ISSN: 2454-1311

Damping Analysis of Composites Used in Drilling Machine Bed

Sachin Kumar Kashyap, Abhishek Yadav, Deepak Garg

Department of Mechanical Engineering, MIET, Shahabad, Kurukshetra, Haryana , India

***Abstract*— *Vibrations are generally occurs during the machining process as drilling, milling etc. which is the main cause of defects in the machine tools. So vibrational damping study is very necessary for minimizing the vibrational effect on the machines bed. At present work glass fiber epoxy and glass fiber polyester are the composites used as the drilling machine bed as a base of the work piece. The purpose of the paper is to analyze the damping of sandwich composites used in this work is calculating by the energy balance approach method.*

Keywords*— *Damping, Energy balance approach, Glass fiber epoxy, Glass fiber polyester, Vibration.

I. INTRODUCTION

1.1 Damping

Damping is an influence within or upon an oscillatory system that has the effect of reducing, restricting or preventing its oscillations. In physical systems, damping is produced by processes that dissipate the energy stored in the oscillation.

Fiber reinforced composites are used as alternatives for conventional materials primarily because of their high stiffness, specific strength etc. Vibrational damping is an important parameter related to the study of dynamic behavior of fiber reinforced composites structures. Generally the damping of metals structures is low but for fiber reinforced material the damping is higher and depends upon the constituent properties.

II. LITERATURE REVIEW

Damping of materials and members in structural mechanics around 2000 results found by Lazan, B. J. [1].Haranath, S. Ganesan found that improvement can be done by different applied damping treatments [2]. A survey on damping capacity of fiber reinforced composites and found fiber reinforced composites have high damping capacity than structural metallic materials by Bert, C.W. [3]. Vibration Damping study by Nashif, A.D, Jones [4].Research on damping in fiber-reinforced composite materials have done by Chandra, Singh S.P [5]. The behavior of material damping of composites assumed as description of viscoelasticity by Gibson [6]. Prediction of material damping of laminated polymer matrix composites analyzed by Sun, C.T [7] and Morison W.D [8]. A study is conducted on damping and modulus of elasticity by Kinra [9]. Finite element method using in the transverse shear deformation on the modal loss factors and the natural frequencies of composite laminated plates by Koo K.N [10]. Singh S.P analyze that the Damped free vibrations of composite shells assumes a uniform distribution of the transverse shear across the thickness [11]. R. Chandra gives a review on damping studies in Fiber reinforced composites [12]. An Experimental Analysis of Passive Damping Technique on Conventional Radial Drilling Machine Tool Bed using Composite Materials and found optimum results by Krishna Mohana Rao [13]. Mustapha Assarar found the damping result of sandwich materials [14]. K Lavanya Analyze the damping characteristics of glass fibre reinforced composite with different orientations and Viscoelastic layers [15].

III. DAMPING CALCULATION

The loss factor η is commonly used to characterize energy dissipation, due to inelastic behaviour, in a material subjected to cyclic loading. Assuming linear damping behavior

$$\eta = \frac{1}{2\pi}\frac{\Delta w}{w}$$

where ΔW is the amount of energy dissipated during the loading cycle and W is the strain energy stored during the cycle. Assume

η_1– normal loading in fiber direction

η_2– normal loading perpendicular to fibers

η_{12}-inplane shear loading

In case of Glass fiber polyester material damping for single plate is

Material damping = $\dfrac{\eta_1+\eta_2+\eta_{12}}{60}$ = 0.0013

In case of Glass fiber epoxy material damping for single plate is

Material damping = $\dfrac{\eta_1+\eta_2+\eta_{12}}{60}$ = 0.0011

In case of sandwich plates of materials damping is

Material damping $= \eta_1 \frac{W_2}{W} + \eta_2 \frac{W_1}{W}$

$W_1 = 0.43$ kg, for Glass fiber polyester
$W_2 = 0.37$ kg, for Glass fiber epoxy
Material damping = 0.0012

IV. RESULTS

For a single plate of glass fiber polyester and epoxy material damping is 0.0013 and 0.0011.
And for different number of plates is given in table 4.1.

Table 4.1 Material damping of the composite layers

No. of Plates	Glass fiber Polyester	Glass fiber Epoxy
1	0.0013	0.0011
2	0.0024	0.0020
3	0.0036	0.0030
4	0.0048	0.0040

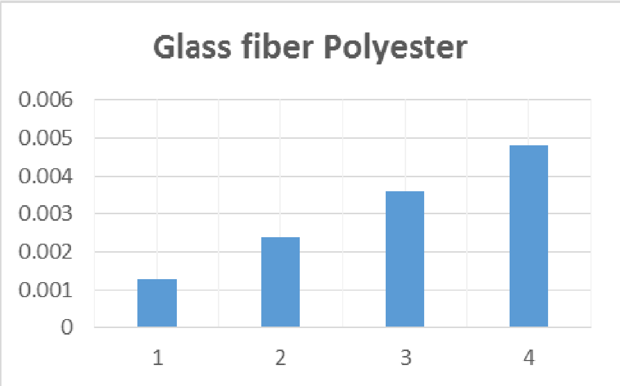

Fig. 4.1 No. of Plates Vs Damping of Glass fiber Polyester

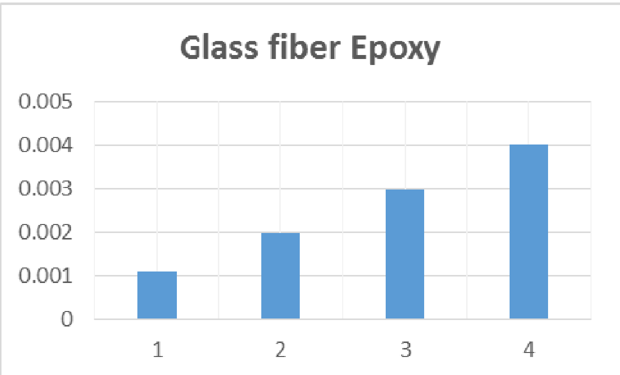

Fig. 4.2 No. of Plates Vs Damping of Glass fiber Epoxy

And for sandwich plates is given in table 4.2

Table 4.2 Material damping of the Sandwich plates

Number of plates	Sandwich plates
2	0.0012
4	0.0022
6	0.0033
8	0.0044

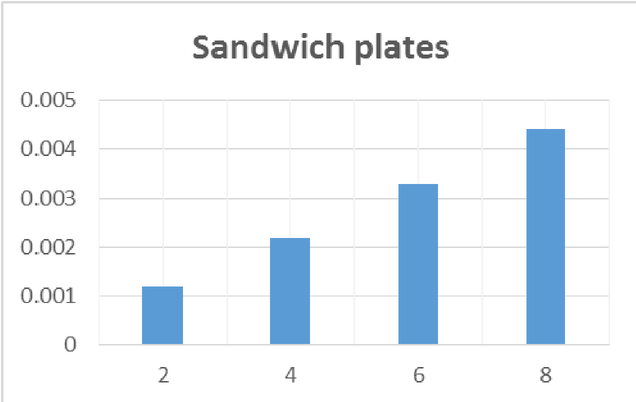

Fig. 4.3 No. of Plates Vs Damping of Sandwich plates

V. CONCLUSION

Considerable research in the area of vibrational damping of composites has validated that fiber reinforced composites posses good dynamic properties as well as high damping. Damping has been characterized extensively for extensional mode, whereas there is need of developing models for transverse and shear modes. There is need to study the effect of stress and amplitude of vibrations on damping in composites specially fiber reinforced composites both in the linear and non linear range as these composites has good dynamic properties. The matrix phase has the important role for analyzing the damping. As result is concluded that damping of glass fiber polyester and glass fiber epoxy is increases with increase in number of plates and also sandwich plates have good damping capacity as compared to other metallic structural materials.

REFERENCES

[1] Lazan, B. J., "Damping of Materials and Members in Structural Mechanics". Pergamon Press, London (1968).
[2] Haranath, S. Ganesan, N. and Rao, BVA."Dynamic analysis of machine tool structures with applied damping treatment".

[3] Bert, C.W., "Composite materials: A survey or the damping capacity of fiber reinforced composites in damping applications for vibration control Nashif, A.D, Jones, D.I.G and Henderson, J.P. Vibration Damping, Wiley, New York, (1985).
[4] Nashif, A.D, Jones, D.I.G and Henderson, J.P. Vibration Damping, Wiley, New York, (1985).
[5] Chandra, R., Singh S.P, and Gupta.K Damping studies in fiber-reinforced composites—a review.
[6] Gibson, R.F., Chaturvedi, S.K. and Sun, C.T., "Complex moduli of aligned discontinuous fiber-polymer composites" and "Internal damping of short-fiber reinforced polymer matrix composites.
[7] Sun, C.T , Wu, J.K. and Gibson, R.F., "Prediction of material damping of laminated polymer matrix composites''.
[8] Morison W.D, "The prediction of material damping of laminated composites",
[9] Kinra, V.K., Wren G.G., Rawal S.P. and Misra. M.S. "On the influence of ply-angle on damping and modulus of elasticity of a metal-matrix composite.
[10] Koo K.N, Lee.I."Vibration and damping analysis of composite laminates using deformable finite element". AIAA J; 31 (4): 728-35,(1993).
[11] Singh S.P., Gupta K., "Damped free vibrations of layered composite cylindrical shells".
[12] R. Chandra, S.P. Singh"Damping studies in Fiber reinforced composites" IIT, Delhi(1999).
[13] Krishna Mohana Rao. G, and Vijay Mohan. S "Experimental Analysis of Passive Damping Technique on Conventional Radial Drilling Machine Tool Bed using Composite Materials", International Journal of Mining, Metallurgy & Mechanical Engineering (IJMMME) Volume 1, Issue 2 (2013) ISSN 2320–4060.
[14] Mustapha Assarar "Analysis of the Damping of Sandwich Materials and Effect of the Characteristics of the Constituents" International Journal of Material Science (IJMSCI) Volume 3 Issue 2, June 2013
[15] K Lavanya "Analysis of the damping characteristics of glass fibre reinforced composite with different orientations and Viscoelastic layers" International Journal of Conceptions on Mechanical and Civil Engineering Vol. 1, Issue. 1, Dec' 2013; ISSN: 2357 – 2760.