# Corrugated Box Welding By Ultrasonic Technique

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*Abstract :* A wide variety of ultrasonic corrugated plastic box welding machine options are available to you. Ultrasonic pp corrugated box welders as a special purpose machine for variable sizes of pp boxes that is a no bench type welding machine to weld pp boxes this is created with innovative technology at its perfection. Advantages of ultrasonic welding are better aesthetic looks. Polypropylene corrugated box welding machine corrugated boxes are fast replacing traditional corrugated boxes in the case staples are fast replaced by ultrasonic welding. . This machine can weld one or two welding spot together which make it production friendly. These are specifically designed to ensure easy handling reliable welding results and reproducibility while advancing and optimizing the machine.

***Index Terms* – Ultrasonic Plastic Welding, Polypropelyene Material, Production rate, Design and Analysis**

## I. INTRODUCTION

Ultrasonic welding is a solid-state joining process that produces joints by the application of high frequency vibratory energy in the work pieces held together under pressure without melting. It was discovered is early 1950's . This falls under frictional welding .These processes involve either the use of deformation or of diffusion and limited deformation in order to produce high-quality joints between both similar and dissimilar materials. Ultrasonic welding produces a weld by introducing high-frequency vibration to the weldment as it is held under moderately high clamping forces. The welding tool (sonotrode) couples to the part to be welded and moves it in longitudinal direction. The part to be welded on remains static. Now the parts to be bonded are simultaneously pressed together.

Two major types of ultrasonic welding machines are

1. Ultrasonic plastic welding machine (USPW)
2. Ultrasonic metal welding machine (USMW)

Due to higher surface finish, high impact strength, higher moulding capability of thermoplastic material, use of thermoplastic material has increased compared to thermosetting material in modern components. There are several methods available for welding the plastic materials, like hot gas welding, friction welding, ultrasonic welding (USW), and laser welding etc.

Mostly, plastic materials are joined by ultrasonic welding method because of the advantage of very less welding time. Quality of weld not only depends on welding technique but also depends on property of welding materials. Ultrasonic welding is a solid state welding process. It is basically a joining process of similar or dissimilar metallic/nonmetallic material. Here the joint produced is by the application of the high frequency vibratory energy in the workpieces held together under pressure without melting . Major factors affecting the welding strength are welding pressure, welding time and amplitude.

Ultrasonic welding, one of the most widely used welding methods for joining thermoplastics, uses ultrasonic energy at high frequencies (20 – 40 kHz) to produce low amplitude (1 – 25 μ m) mechanical vibrations. The vibrations generate heat at the joint interface of the parts being welded, resulting in melting of the thermoplastic materials and weld formation after cooling. Ultrasonic welding is the fastest known welding technique, with weld times typically between 0.1 and1.0 seconds.

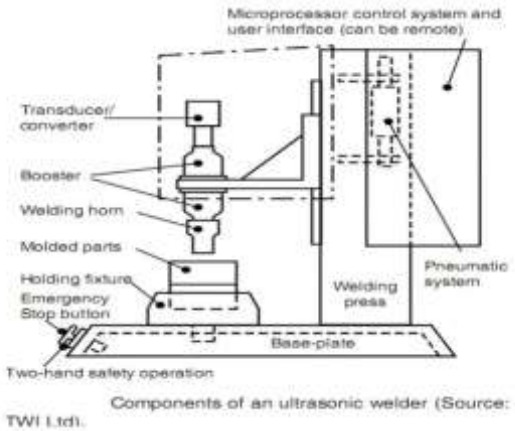


Fig.1.1.Skematic Diagram Of Ultrasonic Welding

## II. LITERATURE SURVEY

Process has had widespread industrial use in the last 25 year.

Most of the earlier studies authored by investigators in the soviet union.

Much of published literature on ultrasonic welding is qualitative , and it gives a good overview of ultrasonic welding and its application.

**Potente** has studied various aspect of the process including the longitudinal response of part to imposed vibration.

**Benator** studied theoretically and experimentally the ultrasonic welding of thermoplastic.

Until recently many researchers have shown interest in the field of ultrasonic welding and the resulting joint strength. They have carried out numerous laboratory experiments and observations to illuminate the darkness of this field. Their findings and suggestions are reviewed here. Here I began a short literature review on the USW process and the parameter affecting the process. I found some likely research paper. When I read each, I wrote a paragraph description of each:

### A. Mantra Prasad Satpathy, Bikash Ranjan Moharana, Shailesh Dewangan,,Susanta Kumar Sahoo.

In this study, the control parameters like vibration amplitude, weld pressure and weld time are considered for the welding of dissimilar metals like aluminium (AA1100) and brass (UNS C27000) sheet of 0.3 mm thickness. Based on its main effects results, the most influencing parameter on the response is the vibration amplitude as it occupies rank 1 followed by weld time and weld pressure. Observations indicate that the fuzzy modelling results a high FMPI value than GA. So, fuzzy technique could be an economical and better method for prediction of quality characteristics with respect to the process variables Tensile strength values also increase with weld time up to a certain point and then decreased due to formation of cracks around the weld zone.

### B. Marius Pop-Calimanu, Traian Fleser.

In this paper, welding parameters, like welding time, welding pressure and amplitude of the vibration are taken into account during the realization of ultrasonic welded joints of Al/20%SiC composite material under disks form, whose thickness are 1 mm. This work **Sooriyamoorthy Elangovan & K. Prakasan & V. Jaiganesh. [3]**

In this work welding parameters like welding pressure, weld time and amplitude of the vibration are considered while producing ultrasonically welded joints of copper whose thickness is 0.2 mm. A suitable experimental design based on Taguchi's robust design methodology was designed and executed for conducting trials. The analysis of variance (ANOVA) and signal to noise ratio analyses are employed to investigate the influence of different welding parameters on the weld strength and to obtain the optimum parameters.

It is observed that weld pressure, weld time and amplitude has significant effect on the response (weld strength). The interactions between weld pressure and weld time and that between weld pressure and weld amplitude have significant effect on weld strength. The interaction between weld time and weld amplitude does not have significant effect on weld strength.

**C.Harras, K C Cole.**

The ultrasonic welding of PEEK-carbon composites was studied in order to better understand the process and determine the optimum welding conditions. The parameters varied were the applied pressure and the welding time. The optimum applied pressure at the horn-sample interface was found. The joint properties were evaluated through fracture test in both Mode-I (opening) and Mode-II (shear). It was found that the optimum welding time depends very much on the physical configuration of the specimen being welded; this effects the efficiency of conversion of the ultrasound into thermal energy in the composite. However, for the both types of specimen tested (Mode I and II) the optimum joint strength was found to correspond to a specific value of total energy input. It is noted that a variance of the energy by 10% in either direction resulted in a decrease in properties by about half. Hence the weld energy can be used as a reliable.

### A. S. Elangovan & K. Anand & K. Prakasan. [5]

This paper focuses on the development of an effective methodology to determine the optimum welding conditions that maximize the strength of joints produced by ultrasonic welding using response surface methodology (RSM) coupled with

genetic algorithm (GA). Experiments were conducted as per central composite design of experiments for spot and seam welding of 0.3- and 0.4-mm-thick Al specimens.

It is concluded that weld strength decreases with increase of pressure because increase in clamping force (pressure) reduces the relative motion between surfaces leading to reduced area of contact and hence reduced strength. Also, weld strength increases with increase of amplitude because increase in amplitude gives increased area for rubbing action between the metallic surfaces that leads to better bonding and increase of weld strength.

**Gap Analysis**

GAP analysis means the analysis of the research done already and the possible work that can be done after today. This kind of analysis helps the researcher to find out the way of doing the research. Here according to above research paper, it is noted that the since today all research was done on the ultrasonic welding for majorly on metals and also some on plastic materials. There are various methods which is used to optimize the parameters. Some of the researchers used the taguchi method else some used response surface method with ANOVA. ANOVA means analysis of variance. It is Statistical technique for comparing means for multiple (usually $\geq$ 3) independent populations. Here some research paper is following the GA-genetic algorithms. By doing the literature survey it is found that, there are always two types of factor that affect any process one is the controlled and another is uncontrolled factors. Here in the USW, the controlled factors are welding time, welding pressure, input power, frequency, amplitude etc. the uncontrolled factor are that factors which can't be controlled during process. In this paper, the uncontrolled factors are neglected and controlled factors are selected for study. It is noted that mostly affected parameters are welding time, welding pressure and amplitude of sonotrode. As per the literature review consort, in many research's the output parameter is the joint strength. It also known as the tensile strength of the welding joint. Ultrasonic welding is widely used in the automobile industries for weld the different parts. So it is require to have a good Strength of joint. All the studied research papers are providing the optimum values of their input parameters for maximizing the output parameter.

## III. PROBLEM STATEMENT AND SOLUTION

Now customer is using welding machine equipped with single horn welding system. Which results in fatigue and higher production time. For completing one box time required is all most 2 min.

So here is a need to develop machine with 4 welding horns , so that in single stroke 3 welding points can be covered with 60 % time saving & higher productivity. Also for bigger size boxes 4 welding can be achieved in one stroke. For sequential operation logic we are using PLC system with HMI screen of **SELEC** company.

1. Procurement of Ultrasonic tuning system.
2. Mechanical assembly development.
3. Pneumatic cylinder selection & development of sliding joint.
4. Analysis of mechanical structure.
5. Testing of complete system.

## IV.DESIGN AND ANALYSIS

### 1.DESIGN

In our attempt to design a special purpose machine we have adopted a very a very careful approach, the total design work has been divided into two parts mainly;

- **System design**
- **Mechanical design**

System design mainly concerns with the various physical constraints and ergonomics, space requirements, arrangement of various components on the main frame of machine no of controls position of these controls ease of maintenance scope of further improvement; height of m/c from ground etc.

**In Mechanical design the components are categorized in two parts.**

- **Design parts**
- **Parts to be purchased**

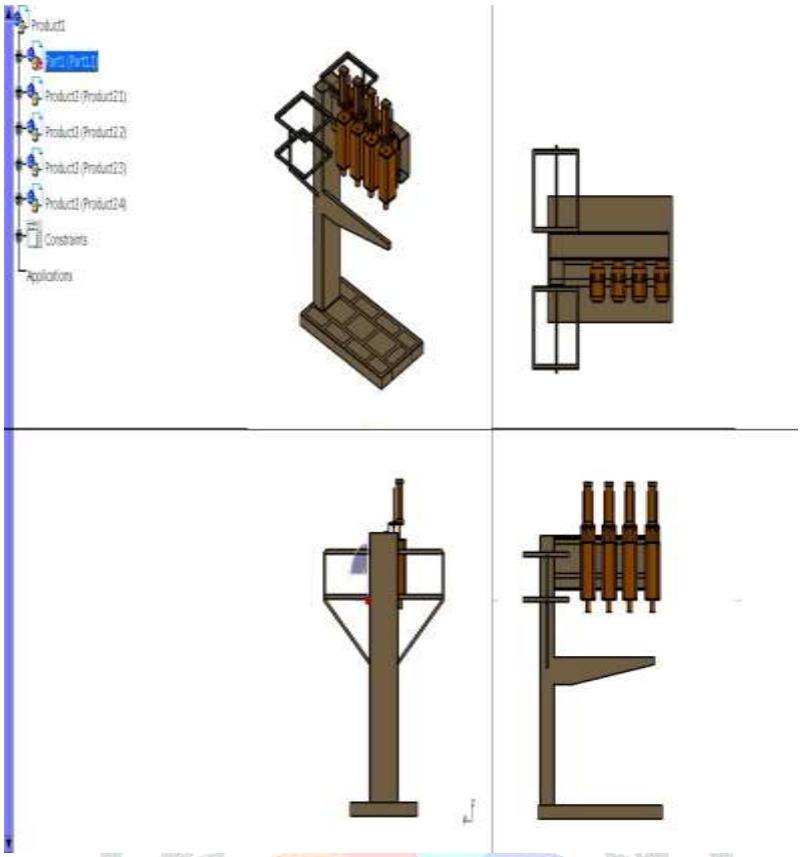

Fig.4.1.1.System Design

**2.ANALYSIS:**

The flow chart shown in Figure illustrates the process flow of conducting the static test on the Frame design in Solid works software. Initially, the assembled drawing of the Frame designed is prepared by connecting all the parts included in the Frame design. Then, the static test function is selected in order to start the experiment on the Frame structure. After that, the material of the Frame is chosen from the list provided in the database of the Solid works software. Some specifications of the materials can be edited and need to be edited if the material used having different specifications. Then, the fixtures for the Frame are applied. Fixtures that available in the software are such as fixed geometry, fixed hinge and roller/slider. Then, the load is applied to the Frame structure. The value of the load is based on the total Frame weight and driver's weight, multiplied by the desired factor of safety. After that, mesh is created. Meshing is a process of splitting the geometry of the design into small andsimple shaped called finite elements. The finer the elements will increase the accuracy of the data obtained from the experiment. After the meshing is done, the test is started and the result for the test is obtained.

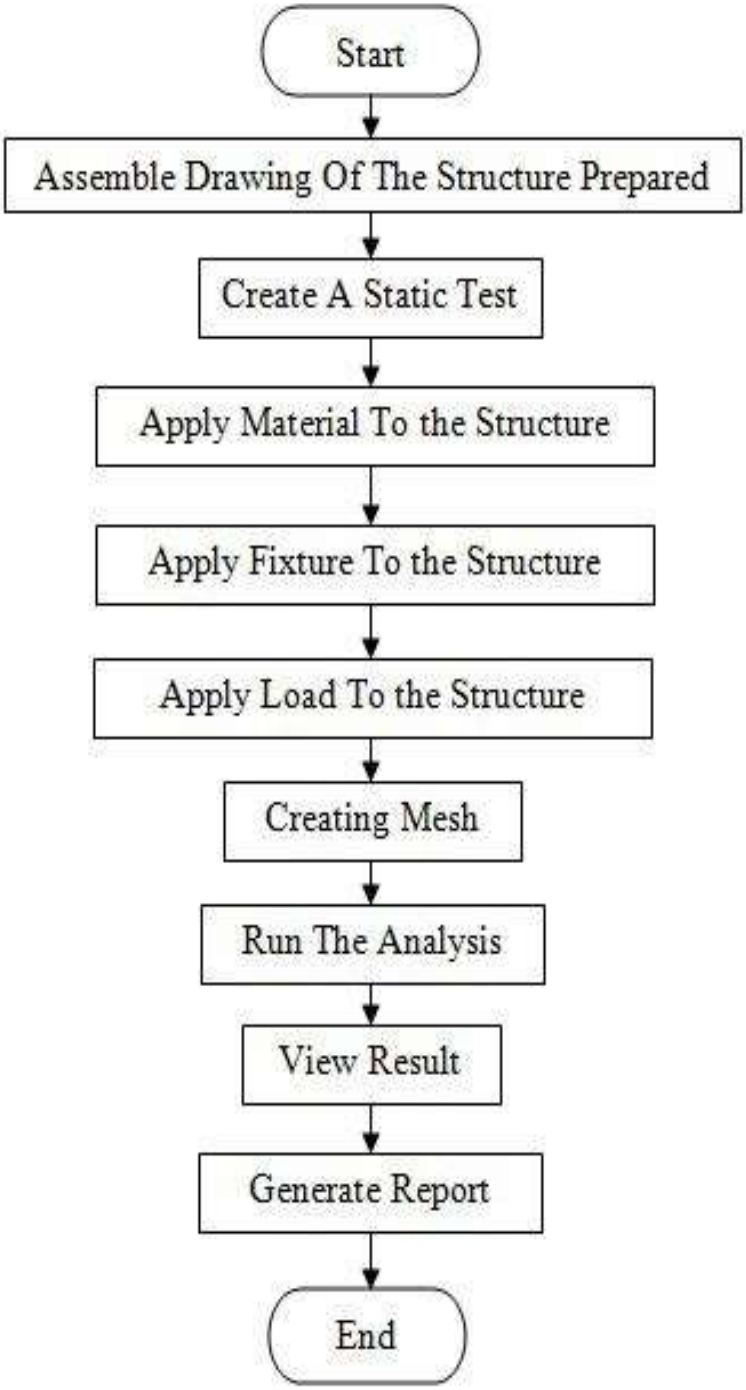


Fig.4.2.1.Flowchart of Analysis Process

## V.RESULT

Given fig shows that two sheets of polypropelyne (PP) has been welded.The PP material which comes in corrugated form after welding it's converted into boxes.

**Fig.5.1.Welded PP box ( Final Result)**

## VI. CONCLUSION

Presently, the ultrasonic system is widely used in the people's livelihood .such as ultrasonic pulverization in the pharmacy, ultrasonic welding and ultrasonic washing in the spinning and weaving, ultrasonic test and ultrasonic crack detection in the projection. At the same time, it has testified that ultrasonic has improved efficiency and brought convenience. For different applications, we should based on the different function step by step complete the theory analysis and the design then take the specific applications for it.

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