GLOBAL JOURNAL OF ENGINEERING SCIENCE AND RESEARCHES

Analysis of Pottery Clay Adhesive Through Bump and Random and Sine Vibration Tests

M.S.Vijaykumar[1], Dr. R.Saravanan[2] and Dr.D.SARAVANA BAVAN[3]
[1]Research Scholar, Mechanical Engineering Department, Jain University, Bangalore
[2]Assistant Professor, Mechanical Engineering Department University Visvesvaraya College of Engineering, Bangalore University, Bangalore
[3]Associate Professor, Mechanical Engineering Department, Dayanand Sagar University Bangalore

ABSTRACT

Three lap joint specimens were prepared with adhesive by using pottery clay of 45 microns/resin/hardener/paint hardener and were subjected to bump test, random vibration test and sine vibration test in all the three axes (X,Y,Z). The tests were carried out in cantilever and simply support mode and the shear strength results were found satisfactory.

Keywords- *Pottery clay, Bump test etc.*

I. Introduction

The present study analyzed the lap joint specimens prepared with adhesive by using pottery clay of 45 microns/resin/hardener/paint hardener and were subjected to bump test, random vibration test and sine vibration test in all the three axes (X,Y,Z).

II. Literature Review

He and Oyadiji (2001) found that the transverse natural frequencies of the single lap joint cantilever beams increase with increase of young's modulus of adhesive but does not change significantly with increase of poisson's ratio. Stiffer adhesive is more prone to fatigue failure than softer adhesive.

Davies and Sohier (2009) examined the physico-chemical and mechanical behaviour of aluminium substrates bonded with epoxy adhesive joints of different thicknesses. There is no evidence that changing the joint thickness results in significant modifications to the polymer structure, the interface region nor the presence of defects for this assembly, over the range from 0.2 to 1.3 mm. For adhesively bonded aluminium assemblies tested using the modified Arcan fixture a small influence of bond line thickness was noted under shear and tension/shear loads; a small reduction in mechanical properties was noted as bond line thickness was increased.

Prashant Sudiranjan Rade et al. (2013) developed a mathematical model for optimized joint conditions ensuring maximum shear strength for different lap joints.

Kadam et al. (2015) found that, for the same adhesive thickness and material properties the stress induced is directly proportional to the load applied. As stress induced has negative effect on the joint strength, the strength of the joint is decreased with the increase in the adhesive thickness. Further it is observed that the finite element predictions for Von Mises stresses agree well with the experimental results.

Silva et al. (2016) undertook a study of various mixed joints configuration under static and impact conditions. A new experimental technique was developed to manufacture Single Lap Joint with mixed adhesive layers with a minimum amount of defects. The use of a ductile adhesive at the ends of the overlap combined with a brittle adhesive, such as the combination of DP-8005 and AV138, improves the maximum strength of the joints in quasi-static tests. The tests also demonstrated that the mixed adhesive technique increases with the use of longer overlaps, especially when a ductile adhesive is combined with a very stiff one. Impact tests revealed that this type of improvement also happens under high strain rates, where the mixed configuration of DP-8005 and AV138 achieved an even higher increase in joint strength for impact conditions.

 ISSN 2348 – 8034
Impact Factor- 4.022

III. Methodology

Bump test: Three lap joint specimens were prepared with adhesive by using pottery clay of 45 microns/resin/hardener/paint hardener and were subjected to bump test in all the three axes (X,Y,Z).

Specifications:

- Acceleration: 25 g
- Pulse duration: 6ms half sine
- Frequency: 2-3 bumps/sec
- No of bumps: 100

Random vibration test: Three lap joint specimens were prepared with adhesive by using pottery clay of 45 microns/resin/hardener/paint hardener and were subjected to random vibration test in all the three axes (X,Y,Z).

Specifications:

- 20-50Hz, $0.02g^2$/Hz falling to 0.001 g^2/Hz at 500 Hz.
- Duration: 15 minutes per axis in all the three axes

Sine vibration test: Three lap joint specimens were prepared with adhesive by using pottery clay of 45 microns/resin/hardener/paint hardener and were subjected to sine vibration test in all the three axes (X,Y,Z).

Specifications:

20-50Hz, $0.02g^2$/Hz falling to 0.001 g^2/Hz at 500 Hz

Duration: 15 minutes per axis in all the three axes

Methodology employed:

- Cantilever mount method of Lap shear samples.
- Simply support mount method of Lap shear samples.

Method 1:-

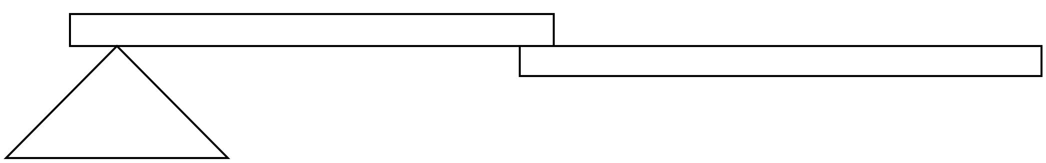

Figure 1.:– Cantilever mount method.

Method 2:-

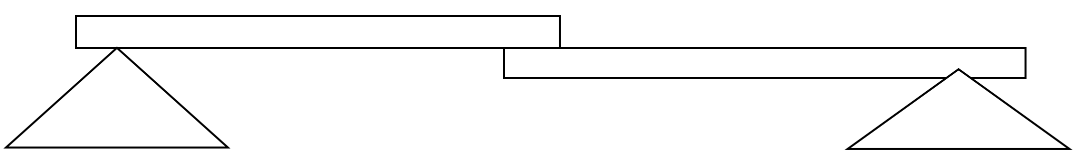

Figure 2: - Simply supported mount method.

Sl No of Lap shear samples	Bump test	Random Vibration test	Sine Vibration test	Results
A	X axis	X axis	X axis	No external physical abnormalities are found in the samples
B	Y axis	Y axis	Y axis	
C	Z axis	Z axis	Z axis	

Table I. Results of Lap shear samples-Cantilever type method

Sl No of Lap shear samples	Bump test	Random Vibration test	Sine Vibration test	Results
A	X axis	X axis	X axis	No external physical abnormalities are found in the samples
B	Y axis	Y axis	Y axis	
C	Z axis	Z axis	Z axis	

Table II. Results of Lap shear samples- Simply support type method

Clay adhesive (45 micron)	Sl. No.	Bonding Length (mm)	Bonding Width (mm)	Load at failure (Kgf)	Shear Strength (Mpa)
	1	12.5	25.4	320.22	9.89
	2	12.7	25.5	331.02	10.03
	3	12.6	25.7	347.55	10.53

Table III. Shear Strength of Lap shear samples (Before vibration)

Sl. No.	Bonding Length (mm)	Bonding Width (mm)	Load (Kgf)	Shear Strength (Mpa)
A	12.9	25.3	336.33	10.11
B	12.8	25.76	341.92	10.17
C	12.9	25.7	349.3	10.34

Table IV. Shear Strength of Lap shear samples (After vibration)

IV. Conclusion

- Bump and Random and Sine Vibration tests were conducted for all the samples in both cantilever method and simply support method and the results were found satisfactory.
- Shear Strength of Lap shear samples before and after vibration tests were found to be within the limits 9.71 to 11 MPa.

References

[1] Davies, P. Sohier L. , Cognard, J.Y.(2009), 'Influence of adhesive bond line thickness on joint strength', International Journal of Adhesion and Adhesives, Vol, 29, Issue 7, pp. 724-736.

[2] He X., Oyadiji S.O. (2001), Influence of adhesive characteristics on the transverse free vibration of single lap jointed cantilevered beams', Journal of Materials Processing Technology, Vol. 119, pp. 366-373.

[3] Kadam M.S., Pankaj Firake, Pawar K.K. (2015) 'Finite element analysis of single lap adhesive joint using RADIOSS', IOSR Journal of Mechanical and Civil Engineering, pp. 66-76.

[4] Prashant Sudiranjan Rade, Dheeraj Deshmukh, Swapnil Kulkarni (2013) 'Enhancement of shear strength of adhesive joint using geometrical changes on lapped surfaces', International Journal of Advanced Engineering Research and Studies, Vol. III, No. I,pp. 40-42.

[5] Silva M.R.G., Marques E.A.S., Da Silva F.M. (2016) 'Behaviour under impact of mixed adhesive joints for the automotive industry', Latin American Journal of Solids and Structures,Vol. 13, pp. 835-853.