International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 06 Issue: 12 | Dec 2019 www.irjet.net p-ISSN: 2395-0072

Sustainable Production in Ultrasonic Plastic Welding Obtaining Maximum Tensile Strength under Given Parameter

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Abstract - *Plastic is pivoted and widely used compound now a days around the globe. They share the huge number of share among the material we use in our day to day life. Plastic are use in the field of aerospace, medical, engineering, electronic equipments and house hold things. Therefore recycling and reusing of plastic is very important. The present Research work is carried out in ultrasonic plastic welding to measure the maximum Tensile strength of welded polymer at the minimum input parameter like Input Pressure and Operation Time. The experiment perform over the Acrylic polymer at Pressure Range of (3-5 bar) and Operation Time (1-2.5 Second). The pneumatic machine having power of 2KW at horn distance of 6 mm.*

***Key Words*: Ultrasonic welding, Acrylic polymer, welding pressure, welding time, tensile strength etc.**

1. INTRODUCTION

Ultrasonic welding are most considerable among the other plastic joining method as it consume less operation time and give the maximum strength over the other joining method like mechanical fastening, adhesive joining and friction welding . It can also perform over the intricate shape of the work piece. A method of welding plastic components in which the surfaces to be joined are heated by contact with electrodes of a high frequency electrical generator. Welding guns for plastics contain an electrically or gas heated chamber through which a gas, usually dry air or nitrogen, is passed. The heated gas is directed at the joint to be welded, while a rod of the same materials as the thermoplastic being welded is applied to the heated area.

1.1 Component of Ultrasonic Welding:

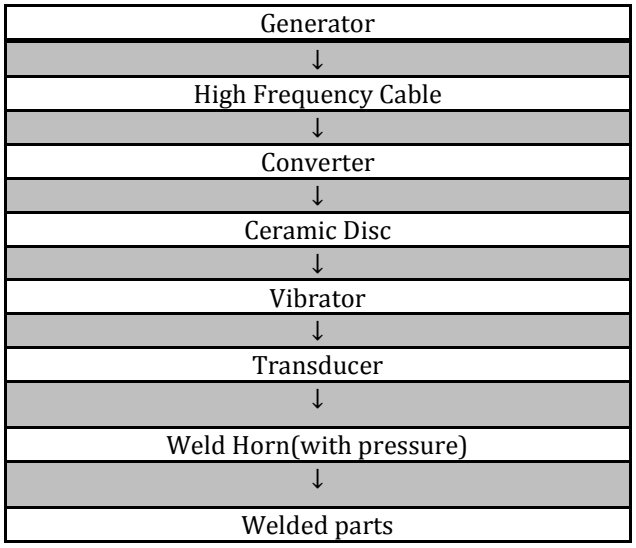

Fig-1: Component of Ultrasonic Plastic Welding

1.2 Advantages

Intricate and complex shape welding can be possible Build up heat is less as compare to the frictional welding Ability to weld huge surface area as per the requirement, with movable horn Low operation cost.

2. EXPERIMENTAL PARAMETERS:-

Maximum force applied between horn	**3000N**
Power	**2KW**
Frequency	**20KHz**
Stoke	**100mm**
Throat depth	**275mm**
Welded time	**1-5 Sec**
Transducer capacity	**9mm**
Pressure	**1-5 Bar**
Polymer Used	**Acrylic Polymer**
Cross Section Area of Specimen	**31.5mmSq**

The stress on the horn is considerable. Hence the design engineer has to strike a balance between the high amplitude requirements and maintaining low stresses experienced by the horn. Owing to the dynamic nature of the horn design considerable research has been carried out to study its performance both analytically as well as by finite element analysis.

Ultrasonic vibration is classified in two different method:-

- Ultrasonic vibration having vertical movement at high frequency.
- Ultrasonic vibration having horizontal movement at low frequency.

3. EXPERIMENT PROCEDURE

The welding were perform over the Acrylic Polymer .In ultrasonic welding the pressure were given over the horn which were input into pneumatic unit .In ultrasonic Welding machine ultrasonic vibration Creates friction like relative motion takes place over the input pressure .The power and operation time is controlled by the pneumatic system.

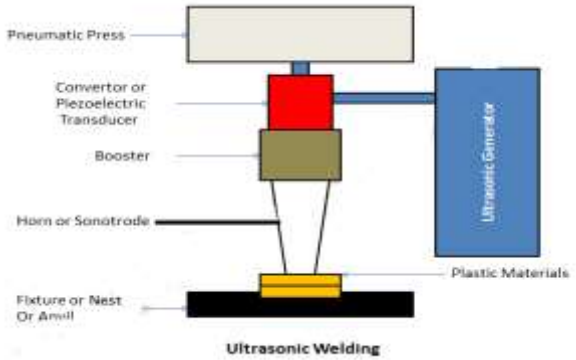

Fig-2: Ultrasonic Plastic Welding Machine

Step 1.The welded parts should be kept over Anvil

Step 2.The horn contacts the parts to be welded

Step 3. The pressure should be maintain over the anvil and welding joint should be hold statically

Step 4. The horn delivers ultrasonic vibrations which heat up the plastic materials the vibrations move less than a millimeter either up-and-down or side-to-side depends of plastic material and frequency.

4. Experimental Reading

Here,

WT=Welding Time.

WP=Welding Pressure.

TS=Tensile Strength.

Table - : Reading of t.s of acrylic polymer during working pressures.

S.no.	Welding Time(WT) sec	Welding Pressure (WP) bar	Maximum sustaining Force (N)	Tensile Strength (TS) MPa
1.	2.5	3	1288.35	40.9
2.	2.5	4	1442.7	45.8
3.	2.5	4.5	1521.45	48.3
4.	2.5	5	1341.9	42.6
5.	1.5	3	1077.3	34.2
6.	1.5	4	1348.2	42.8
7.	1.5	4.5	1398.6	44.4
8.	1.5	5	1471.05	46.7
9.	1	3	882	28
10.	1	4	882	32
11.	1	4.5	1102.5	35
12.	1	5	1134	36

Analysis of Result and discussion: -

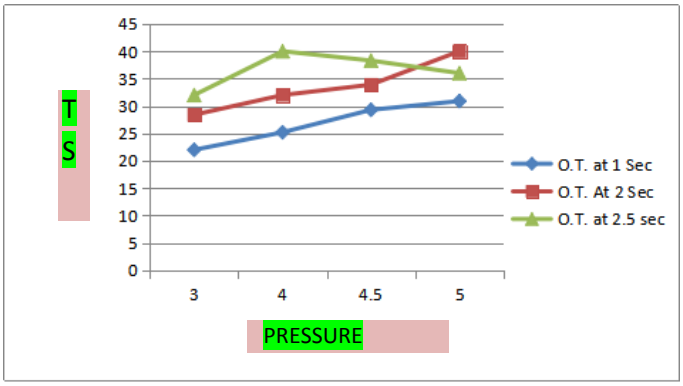

Chart -1: Tensile Strength Vs Pressure graph at 1,1.5, 2.5 Sec.

Blue line: Tensile Strength Vs pressure graph at operation time 1 sec.

Red line: Tensile Strength Vs pressure graph at operation time 1.5 sec.

Green: Tensile Strength Vs pressure graph at operation time 2 sec.

We get the two intersecting line. The intersection point is break point gives most Economical value at given range of temperature and pressure

Calculating intersection point from Line 1 (4.5, 44.5) & (5, 46.7) and Line 2 (4.5, 48.3) & (5, 42.6)

Equation of line $(y-y^1) = m\,(x-x^1)$; $m= (y^2-y^1) / (x^2-x^1)$

$(y- 44.4)= [(46.7- 44.4)/(5- 4.5)]\,(x-4.5)$

2.3x-0.5y-11.9=0 {Equation of line 1}

(y- 48.3)= [(42.6- 48.3)/(5- 4.5)] (x-4.5)

11.4x-y+3=0 {Equation of line 2}

Now From Equation of line 1 & 2 we get

X=3.94 and y=41.92

5. CONCLUSION

At 3.94 Bar, operation time 2 second the Tensile Strength 41.92*31.5=1320.48 N can be obtain which is most economical and sustainable in nature.

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