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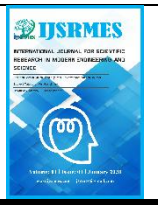

A SURVEY APPROACH OF NUMERICAL CALCULATION OF ULTIMATE TENSILE STRENGTH OF COMPOSITES

Ranveer Singh[1]*, Pulivarti Srinivasa Rao[2]

[12]Department of Mechanical Engineering, Christian College of Engineering & Technology, Bhilai (C.G.), India.

Abstract

Die casting enables the production of thousands of consumers, commercial, and industrial products in high volumes, accommodating components of varying sizes from small to large making it a prime example of mass production. Die casting is widely employed across the industry due to its high productivity and minimal need for post-machining. Because of its lightweight nature and excellent formability, aluminum die casting is crucial in manufacturing transportation and vehicle parts. Some die-cast products were defective, so the process's performance needs improvement. The aim of this study is to assess how injection pressure considering both process and dimensional factors affects the dimensional stability of die-cast components. To study the effect, a RSM model combined with GA was created for each response, using process parameters like injection pressure. ANOVA for each response has also been conducted to identify the influencing factors and their interactions.

Keywords: *Die Casting Process; Gating; Process Parameter, Response; Optimization.*

* *Corresponding author*

1. Introduction

Composite materials consist of two or more distinct components engineered or naturally occurring that possess very different physical and chemical properties. These constituents retain their individual characteristics at both macroscopic and microscopic levels within the final structure. These are materials that consist of strong load-bearing components called reinforcement, embedded within a weaker material referred to as the matrix. Reinforcement adds strength and stiffness, aiding in bearing structural loads. The matrix or binder whether organic or inorganic holds the reinforcement in place and ensures its proper alignment. The reinforcement can consist of particles, platelets, or fibers and is typically incorporated to enhance mechanical properties like stiffness, strength, and toughness in the matrix material. Fibers aligned with the direction of loading provide the most effective transfer of load. Among the following properties that can be enhanced by forming composite materials are wear resistance, fatigue life, stiffness, thermal insulation, corrosion resistance, strength, acoustical insulation, and temperature-dependent behavior, among others.

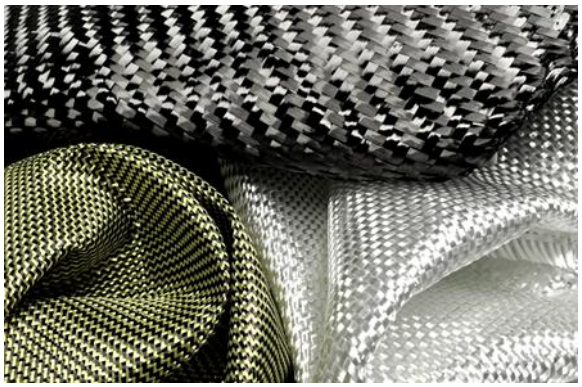

Figure 1. Composite Material

2. Types of Composites

Broadly speaking, composite materials can be categorized into three groups based on the type of matrix material.

- Polymer matrix composites
- Metal matrix composites
- Ceramic matrix composites
- Hybrid composites

3. Characteristics of Composite Material

The characteristics of composite material are as followings:

a. High specific modules and strength
b. High fatigue strength
c. Anisotropic nature
d. Corrosion resistance and durability
e. Low coefficient of thermal expansion

4. Literature Review

Maria Virginia Quintana et al. [1] they have presented an analysis of the free vibration of plates using the Ritz variational method, with internal hinges arranged along a straight line. First-order shear deformation theory is employed to model the plate, which features symmetric stacking sequences. The results demonstrate how line hinge parameters influence natural frequencies and mode shapes in symmetric multilayered plates.

M. Amabili et al. [2] they have compared the first and higher order shear deformation theory and classical Von Karman theory for study of nonlinear forced vibration of laminate composite and isotropic plates. In which the

boundary condition of plates is simply supported with immovable edges. In this study the frequency response curves for large amplitude vibration is almost same in all the three theories for isotropic material but for laminated composite plate for thick plate difference arises and for thin plate again it is almost same for all the three theories.

A. V. Borgaonkar et al. [3] they have used Statistical Energy Analysis (SEA) to study the vibrational response of idealized subsystem made up of composite material theoretically. This analysis method largely depends on the damping loss factors, the modal densities and coupling loss factors of the subsystem. In which for rectangular composite plate of fibre glass modal density obtained by theoretically and experimentally. Also analyse the effect of ply orientation on modal density for same sized plate.

Sang Kwon Lee et al. [4] they have presented the analysis of effect of various ply orientation on acoustic and vibration responses of rectangular CFRP plates. First the harmonic force is applied to calculate vibration and acoustic response for CFRP plates theoretically and compared it with numerical solutions. Experimental solution is also presented for acoustic and vibration response of CFRP plates.

S. Sarangan et al. [5] they have used non-polynomial zigzag theories with finite element formulation for prediction of free vibration and bending analysis of sandwich and laminated composite plates. In which the mathematical model is combination of non-polynomial shear strain functions and zigzag theories and the variation of transverse displacement is constant.

S. Ganesh et al. [6] they have analysis the free vibration analysis of composite plate using equivalent single layer theory with finite element method. In which two types of boundary condition have taken i.e. cantilever type and simply supported type. They also calculate the deformation in composite plate at various points by analytical and computational approach.

R. Muni Rami Reddy et al. [7] they have worked thin and thick multilayered composite plate of graphene nano-platelets for the analysis of free vibration behavior by first order shear deformation theory with finite element approach. Using Halpin-Tsai model effective young's modulus and distribution type calculated for each layer of composite plate. Mass density and Poisson's ratio are calculated by rule of mixture.

Nayak et al. [8] they have presented Glass-carbon/epoxy hybrid composite panels for parametric study of vibration and buckling by experimental and numerical investigation. In which the effect of lamination sequence is also calculated for natural frequencies of vibration and buckling strength. FFT analyser, accelerometer and impact hammer excitation are used for study of vibration.

Mehar et al. [9] They have numerically computed the nonlinear bending responses of the MW-CNT-reinforced composite plate using a newly developed higher-order nonlinear finite element model. The current developed model is verified by comparing its numerical outcomes with established benchmark data and additional experi-

mental results gathered internally. In the present theoretical analysis, the effective material properties of the composite plate are determined via the MoriTanaka method. For the experimental analysis, the MW-CNT reinforced composite plate is manufactured using the hand lay-up method.

Shelly Simcha and others [10] They have concluded, based on experimental results, that a Titania coating prepared via the sol-gel method is a superior surface treatment for boosting the thermo-mechanical properties of epoxy nanocomposites, without substantially raising viscositya key factor for filament winding resin systems. An increase of up to approximately 10% in Tg has been realized for the two epoxy systems incorporating 0.050.3 wt% of titania-coated MWCNT. The storage modulus has increased by 30% in the LY556/ Amine hardener A/DY026 matrix incorporating 0.3 wt % titania-coated MWCNT.

5. Conclusions

In this chapter, detailed discussions about the thermal effect and flow effect field characteristics of vortex tube with different nozzle inlet shape, number of nozzles, and axial angle have been presented. For 3-D space, a 3-D model and for viscous models a k-ε (2 equa.), simulation has been required at a steady state time dependency with RNG turbulence model with a standard wall function condition has been considered for present models.

References

[1] M. V. Quintana and J. L. Raffo, “AC SC,” 2018.

[2] M. Amabili and S. Farhadi, “ARTICLE IN PRESS Shear deformable versus classical theories for nonlinear vibrations of rectangular isotropic and laminated composite plates,” vol. 320, pp. 649–667, 2009.

[3] A. V Borgaonkar, M. B. Mandale, and S. B. Potdar, “ScienceDirect Effect of Changes in Fiber Orientations on Modal Density of Fiberglass Composite Plates,” vol. 5, pp. 5783–5791, 2018.

[4] S. Kwon et al., “International Journal of Mechanical Sciences Effect of fi ber orientation on acoustic and vibration response of a carbon fi ber / epoxy composite plate : Natural vibration mode and sound radiation,” vol. 117, pp. 162–173, 2016.

[5] S. Sarangan, B. N. Singh, and B. N. Singh, “Evaluation of Free Vibration and Bending Analysis of Laminated Composite and Sandwich Plates using Non-polynomial Zigzag Models : C 0 Finite Element Formulation,” 2017.

[6] G. Shankar, S. K. Kumar, and P. K. Mahato, “Thin-Walled Structures,” vol. 116, no. March, pp. 53–68, 2017.

[7] R. M. R. Reddy and W. Karunasena, “Free vibration of functionally graded-GPL reinforced composite plates with different boundary conditions,” vol. 1, pp. 1–10, 2018.

[8] N. Nayak, S. Meher, and S. K. Sahu, “Experimental and Numerical Study on Vibration and Buckling Characteristics of Glass-Carbon / Epoxy Hybrid Composite Plates,” 2013.

[9] K. Mehar and S. K. Panda, "Large deformation bending responses of nanotube-reinforced polymer composite panel structure : Numerical and experimental analyses," vol. 0, no. 0, pp. 1–10, 2018.

[10] S. Simcha, A. Dotan, S. Kenig, H. Dodiuk, S. College, and R. Gan, "Characterization of Hybrid Epoxy Nanocomposites," pp. 348–365, 2012.