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AN ART OF REVIEW ON DYNAMIC BEHAVIOR OF SiC PARTICULATE REINFORCED POLYMER COMPOSITE BEAMS

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ABSTRACT

In the current work attention is made in the first stage on various ways of design and modeling for preparation, fabrication of SiC particulate reinforced in polymer composite materials. In the second stage, interest is drawn in different numerical methods, finite element methods and experimental methods to learn dynamic behavior and corresponding natural frequency and mode shape of beam type structures which are carried out by previous researchers. At present a few different techniques like volume fraction, mixture rule, orientation and weight fraction are studied which are considered by previous researchers. Different numerical methods like Euler's differential method, Timoshenko's beam theory, wavelet method and strain energy method are studied to learn vibration of beam type structures.

KEYWORDS- composite, beam, design, Euler's, mode shape, frequency.

INTRODUCTION

Presently engineering materials are key parameter to bring cost effective revolution in industries like automobile industry, army, marine, aircraft industry, etc. Today, industries are facing challenges how to increase mechanical properties, physical properties, and thermal properties of engineering materials. In this domain composite materials have quite noticeable properties which bring together all desired properties to overcome present industries challenges. From last two decades researchers are working in this challenging subject to bring revolutionary composite materials which will have moderated properties. Engineering structural elements made up of composite materials have shown low density, high stiffness, and other desired properties. Composite material can design as per requirement of improved/lowered desired material properties by the industry whereas traditional materials have no such properties. This is the very important key aspect of composite materials, so every industry has rushed towards design and modeling of composite materials which will be the substitute of traditional materials. Particulate reinforced composites have significant role in industry to meet their challenges.

Keeping these above challenges, at the present, challenges are taken to understand various composite material design, modeling and fabrication methods which have carried out by previous researchers. The design, modeling, fabrication of composite materials and vibration analysis are carried out by researchers as follows in Section 2.

ART OF REVIEW

Jones (1975); Christensen, (1979); Tsai and Hahn (1980); Hull (1981); Halpin (1984); have presented different methods to prepare particulate composite materials and mechanical formulations for finding properties with refer to weight fraction of fibers and matrix in composite materials. Vinson and Sierakowski (1986) have derived mathematical expression for composite beam/plate in dynamic surroundings considering various load conditions like axial loading, bending moment, and shear force. They have also discussed the mixture formulae to get the various physical and mechanical properties for different fiber fraction in composite materials. Gibson (1994) has given the different techniques about the manufacture process of composite material. Phillip and Enmanuel (1994) have investigated the design, synthesis, and characterization of Polymer-ceramic nanocomposites. They have worked to form a new polymer-ceramic nanocomposite with unique properties; they pointed on the use of mica-type silicates (MTS). They have also discussed its effect in their composite material. Alexandere & Dubois (2000) have investigated a new class of material which is based on smetite class usually rendered hydrophobic through ionic exchange of the sodium interlayer cation with an onium cation. i.e. (Polymer-layered silicate nanocomposite) they found exhibits enhanced properly even at very lower filler level. Such as Young's modules, storage modules thermal stabilities, Gas barrier Properties & Good Flam resistance. Chisholm et al. (2004) have designed laboratory setup to prepare nano-composite material. They have synthesized nano-composite material by doping SiC in epoxy resin at room temperature. During the preparation of mixture they have used vacuum transfer molding technique. They have investigated mechanical properties and impact test at low velocity on it. They have found enhance of mechanical properties. They have also observed that by infusion of nano size SiC particles, the samples exhibit high rates of strain. Edson et al. (2005) have studied the effect of moisture in mechanical properties of carbon/epoxy composite materials. They have found experimental that bidirectional composites ([0/90]s and [±45]s) leads to a lower rate of moisture absorption as compared to unidirectional reinforced composites due to the edges effect. Suresha et al. (2006) have examined the comparative performance of glass-epoxy composite system interfaced with graded fillers has been examined. in this study they have used a Pin-on-Disc type wear tester for investigation of composite material under varying load and sliding velocity. It was observed that the graphite filled G.E composite shows lower coefficients of friction than the other two composites irrespective of variation in the load/sliding velocity. Among the different filler material, they have observed SiC filled G-E composite exhibited the max wear Resistance. Wrobel et al. (2009) have investigated fatigue life and ageing of polymer composite material by non-destructive method. They have numerically modeled the equation using finite element method and simulated dynamic acoustic under thermal surroundings. They have studied the changes of physical properties of composite structure like stiffness, acoustic wave propagation velocity and thermal conductivity under the model structural and parametric modifications. Muthirakkal et al. (2010) have studied the moisture absorbed behavior of polymer composite in humidity and tropical surroundings. They have found that Vinylester/carbon samples shown better to epoxy/carbon in all the test conditions. Zhang et al. (2011) have demonstrated that the combined carbon nanofibers and microsized short carbon fibres on epoxy leads to significant improvement in the mechanical properties of the matrix. It was revealed that the combined use of SCFs and silica the nanoparticles exerts a synergetic effect on the mechanical properties and fracture properties of Epoxy. Jianing Gao, Junting Li et al. (2012) have observed during experimental process that the particles were synthesized by a sequential reversible addition-fragmentation chain transfer (RAFT) polymerization. The inner rubbery block poly (n-hexyl methacrylate) (PHMA) had a glass transition temperature below room temperature. The outer block poly (glycidyl methacrylate) (PGMA) was matrix compatible. Both systems enabled cavitation or plastic dilatation. Improvement of the strain-to-break and the tensile toughness was found in both systems. Rojek et al. (2013) have worked on alternative composite armor plate which is provided resistance to bullet fired from arm weapons. They have investigated this proving resistance in epoxy glass fabric composite sheets by punching and destructive techniques. Begum K.& Islam M.A, (2013) on their research they have compared natural fiber reinforced polymer composites with the glass fiber reinforced polymer composite and they conclude that NFRPS is the alternative to SFRPS in many application for their many advantages. Islam et al. (2013) they were reviewed the effect of weight fraction of nanoparticles on mechanical behavior of silica-epoxy nanocomposites and they got the following conclusions: (1) Increasing of Young's modulus, tensile stress, and yield stress with rigid particles and these values are decreased for soft particle, (2) the tensile strengths, compressive strengths, Young's modulus, flexural strength, flexural modulus and fracture toughness increases with increasing of particle loading. Alhuthali and Low have taken vinyl-ester/nano-silicon carbide nanocomposites and they have investigated its mechanical and fracture properties. They have observed that the addition of nano-SiC particles increases the magnitude of modulus and strength, but it reduces toughness. Nadia et al. (2014) have studied thermal and mechanical properties of new composite materials of palm fibers reinforced in natural mortar. In their investigation, they have fabricated this composite with different weight percentage and three different sizes of fibers. They have found that this composite material is a suitable thermal insulating material for insulation of buildings and energy. Mohan et al. (2014) have prepared two verities of composite materials: first material is glass fabric with epoxy and second material is SiC dopped in glass fabric with epoxy. They have studied their mechanical properties and wear resistance under different loading and temperature environment. They have observed the composite with SiC filler shows higher friction resistance but low wear rate as compared to composite of glass fabric with epoxy under same loading conditions. Arpitha et al. (2014) have prepared composites (using sisal/glass/Sic fiber reinforced epoxy) and they have examined and observed their properties by laboratory test for example tensile strength, flexural strength and impact strength. They have concluded that composites without filler (SiC) have exhibited good results over composites with filler (SiC). Sanjay et al. (2014) have studied natural fiber reinforced polymer composite. They have prepared composites by using weight fraction ratios. They have compared their mechanical properties by laboratory testing. From the testing results, they have concluded that the composite with combination of 50% jute + 50% glass fibers shows good tensile and impact strength as compared to other weight fraction ratios, whereas the composite of composition of 40% Jute-60% glass fibers shows good flexural strength as compared to other weight fraction ratios. Chao Chen et al. (2014) have taken silver nanowires (AgNWs) to distribute or spread homogeneously in epoxy resin. They have used silica-coated silver nanowires (AgNWs@Sio2) with epoxy. In experimentally, they have found that the thermal conductivity of epoxy/AgNWs@Sio2 composite is higher than those epoxy/ AgNWs composite with the same loading.

Jena et al. (2012) have derived mathematical expression for vibration of beam with different boundary conditions. Parhi et al. (2014) have studied the various beam structures behavior in dynamical surroundings and their vibration parameters under different boundary conditions and loading. Jena et al. (2014) have worked on vibration behavior of fiber reinforced composite beam. They have stated the fiber distribution and orientation have a role on mechanical properties as well as stiffness of the composite beam. They have used finite element method to learn the vibration mode shape and natural frequency of composite beam. Further, Jena et al. (2015) have successfully applied the finite element method to examine the vibration parameters of aluminium metal matrix composite + SiC produced in plunger techniques.

CONCLUSION

From the different investigations for design, modeling, numerical methods, and finite element method, it is understood that weight fraction, volume fraction are the two key parameters of composite beam to improve stiffness of the beams. Further it is concluded that in the future work, weight fraction will be considered to design and modeling of SiC particulate reinforced composite beams and Euler's beam theory will be derived to learn the vibration parameters i.e. natural frequency and corresponding mode shape.

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