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Review Paper on Laser Welding Machine

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Abstract: This paper gives literature review of laser welding machine and parameter optimization of laser welding machine. In this paper literature, introduction , methodology and objectives of laser welding machine are described. It is very difficult to join dissimilar material combination to large difference in their physical and chemical properties of metals.
Keywords: Optimization, Laser welding Machine, Taguchi method, Literature, Analysis.

I. INTRODUCTION

Majority of recent developments in welding have been driven by the requirement of higher productivity and lower cost. It is very difficult to join dissimilar material combination to large difference in their physical and chemical properties of metals. The high power density and low energy input of laser provides solution to a number of problem commonly encountered with conventional joining techniques. Joints between dissimilar metal are particularly common in components used in solar panel, power generation and chemical, petrochemical, nuclear and electronics industries . The use of different metals and alloys in product provides the designer and production engineer with greater flexibility and often results in technical and economic advantages over components manufactured from a single material. Expensive material with specific properties can be used in critical locations, with less expensive alloys being in supporting .

Continuous welding is the simplest form of the laser welding. There are two types of continuous welding modes: conduction and penetration. The conduction welding mode is employed for micro-joining purposes. Penetration welding permits aspects ratios (ratio of depth to width) much higher than unity. In continuous welding the effect of process parameters such as the welding speed, the focal length of the beam, type focusing lens, the work piece position relative to the beam focal point and the shielding gas type and flow characteristic on weld strength [11]. Experimentation will be based on the shear test (weld strength). Shear test will be performing on sample of dissimilar metals on tensometer, to observe the strength of continuous weld.

There are following objectives, which needs satisfied in laser continuous-welding.

A. Highly accurate positioning of the components to be weld.
B. Creation of a protective atmosphere.
C. Accurate positioning of the components in the focus of the laser to prevent variations in the irradiance.

II. LITERATURE

A. Tzeng [27] focused on the process parameters affecting pulsed Nd:YAG laser welding. Pulsed laser seam welding is characterized by having a large number of process parameters that have influence to various extents on the welding performance. The parameters can be grouped into a diagram, depicted in figure 2 [27], which demonstrates the various factors affecting the quality pulsed laser welding. It indicates both the flexibility and complexity in the selection of pulsed laser parameters. The question that thus arises is how to select a satisfactory combination of the associated parameters to enable efficient effective pulsed laser welding application.

B. Sun Z.et.al. described the principles underlying laser welding of dissimilar metal combination and highlight the above benefits in a number of practical applications. It is concluded that there is potential for its application in many industrial sectors.

C. Abdel-Monem El-Batahgy et.al. was discussed about the bead on plate and autogenous butt weld joints were made using CO2 laser with maximum output power of 5 KW, And found that penetration depth increases with increasing power. Mechanical properties were not significantly affected by heat input.

D. Zhao H. et.al. was discussed about the problems that automotive industry facing now a day. Laser welding plays important role in joining the aluminum alloys that seems to be probable answer for the weight reduction.

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E. Yang Y.S.et. al. was represented on laser spot weld and resistance spot weld were performed on mild steel to compare the strength of laser welded joints. A low-cycle fatigue test was performed .The result showed that the fatigue strength of laser spot welds was superior to that of the resistance spot welds.

F. Tzeng Yih-Fong focused on the large number of process parameters has influences on welding performances. They have described the effect of pulsed laser parameters on the heat flow for rectangular power pulse.

G. Reed C.B. et. Al. focused on influence of process parameters on weld surface quality. Result show that as laser power is decreased surface roughness increases rapidly.

H. Wagner F.et. al. was represented the joining of dissimilar metals such as aluminium to steel and aluminium to titanium can be realized by laser welding due to a very localized energy input of the welding sources. Localized energy input leads to a controlled heat distribution and to the joined materials.

I. G. Padmanaban and V. Balasubramanian et.al. was discussed about the empirical relationship is developed to predict tensile strength of the laser beam welded AZ31B magnesium alloy by incorporating process parameters such as laser power, welding speed and focal position. The experiments were conducted based on a three factor, three level, central composite face centered design matrix with full replications technique. The empirical relationship can be used to predict the tensile strength of laser beam welded AZ31B magnesium alloy joints at 95% confidence level. The results indicate that the welding speed has the greatest influence on tensile strength, followed by laser power and focal position.

J. M. M. A. Khan et. al. focused on the experimental design approach to process parameter optimization for the laser welding of martensitic AISI 416 and AISI 440FSe stainless steelsin a constrained overlap configuration in which outer shell was 0.55 mm thick. To determine the optimal laser-welding parameters, a set of mathematical models were developed relating welding parametersto each of the weld characteristics. These were validated both statistically and experimentally. The quality critera set set for the weld to determine optimal parameters were the minimization of weld width and the maximization of weld penetration depth, resistance length and shearing force.

K. Baohua Changa et. al. was represented the conduction mode and keyhole mode welds may be formed in laser spot welding of NdFeB permanent magnets with low carbon steel. Conduction mode and keyhole mode welds may be fomed in laser spot welding of NdFeB permanent magnets with low carbon steel. The critical power density for transaction from conduction to keyhole mode is found to be about (7, 15-8.44) ×105 W/cm2. The welding mode can be altered by adjusting the peak power and/or defocusing distance but not by changing the pulse duration. Three types of fracture, namely ‘nugget pullout’ made is observed in peel tests. The mechanical locking effects are the substantial causes for different fracture behavior sunder different loading conditions, For ‘nugget pullout’ mode fracture behaviors under different loading conditions. For ‘nugget pullout’ mode fracture, the metallurgical quality of joints is the controlling factor of fracture forces; for ‘nugget through’ and ‘magnet crush’ mode fractures, the controlling factors are the size and strength of the nugget and base magnet.

L. M. J. Torkamany el. al. focused on the laser welding of low carbon steel to 5754 aluminum alloy was studied in keyhole welding mode in steel on- aluminum overlap configuration. In order to decrease of intermetallic components during laser welding, effect of laser power, pulse duration and overlapping factor was investigated. Tensile test was performed to identify the effect of each parameter on the weld. The phase composition was characterized by energy dispersive spectrometry and Vickers microhardness test and microstructure by optical and scanning electronic microscopes. Results obtained show that increasing peak power (in constant pulse energy), pulse duration (in constant peak power) and overlapping factor (in constant pulse energy and peak power) will increase percentage of intermetallic components (PIC). On the other hand, decreasing the mentioned parameters will cause distractive effects such as inadequate penetration depth, spattering and cavity formation. Improvement in the tensile strength was attributed to low values of intermatallic components in weld metal. Finally, an optimized peak power, pulse duration and overlapping factor were reported.

M. Xiao-dong Qi et. Al. focused on the AZ31B magnesium alloy and 6061-T6 aluminum alloy were lap joined together with the addition of Fe interlayer by fusion welding of hybrid laser-tungsten inert gas (TIG) technique. The influence of location of laser focal spot (LFS) on joint penetration depth and that of the depth on joint strength were investigated. The result showed that when the LFS was just on the surface of Al plate, the deepest penetration could be obtained, which contributed, to the improvement of shear strength of Fe-added joints, but not to the elevation of the strength of Mg/Al direct joints. The fusion zone of lap joints mainly bears the external load during tensile shear test. The fracture types of 0.07 and 0.13 mm Fe-interlayer-added joints are both quasicleavage, while those of direct and 0.22 mm interlayer-added joints are cleavage. The theoretical shear strength for Fe-added joints is 130 MPa.

N. U. Reisgen et.al. was represent the possibility of a CO2 LBW optimization procedure of DP/TRIP steels sheets using RSM is investigated inthis work. The determination of the near- optimal LBW process parameters, laser power (p), welding speed (S) and focus position (F). search for the optimum was based on either minimization or maximization or an objective function, which takes into account the economic aspects and the geometric characteristics (weld penetration and width) of the bead, mechanical properties and welding operation cost. Strong, efficient and low-cost weld joints could be achieved using the optimum welding conditions. The welding geometries were not assigned high weight or high important since they are indirectly affected by the welding quality.

O. Bappa Acherjee et.al was discussed about the experimental investigation on diode laser transmission welding of dissimilar thermoplastics between PMMA (polymethyl methacrylate) and ABS (acrylonitrile butadiene styrene) has been carried out. The effect of the laser welding parameters such as laser power, welding speed, stand –off distance and clamp pressure on weld strength and weld width is investigated using response surface methodology (RSM). Planned experiments and subsequent analyses are carried out to develop the mathematical models to establish the correlation between the process parameters and the responses. The adequacy of the developed models is tested using the sequential F-test, lack-of-fit test and the analysis-of-variance (ANOVA) technique.

P. Ming Gao et.al. focused on the high power laser-metal inert gas (MIG) hybrid welding of AZ31 Mg alloys was studied. Microstructure and fracture surface of welded joints were observed by optical microscope and scanning electron microscope and scanning electron microscope. The mechanical properties of welded joints were evaluated by tensile test. Under the optimal welding parameters, the stable process and sound joints were obtained. The tensile strength efficiency of welded joints recovered 84-98% of the substrate.

Q. Donald C. Zippaerian discussed in detail the steps for proper metallographic specimen preparation, as documentation, sectioning and cutting, mounting, polishing, measurement etc. can be carry out. Hence a systematic methodology was defined which is helpful for the sample preparation and analysis.

III. DEFINITION OF PROBLEM BASED ON LITERATURE REVIEW

An empirical relationship will be develop to predict weld strength of the laser beam welding of dissimilar metals by incorporating process parameters such as laser power, welding speed and beam diameter.

IV. OBJECTIVE

Study and analyzing the laser welding machine for the various combination of welding process parameters.

A. Conducting the experiments according to the Taguchi's L9 orthogonal array on Laser welding machine.
B. Measuring the welding process parameters and responses.
C. Analyze the data by using Taguchi method.
D. To find out optimum set for laser welding

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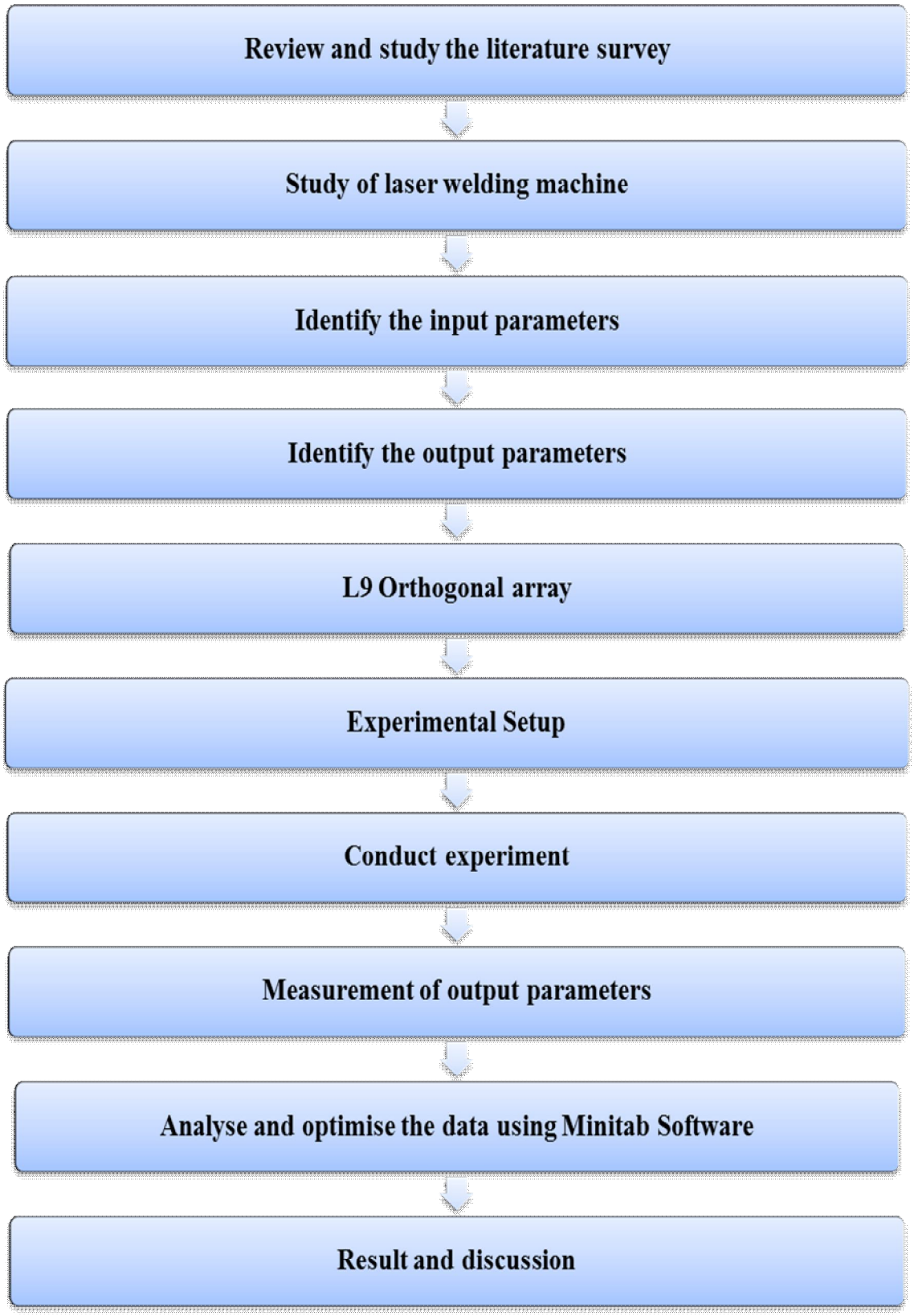
V. EXPERIMENTAL PLAN



STEPS IN EXPERIMENT

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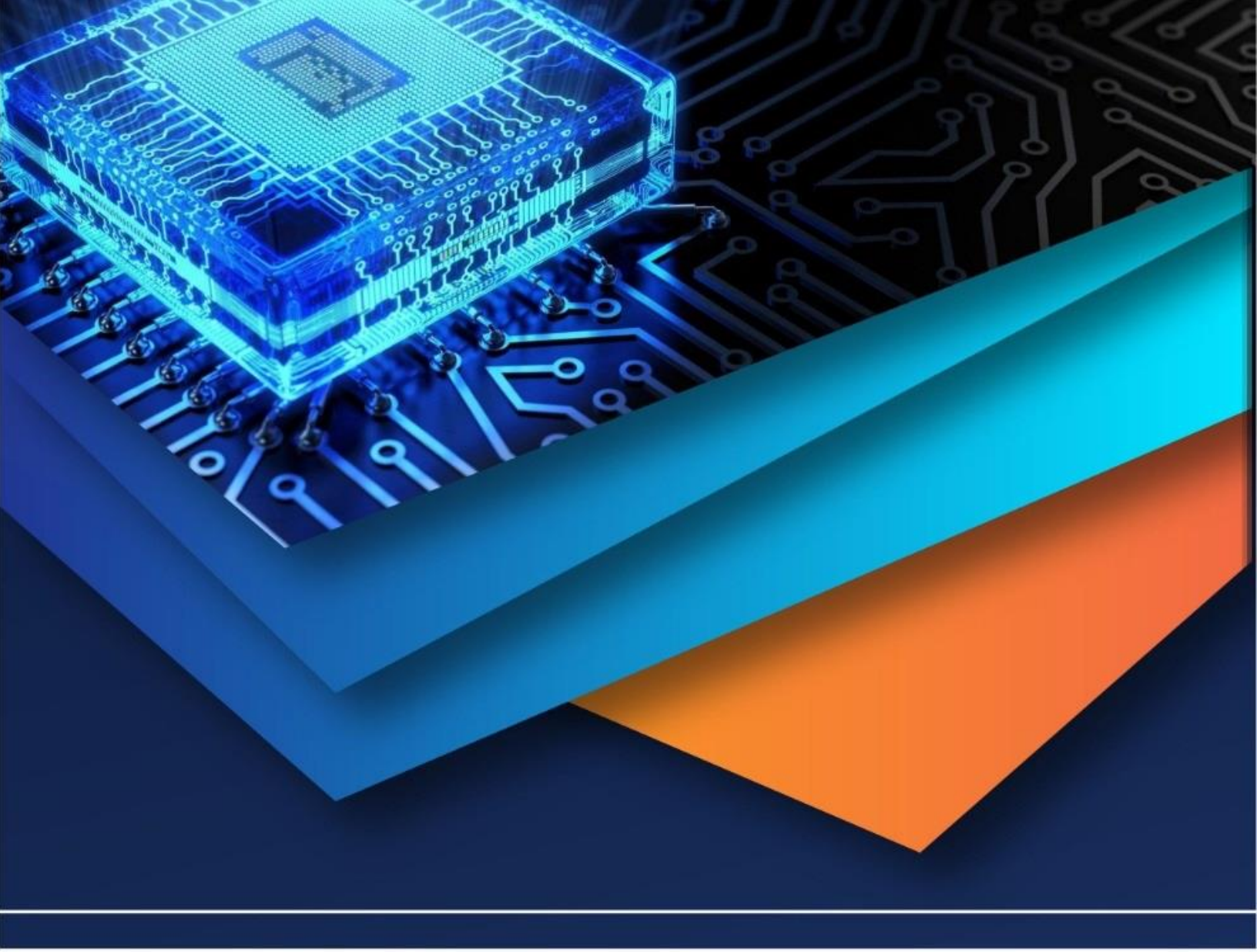

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