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# Genetic Algorithm Based Optimization of the Process Parameters for Manual Metal Arc Welding of Dissimilar Metal Joint

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**Abstract**

A better quality weld in dissimilar metal welding is obtained by optimizing the process parameters because they play a vital role in deciding the weld strength. Dissimilar metal joint is extensively used in industries for boilers, economizers and pressure vessels. In this research paper influence of process parameters on manual metal arc welded joint on weld strength and weld deposition rate is discuss. The independently controllable process parameters affecting the weld strength and weld deposition rate these process parameters are welding current (I), welding speed, root gap, electrode angle (A). Experimental run are decided by using Response surface Method. Genetic algorithm (GA)-based technique is successfully developed to model, simulate, and optimize the welding process parameters for maximum weld strength and minimum weld deposition rate.

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*Keywords: Manual metal arc welding; response surface method; Genetic algorithm*

## 1. Introduction

Welding is a manufacturing process by which fusion of surfaces two different or same material of part are joined together with or without the application of heat, pressure and a filler material. Welding is preferred in industries

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because of its efficiency, faster, quieter, easy joining process over riveting, casting, joints for fabrication of automobile, aircraft, and civil engineering structure and nut bolt. Most important metal joining manufacturing process used is arc welding which is used for joining structural elements for applications, automobiles, nuclear reactors pressure vessels, boilers, economizers [1]. Alloy steel is highly costly to reduce its cost it is combined with the carbon steel [4]. These dissimilar metals are welded together by arc welding for high strength as well as for cost reduction. This objective can be achieved by optimizing the welding parameters like electrode angle, welding speed, welding current, welding voltage, root gap, arc length, type of electrode used. Dissimilar metal are joined by manual metal arc welding which are used commonly in civil structures, boilers, heat exchangers, reactors, pharmaceutical industries for chemicals reaction container [2]. Several methods, models have been developed by different researchers to predict the effect of process parameters on weld strength, metal deposition rate, weld geometry. Lenin N et.al used the Taguchi method to analyze the effect of each welding process parameter on the weld strength and the optimal process parameters are obtained to achieve greater weld strength [3]. The quality problems associated with MMAW include weld spatter, porosity, poor fusion, shallow penetration, and cracking. It is most efficient and cheapest way of joining commercial metals and provides design flexibility. Joints between nozzles and shell in a pressure vessel; which because of their position are difficult to be welded by manual metal arc welding. U.S.Patil et.al decided the experimental runs by using response surface methodology and data analyzed by Artificial Neural Fuzzy Interface System for process parameters of MMAW which was used for welding dissimilar metals [4]. Arvind Kumar Kachhoriya et.al studied many welding parameters whose selection contributes to the welded product as they all affect the strength and quality to a larger extent are weld design (edge preparation), root face, and root gap. This study utilizes the Taguchi design methodology and regression modeling [5].Welding is process comprising of a number of complicated natural phenomena, none of which may be understood. Thus, it may not be always possible to develop an appropriate differential equation of the said process. In such situations, models are made from the outcomes of experiments performed as per some statistical designs and then analyzed to optimized required output [6].All experiments in this field are analyzed and optimize by using tradition methods. From the literature review, it is found that welding of dissimilar metal is a big challenge by conventional arc welding process. Repeatability of welding depends on its control on welding speed and other processing parameters. Considering the literature survey, it is observed that only a very limited literature is available on manual metal arc welding and its parameter optimization for industry application. Research focused on optimization of process parameters in manual metal arc welding using genetic algorithms to get desired results by considering the different process parameters like welding current, speed, and root gap, electrode angle. In the present study stainless steel and mild steel is welded together with MMAW. The quality of weld is improved by increasing the strength and decreasing weld deposition rate. Genetic algorithm is used successfully to optimize the process parameters to obtain predicated results.

## 2. Experimentation and data collection

Experimentation is carried out on manual metal arc (MMA) welding process, a 3.15 mm diameter consumable stainless steel 309 L grade electrode is used to strike an electric arc with the base metal. The chemical composition of mild steel and stainless steel is given in Table 1. Two plates of size 100mmx50mmx3mm are tacked together to form a weld pad of 200mm x 50mm x 3mm.Welding is carried out in the down hand position and beads are laid along the weld pad centerline to form a butt joint. The plates are allowed to cool to room temperature, after the completion of welding.

Table 1 Chemical Properties of SS304 & Mild steel

| Alloys (%) | Cr | Ni | C | Mn | S | P | Si | N |
|---|---|---|---|---|---|---|---|---|
| SS304 | 18.2 | 8.06 | 0.08 | 2 | .03 | .045 | .75 | .1 |
| MS | .069 | .01 | .19 | .8 | .04 | .017 | .4 | - |

Number of experiment conducted for classical method is more and depending on process parameters. Dr.Genichi Taguchi, a Japanese engineer, developed a new concept of robust design and design of experiment. Design of

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