A Review On Optimization Of Process Parameter In Plasma Arc Cutting

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Abstract- *Plasma Arc cutting is one of the most important non-conventional machining or cutting operations (PAC). Plasma arc cutting is a thermal cutting technique that involves melting and cutting metal with a constricted jet of high-temperature plasma gas.cutting speed, stand off size, and gas pressure are the input process parameters considered in this experiment. Experiments are conducted to assess the best process parameter for cutting SS 202. To find an optimised process parameter for cutting SS 202, various factors or performance responses such as Metal Removal Rate (MRR),surface roughness, and hardness are considered. The COPRAS method is used to rank the output response obtained from a combination of various input parameters in order to find the best optimised process parameter.*

Keywords- optimization, plasma arc cutting, surface roughness. SS 202

I. INTRODUCTION

Nonconventional machining is commonly used in industries to cut dense materials because of its high precision, finish, ability to mill any hard material, and ability to cut complex shapes. Plasma cutting, laser cutting, oxy-acetelyne cutting, and water-jet machining are some of the methods used to cut plates or sheets. Plasma arc cutting is best for cutting thick sheets or plates because it is less expensive, takes less time to machine than water jet machining or laser, and produces a better edgy finish than oxy-acetylene. Plasma arc cutting generates a higher energy density arc than other cutting methods, allowing dense materials to be cut without reducing overall cut efficiency. Plasma arc cutting can be used to cut a variety of electrically conductive metals, alloys, and other materials. Plasma arcs have a smaller kerf diameter than oxy-acetelyne cuts, resulting in a clean slash. Plasma is a high-temperature gas that is the fourth state of matter. As a gas reaches a high temperature, its atoms are ionised by a high voltage applied to the ends, causing them to conduct electricity and resulting in the formation of a plasma arc. The temperature of the plasma arc is between 10000 and 14000 degrees Celsius. The primary goal of this project is to investigate the performance response factors that affect metal removal rate, hardness, and surface roughness.

II. LITERATURE REVIEW

SS Pawar[1] Cutting speed, gas pressure, and arc voltage are the input parameters for this parameter. Two parameters, kerf width and taper, were used to evaluate the cut quality in this experiment. It was discovered that increasing the arc voltage causes the kerf width to increase and the taper to decrease. When cutting speed is increased, the kerf width narrows. According to the author, arc voltage and cutting speed have a greater impact on kerf width than gas pressure. Taper is influenced by all three variables. Cutting speed, current, and torch height are the process parameters considered in this experiment, according to RenangiSandeep[2]. Surface roughness and metal removal rate are taken into account in the performance response. Cutting speed, according to the author, is the most important factor in surface roughness and metal removal rate. Metal removal rate increases as cutting speed, current, and torch height rise. Surface roughness decreases as cutting speed and torch height increase. 100 amp current, 1600mm/min cutting speed, and torch height are the best process parameters. Dilipkumar [3] Arc voltage, current, cutting speed, and torch height are the input process parameters considered in this experiment. To find the best process parameter, researchers used the response surface tool, grey relational analysis, and principal component analysis. The best optimal conditions for cutting AISI 316 SS are a feed rate of 970mm/min, a current of 47.5 A, a voltage of 140 v, and a torch height of 1.5mm. John kechaigias[4] The arc ampere is the most critical parameter that affects the eight bevel angle by 58.7%, according to the experimental design. The standoff distance has a 15.7 percent effect on the bevel angle and a 19 percent effect on the cutting pace. The effects of the other processes used in the experiment are negligible.Milan Kumar Das[5] The surface roughness and metal removal rate are optimised using the weighted component analysis process. The work piece is made of EN 31 alloy. There are five different surface roughness efficiency response criteria that are taken into account. According to ANOVA, the most important controlling parameter on MRR and surface roughness is gas pressure.Gas pressure, current, torch height are the input process parameter considered. D.V.RamanaReddy[6] In these experiments, a HARDOX 400 plate with a thickness of 12mm was used. Voltage, cutting speed, and gas pressure are known as input process parameters. Arc voltage is found to be the most important parameter, influencing all aspects of cut quality rather than the arc power effect. At the optimum value of 125 v and 2100mm/min, unevenness for 12mm Hardox plate is 421 micron.

K. KrishnaMohan Reddy[7] Taguchi and utility approach methods are used and compared in this experiment to optimise SS 202 process parameters. Metal removal rate and surface roughness are the two different performance characteristics that are taken into account. The author concludes that the utility-based approach is easier to use than Deng's Grey incidence analysis. MayankPandit[8] Wire feed rate, welding speed, voltage, stand off distance, and torch angle are the variable controllable input parameters considered. The angular distortion is a parameter that is taken into account as an output parameter. The substance used in these experiments is SS 202. After optimization, the process parameter for mig welding SS 202 with the lowest angular distortion of 2.75 degrees was obtained at wire feed rate of 0.65m/min, welding speed of 43cm/min, voltage of 16V, standoff distance of 13mm, and torch angle of 105 degrees. Shovan bhowmick[9] The analysis of plasma arc cutting on AISI 304 is presented in this paper. For each parameter, the experiment is broken down into three process parameters and three factor levels. To find the optimal value of MRR and surface roughness for the expected value of a process parameter, a multi objective optimization is used. The pace and thickness are more important, according to the analysis of variance. With increasing friction, decreasing speed, and decreasing thickness, the Ra value of surface roughness decreases. MRR increases as strain, speed, and thickness increase .B.Venugopal etal[10] Response surface analysis was used to establish a mathematical model for surface roughness and metal removal rate, which was then tested using data from the experimental work. During plasma machining of SS420 content, response surface methodology and grey taguchi are used to optimise machining parameters. M.H. Norizaman[11] Cutting speed and arc gap are two process parameters that were considered in this study. MRR and SR values are inversely proportional. The MRR is calculated by comparing the weight of the specimen before and after machining .A.Rajesh Kannan[12] The author concludes that the Taguchi OA method is one of the easiest methods for performing a large number of experiments in a limited amount of time to achieve the best results. In each case, three levels are considered, and the arc current, standoff distance, and cutting speed are found to be the main influencing variables in the cutting process. S/N ratio graphs, mean of means plots, and ANOVA are used in the study and discussion. The cutting conditions that resulted in the least amount of surface roughness were found to be 70 amps present, 0 mm standoff width, and 7 seconds cut time. Furthermore, it was discovered that the standoff gap had the greatest effect in SR from 0 to 4.68 mm, but had no impact from 4.68 to 9.48 mm. Other parameters, such as current, have a fluctuating effect on SR, while cut time has a linear rise in SR. Parthkumar Patel[13] Three process parameters were considered in this experiment: cutting speed, gas pressure, and torch height. In this analysis, two separate optimization techniques: TLBO and GA algorithm were used to compare the optimal results in Plasma arc cutting of AISI D2 steel in order to minimise surface roughness (Ra). The parametric condition obtained from the TLBO showed its effectiveness over GA. Devaki Nandan Sharma[14] In this analysis, the formation of dross in the plasma arc cutting process on low carbon steel materials is investigated. The main goal of this study is to investigate the impact of various PAC process parameters on DFR using a Design of Experiments (DOE) layout and to determine the best solution for minimising DFR using the Response surface method. Thickness 2 mm, Current 40A, Arc Gap Voltage 146.84 V, Speed 700 mm/min, and DFR 0.0214695 g/s are the best values.

Raj Kumar[15] The aim of this study is to find the best combination of cutting parameters for the smallest heat-affected zone when cutting a board. Response Surface Methodology (RSM) was used to examine the mechanism and dependencies of input/output parameters. In comparison to other input parameters, voltage and cutting speed have a greater impact on the heat affected field. The obtained suitable zone shows that the voltage should be held between 116 and 118 V, the cutting speed between 900 and 1000, and the torch to workpiece distance between 1.625 and 1.875 for the lowest temperature value. D.Rajamani[16] The effect of PAC process variables including arc current, gas pressure, cutting speed, and stand-off distance on evaluating the surface roughness, kerf width, and micro hardness of Monel 400TM superalloy is investigated in this experiment. A multi objective desirability method was used to find the best machining process conditions, which included a cutting speed of 2427.08 mm/min, gas pressure of 3.83 bar, arc current of 45 A, and stand-off distance of 2.14 mm. H.Ramakrishnan [17] The cut quality characteristics of SS321 are investigated using plasma arc cutting in this study. Cutting speed, current, standoff distance, and gas pressure are all input cutting parameters. Surface roughness, kerf distance, and heat-affected zone are the performance parameters. Lower current and Standoff Distance values are thought to result in better surface roughness and a smaller heat-affected region. Deepak Kumar Naik[18] Using a CNC plasma cutting unit, the tests were carried out on 10 mm hardox-400. An investigation of plasma arc cutting of hardox-400 with various forms of plasma gases was carried out. As argon and oxygen are used as plasma gases, a higher rate of material removal can be achieved. The release of the most energy during material cutting results in greater material removal. R.Adalarasan[19] Cutting parameters such as arc current, torch stand-off, cutting speed, and gas pressure, according to the author, play an important role in determining the quality of a cut surface. During the cutting of 304 L stainless steel, the surface roughness and kerf width were measured to determine the cut surface consistency.Marin Gostimrovic[20] For specific machining parameters, an experimental analysis of the characteristics of machining precision and surface integrity was carried out (cutting speed, arc current, arc voltage, plasma gas pressure, stand-off distance and nozzle diameter). Three accuracy parameters (top kerf width, bottom kerf width, and kerf taper angle) were used to evaluate the kerf geometry. SVSS Srinivasa Raju[21] For cutting mild steel E350 grade sheets, the process parameter that influences the quality of cut in terms of the bevel angle has been statistically analysed.Gurwinder singh[22] In the industry, research and development in hard metal precision and accuracy machining technology is becoming increasingly important. The main goal of the practical experiment is to find the best setting and parameter possible. John Kechagias[23] (2017) Cutting speed (mm/min), torch standoff distance (mm), and arc voltage were the cutting parameters investigated. Following the complete factorial style experimental method, the linear dimensions of a rectangle workpiece were determined after PAC cutting.Sahil sharma [24] (2017) Using the Taguchi L16 orthogonal array process, this paper presents an experimental investigation into the optimization and effect of the cutting parameter on metal removal rate in plasma arc cutting of EN-45AA material.

III. PROBLEM IDENTIFICATION

Based on literature review plasma cutting has not been used to cut SS 202.It is difficult to cut thin plates and sheet metals of thickness less than 3mm.Requirements in the workplace to cut SS 202 in a more effective manner. Plasma cutting process parameters optimization in SS 202 is not done. COPRAS method is not used to optimize process parameter in plasma cutting. To study the effective way for the cutting process of stainless steel. To find the important cutting parameters that influence the quality of plasma cutting. Plasma cutting takes place at high temperature metal impingement occurs in nzzle of the torch. Initial cost of this equipment is high.

IV. CONCLUSION

Based on the literature review influencing important input parameters are gas pressure, cutting speed and current. By using argon and oxygen gas metal removal rate can be increased. Surface roughness and metal removal rate are considered to check the quality of plasma cut Varying standoff distance between 0- 5mm has maximum effect on surface roughness. arc voltage and cutting speed have a greater impact on kerf width than gas pressure.

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