International Journal of Innovative Studies in Sciences and Engineering Technology (IJISSET)

ISSN 2455-4863 (Online) www.ijisset.org *Volume: 2 Issue: 5 | May 2016*

Ultrasonic Plastic Welding Of Glass Fiber Reinforced Plastic

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Abstract: *Ultrasonic welding has received significant attention during past few years due to their suitable applications in comparison to conventional fusion welding techniques. The ultrasonic plastic welding of Glass Fiber Reinforced Plastic (GFRP) is of great challenge nowadays. The welding of GFRP is found to be used in major applications in the field of medicine, textiles, electrical, packaging etc. The Strength of ultrasonically welded GFRP depends on process parameters like pressure, weld time, thickness ratio, and amplitude. This study involves Hold Time (HT), Weld Time (WT) and Delay Time (DT) as the major parameters. The effect of welding parameters has been studied in this project in which only weld time is the variable parameter. The GFRP specimens are welded for different parameters and found to be having sound weld joints. The shear strength of weld specimens was analyzed showing the effect of weld time. The value of shear strength is found to be increased with increase in weld time..*

Keywords: *Ultrasonic Plastic Welding, Glass Fiber Reinforced plastic, Shear Strength*

1. INTRODUCTION

Ultrasonic plastic welding involves the use of high frequency sound energy to soften or melt the thermoplastic at the joint. When welding thermoplastics, the thermal rise in the bonding area is produced by the absorption of mechanical vibrations, the reflection of the vibrations in the connecting area, and the friction of the surfaces of the parts. The problem in welding the plastic is that it gets difficult when we have reinforcement combination. Aurther levy et al [1] discussed the efficiency of process and Brijesh N Patel [2] studied the effect of welding parameter for welding plastic materials. Glass fiber used was reinforced in the matrix of Vinyl ester resin. The weld parameters include Delay Time, Hold Time and weld time. Rashiqah rashil et al [3] studied the optimal parameter for welding of plastics using Taguchi method. Here in this study reference to the above said paper the parameter are set varying only the Weld time. The present study gives the effect of Weld time over the strength of the weld joints. By knowing the higher value for different Weld time, an optimum parameter is found for the welding of GFRP.

2. MATERIALS AND METHODS

2.1 Material Selection

The material selected for the study is Glass fiber as the reinforcement material. The resin used here is Vinyl Ester. The material combination is chosen for better strength for the weldment. The Glass fiber analysis is shown below in the table 1.

Table 1: *sGlass fiber Analysis*

Property	Glass	Penetration Rate (S)	Width (mm)	Moisture Content (%)	Area Weight (%)	Breakage Strength (N/150mm)	Loss on Ignition (%)
Emulsion 300	E	<180	± 5	<0.20	300±10	≥120	4.2 ~ 4.8

The raw materials for the study are

Fiber : Glass fiber

Resin : Vinyl ester resin

Catalyst : Methyl Ethyl Ketone Peroxide(MEKP)

Accelerator : Cobalt Octate

The above said materials are mixed together to form a reinforced plastic and welded then. A Mould box is prepared with 300x300x5 mm dimensions. The ratio of addition of resin, Catalyst, accelerator is added in correct proportion to form a product and they are cut in to pieces of 200x200 mm dimension specimens.

2.2 WELDING PROCESS

The welding process is done using a Ultrasonic Welding machine with the following specification

Working Frequency : 20 kHz

Maximum output power : 1500 Watts

Pressure : 5 bar

Before setting the parameters various trial runs are made for fixing the parameter values. The table below shows the trials runs

Table 2: *Trial runs*

Factors	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5
Delay time , Sec	2	2	2	2	2
Holding time, Sec	12	10	13	15	15
Weld time, Sec	2.0	0.5	0.8	0.9	1

From the above trial runs the welding parameters are fixed and shown below.

Table 3: *Actual runs*

S. No	Delay time , Sec	Hold time , Sec	Weld time , Sec
1	2	15	0.9
2	2	15	1.0
3	2	15	1.2
4	2	15	1.4
5	2	15	1.6

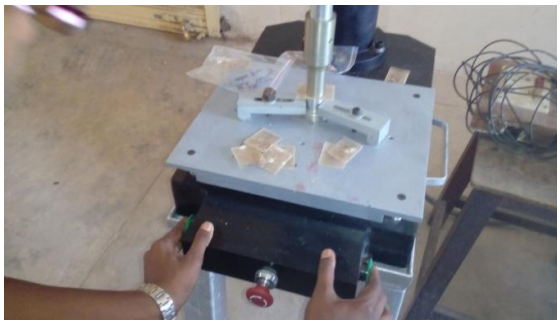

Fig 1: *Ultrasonic welding process*

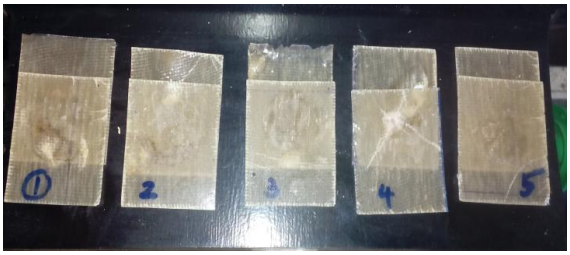

Fig 2: *Weld Specimens*

3. RESULTS AND DISCUSSION

3.1 SHEAR TEST:

Specimen Dimension as per the standard ASTM D 732 was prepared. The test is performed by clamping a test sample attached between two metal fixtures. A male punch is then forced through the hole in the metal fixture causing shear along the edge of the hole. A universal testing machine is used to push the punch until shearing of the specimen occurs.

Table 4: *Shear strength*

S.No	Welding parameters			Lap Shear Strength (MPa)
	Delay time(sec)	Hold time(sec)	Weld time(sec)	
1	2	15	0.9	17
2	2	15	1.0	20
3	2	15	1.2	21
4	2	15	1.4	23
5	2	15	1.6	26

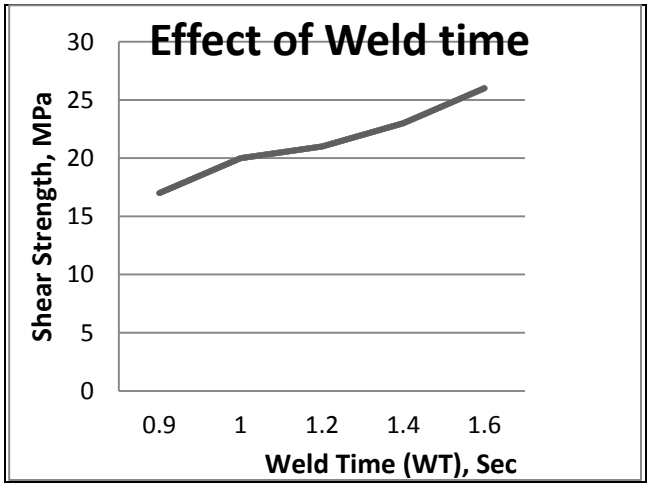

Fig 2: *Effect of weld time*

The above figure Fig 2 shows the effect of weld time.

4. DISCUSSION

From the above Figure 4.1 it is found that the value of shear strength for the weld joints increases with increase in Weld Time.

On considering in the five parameters ,the fifth parameter DT= 2 Sec, HT=15 Sec, WT=1.6 Sec is found to be the optimized parameter for the Ultrasonic Plastic Welding of GFRP.

Optimized Parameter:

Delay Time, Sec	Hold Time, Sec	Weld Time, Sec
2	15	1.6

5. CONCLUSIONS

- Ultrasonic Plastic Welding of Glass fibre Reinforced Plastic(GFRP) is successfully fabricated with sound weld.
- The shear strength increased with increase in Weld Time(WT) for the Weld joints.
- The optimized parameter for Ultrasonic Plastic Welding of GFRP is Delay Time = 2 Sec,Hold Time =15 Sec,Weld Time =1.6 Sec.

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