforced NieCr metal-ceramic composite under dynamic loading was studied using model by Smolin, et al in [20].

Fiber inclusion of all types increased compressive strength, although this increase was not that significant and could have been obtained with simpler and moreeconomical methods like reducing water-cement ratio. High strength micro steel fiber OL 6/16 proved to be efficient in strengthening the matrix[21,22].

The mechanical properties of jute composites, except compression strength, can be significantly improved by effective hybridization with glass fiber as extreme glass plies[23].

The constituent fibers are intimately mixed such that no clusters of either type are present in the composite. Kalaprasad et al. [24] [25] have observed a considerable improvement in the in the mechanical properties of Low Density Polyethylene (LDPE) based short banana-glass fibers.

The present research work is undertaken to develop a new class of natural fiber reinforced polymer composite filled with ceramic filler and to study their mechanical and erosion wear behavior.The hybridization of natural fibers with synthetic fibers, which are stronger and more corrosion resistant are gaining much interest. The idea is that by using two types of fibers in a hybrid composite, the shortcomings of one can be compensated by the advantages of the other[26][27][28].

IV. SOFT COMPUTING IN COMPOSITE MATERIALS

The decision process underlying the development of engineering systems requires that a compromise be between usual conflicts and objective[29].The soft computing approach is appropriate to support this type of decision because itstechniques are very efficient at handling imprecise, uncertain, ambiguous, incomplete, and subjective data and information.

Y. Rostamiyan, et al in [34] explained that in order to optimize the mechanical properties of the nanocomposites, an artificial neural network was employed to generate a model, which was fed to a genetic algorithm that was then used to optimize the predicted mechanical properties.

For predicting the fatigue life of reinforced composite material Hany el Kaidi, et al in [37] derived a mathematical modelling based on Artificial Neural Network which was used by them as an alternative non linear modelling technique because of its ability of learning by training.

Soft computing techniques make it possible to create models and systems by exploiting the approximate reasoning and partial truth in order to mimic the remarkable decisions making ability of humans in real-life situations[40].

In composite materials development, this approach can facilitate an algebraic exploration and experimentation, which includes proofs, with various composite models before the commitment of more important materials engineering resources.

This will, in effect, facilitates an appropriate management of human efforts as well as natural materials and resources, particularly those that are susceptible to depletion[41][42][43].

Experimental data of consumption of Metal Matrix Composite collected were tested with artificial neural network technique[45].Multilayer perceptron model has been constructed with feed forward back propagation algorithm using the input parameters of cutting speed, cutting feed, and volume fraction of the reinforced particles. Output parameters were the thrust force and cutting torque. Experimental test, an ANN is used to validate the results obtained and also to predict the behaviour of system under any condition within the operating range.

V. CONCLUSION

In this paper a review on application of artificial intelligence in hybrid composite material is been done and found out he conclusion that it is used to develop a mathematical model which can be used to optimize the mechanical properties of hybrid composites. Various others have implemented techniques like Neural network, Fuzzy logic and Genetic algorithm for formulating a mathematical model.

Decision making problems in the production industry regarding raw material and selection of composite material which is optimized can be easily done by using techniques of soft computing.

This review brings out the fact that new AI paradigms which consists of integrated modular and hybrid nature of intelligent computing can enhance the performance of production industry.

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