A Review on Optimization of Welding Process Parameters for Improving Welding Strength of Material on Robotic Welding Machine

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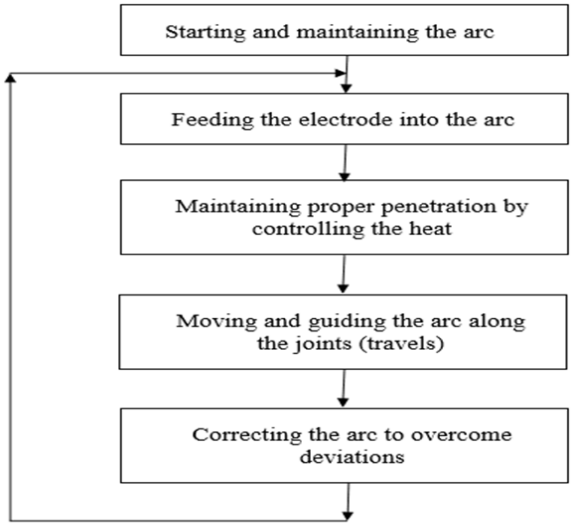
***Abstract*- In recent days, all manufacturing industries pay more attention to increase their productivity and customer satisfaction for gaining more profit and improving quality of products. Development in the agricultural area increasing day by day due to new technologies, equipments and tools. So, there is a large scope of research in field of agricultural equipments and their improvement.Day by day,due to number of increasing manufacturing industry, the compititions between industries rapidly increases.So,for increased productivity and profit ,the company must investigate the defects occurring in the manufacturing product and try to solve all the issue. This research include the improvement of the welding process done on Robotic Welding Machine. MIG (metal inert gas) welding parameters like current, voltage and speed are selected to obtain optimum strength from welding. Optimum combination of parameters is obtained by Taguchi method.**

***Index Terms*- MIG, Taguchi, Robotic welding, strength.**

I. INTRODUCTION

The welder is an important person, who does the welding operation under the continuous control of the quality in both manual (MA) welding and also in semiautomatic welding .They still involve a relatively high fatigue level because the welder must watch the arc, hold the gun to control the placement of the molten weld metal, and follow the joint. Simultaneously the slag should be removed continuously. While doing this, the welder is watching a very bright light and is exposed to heat, smoke and sparks The skills required by the individual and operator fatigue are greatest when all the functions are controlled by the person and diminish as the functions are taken over by a robot. Also, the implementation of automation to carry heavier tools, torches and cables allows the application of higher currents, which yields safer work environment.In this review, Metal Inert Gas (MIG) welding is used which is capable of achieving the highest quality welds. MIG welding is one of the most widely used processes in industry. It can be used with virtually any weld-able metals, including dissimilar metals, and thicknesses from 0.5mm upwards. MIG welding is a commonly used high deposition rate welding process. The optimum combinations of process parameters like current, voltage &speed are obtained by using taguchi approach. The sequence of works made by the welder to obtain a fine quality of weldment is given in a flowchart as shown in Figure



II. ROBOTIC WELDING & HISTORICAL BACKGROUND

The International Federation of Robotics, in its 2011 report, stated that there are more than 1.1 million industrial robots operating in factories over the world. An increasing number of welding robots, mostly "Teaching and Playback" robots are being used in the automated welding industry. For these types of teaching and playback robots, the parameters are set in advance and these values of pre-set parameters cannot be varied/ adjusted online if the welding conditions change or disturbances occur during welding process. Even in robotic welding, quality of the weldment purely depends on the selected parameters in the programming level itself. But in the manual arc (MA) or sub-merged arc welding (SMAW), the final quality of the joint purely depends on the parameter selection and the of welder's skill. But in robotic welding, the final joint quality purely depends on the programmer's skill. Robotic metal inert Gas (MIG) welding is used extensively in manufacturing automotive components such as car bodies. In both cases, there is a high demand for quality and reliability as well as productivity. The quality of the welds is checked by visual inspection only. Therefore, it is even more important to control all the parameters before welding (Gudmundson, 2008). Kim et al (2003a) found out the relationship between process variables and bead-penetration in robotic CO2 arc welding. Four two-level process variables, namely welding current, arc-voltage, welding angle, and welding speed were considered as input parameters to determine the penetration. It was concluded that the welding current, arc-voltage, welding speed and welding angle affect bead-penetration in the CO2 arc welding process.

III. ROBOTIC WELDING METHODOLOGY

Robots are essentially position-controlled devices that can receive a trajectory and run it continuously.In fact,that is practically the only thing they can do with welding applications, It I is necessary to start from a trajectory,given,for example,from a CAD model of the working piece,and havethemeanstocorrectitinrealtimeas a function of the observed results of the welding process. For that, systems for guidance and inspection, the possibility of real-time correction of the position of the robot and the welding parameters, and a computational platform suitable for developing the software to handle all these monitoring and control tasks are needed .The welding parameter like current, voltage and spees are selected from taguchi approach to find optimum value o this combinations on mild steel, HR steel and E34 steel to find better rength of weld. MIG/MAG welding process, also known as gas metal arc welding process, uses the heat of the electric arc to melt the electrode wire and the metallic components to be welded. The fusion is carried out under the protection of a gas, or mixture of gases, in order to prevent pernicious contamination with atmospheric gases (oxygen, nitrogen,and hydrogen). The stability of the welding processis sensitive to basic welding parameters,especially current,voltage, welding speed,stick-out (length of wire out of the contact tube),shielding gas,and arc length.Figure shows the mechanim of mig welding.

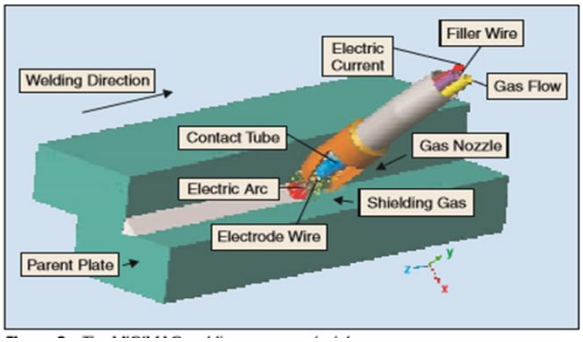


Fig:Process of MIG welding

IV. LITERATURE REVIEW

K Abbasi et al. concluded, the effect of MIG welding parameters on the weld bead and shape factor characteristic of bright drawn mild steel specimen. They uses input parameter of welding current, arc voltage, welding speed, heat input rate and studied effect on depth of penetration and weld width.

S.Utkarsh et al.studied effect of input parameter like Current (A), Voltage (V), Gas Flow rate (L/Min) and Speed(M/Min) on Ultimate Tensile Strength(UTS) of st-37 low alloy steel material in Gas Metal Arc Welding (GMAW) Experimentation carried by using L9 orthogonal Array to find out UTS and to find out optimal run set of current, voltage speed and gas flow rate.

S.Sivakumar et al investigated the effects of different parameters on welding penetration, micro structural and hardness measurement in mild steel that having the 6mm thickness of base metal by using gas metal arc welding.

Ajit Hooda et al. [3], have developed a response surface model to predict tensile strength of inert gas metal arc welding of AISI 1040 medium carbon steel joint. In this research the welding voltage, current, wire speed and gas flow rate are considered as input parameter. The experiment was designed by face centered composite design matrix. From the experiment they conclude that the optimum values of process parameter such as welding voltage 22.5 V, wire speed 2.4 m/min and gas flow rate 12 l/min for maximum yield strength both transverse and longitudinal are remain same but the current value is 190 A and 210 A respectively.

C. Labesh kumar concluded that ,the optimization of parameters by the Taguchi's orthogonal array has proved to be an excellent tool. This experimentation has provided a significant result by considering small experimentation values. The three parameters are contributing to the response and all have been considered for experimentation of MIG welding. Among the parameters Hot Die steel speed is 0.051mm/min, voltage 26 volts and current 200amps. S/N ratios are found to be within the limits of the predicted value and the work has fulfilled by the objective. Hence it can be concluded the parameters are valid and within the range of the machining standards.

Amit Pal et al. [12] presented the effect of different welding parameters like welding voltage, filler wire rate and v-butt angle on the strength of the weld joint and elongation produced during the tensile test. These all parameters have different effect on welding quality. In order to optimize these parameters for better weld quality Taguchi Orthogonal array has been used. The medium carbon steel slabs have been used as welding material. The ANOVA is also employed to predict the percentage effect of each parameter on results.

Ohshima et al (1995) investigated the problem factors for controlling the weld pool. A neural network model was constructed using expert – knowledge, it was very difficult to describe the model based on state equations. The developed model had short learning time compared to the conventional neural network. Also, to control the weld pool, a neural network controller (NNC) was suggested. The welding current and the root gap, on which the penetration depth of the weld pool depended, were given to the neural network. The time response of the penetration depth was calculated by applying the neural network model (NNM), which was trained by using the experimental results in pulsed MIG.

Appendino (2013) discussed a method to reduce process time and increase the quality of robotic laser welding. Stainless steel was chosen as base metal. Traditional techniques have been compared with robotic laser welding techniques and the implementation of robotic laser welding in improving the productivity has been justified welding.

V. CONCLUDING REMARK

- From the literature survey, it was found out very few isolated works have been carried out on optimization of robotic gas metal arc welding parameters
- Many researchers are adopted different techniques viz. surface response methodology, grey analysis, regression analysis etc.
- Many researcher studied different response parameters like depth of penetration, bead width, height, micro-hardness, tensile strength,current,voltage and speed.
- Many researchers have realized the difficulties that arise with the theoretical evaluation of input–output relationships in the welding process, and tried to get those responses. Those models include multiple-linear as well as non-linear regression, Taguchi techniques, response-surface methodology, Several efforts have been made by various researchers to design a suitable model for welding process such as, using parametric optimization, analytical and numerical approaches. Furthermore, intelligent approaches have also been adopted by many researchers to optimize the welding process conditions.

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