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A BRIEF REVIEW ON PLASMA ARC MACHINING

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ABSTRACT

Technology today in metal cutting process require high quality cut surfaces and good dimensional correctness without further operation. Plasma arc cutting process does high temperature and high velocity contracted arc via a amount of gas between the electrode and the work material to be engrave. There are a variety of process parameters such as arc voltage, arc current, gas pressure, cutting speed, standoff distance and gas flow rate that affect the quality distinctiveness of plasma cut like kerf generated, bevel angle, heat affected zone (HAZ) and surface finish. It is very vital to have a good knowledge of process to get better excellence in cut. This paper focus on current research work and results obtained by using plasma arc machining process based on experiments and various optimization techniques that has used for optimization of plasma machining process.

Keywords:PAM, Parameters, Machining, Quality Characteristic

1. INTRODUCTION

In plasma arc Machining a plasma gas used as a heat resource. Plasma is a state of a substance which obtained by supply an incredible amount of energy to any gas or when a gas subjected to a high electric field.older stage it was used to pertain for the few materials such as high alloy steel and aluminum but nowadays, it used to cut a number of materials such as Stainless steel, magnesium, titanium alloys, copper, manganese steel, aluminum and its alloys and cast iron including non- alloy and low alloy steels due to its narrow heat affected zone and high cutting speed.Plasma arc cutting process uses a constricted arc formed by plasma gas as a heat source. In this process, an electric arc produced between the electrode and the work piece, where the electrode acts as a cathode and work piece taken as anode.

2.Literature Review

More Reasearch work done in the Area of Plasma Arc Machining.the characteristics of Machining parameters were analysed S.S.Pawar and K. H. Inamdar(2017) The quality cut measured by out responses Kerf width and tapper. Various thickness of the material has been measured and compared. The optimized parameter identified by the help of ANOVA .In this paper concluded arc voltage influencing parameter affects kerf followed by cutting speed, and gas pressure.Tamiloli. N et al (2016) evaluated surface roughness and material removal rate of aluminium alloy using grey-fuzzy modelling to optimize cutting parameters for multiple performance characteristics. From the anova table it may be concluded that grey fuzzy logic is more suitable for end milling process while machining aluminium alloy.B.Venugopal et.al.(2016) A mathematical model has been developed using response surface analysis for surface roughness (Ra) and metal removal rate (MRR) were

verified using collected results from the experimental work. Response surface methodology (RSM) & Grey Taguchi (GT) are used to optimize machining parameters while Plasma arc machining of SS420 material. Grey taguchi technique is used for optimal process parameters for obtaining minimum Ra and maximum MRR simultaneously. The optimal setting for obtaining minimum Ra and maximum MRR are 100 Amp cutting current, 1300 mm/min cutting speed and 4 mm torch height..Renangi.Sandeep(2015) The process parameters are cutting current, cutting speed and torch height. The special effects of process parameters on responses, it is denotes Ra increases when increasing cutting current, Ra decreases when increasing cutting speed and torch height. ANOVA concluded that the cutting speed has been more control parameter on Surface roughness and MRR.Shane Fatima et.al. (2015) The Author optimize the process parameters of plasma arc welding for welding of dissimilar metals like austenitic stainless steel SS-304 L and low carbon steel A-36.Martensitic structure is initiate in the weld zone of directly welded sample and the weld joint joined with filler wire E309L is mixed and consist of austenite, ferrite and martensitic structure. Tensile test discovered that sample broke from CS(carbon Steel) side which established that weld joint is stronger than base metal.Kaushik Kumar et al (2014) optimized the process parameters for multi-response in plasma arc cutting of EN 31 steel using weighted principal components analysis and maximized the material removal rate and minimized the surface roughness.J.Kechagiaset.al(2014) The experimental design concluded that the arc current is the most important parameter that affects the right bevel angle by 58.7%. The torch standoff distances influence the right bevel angle by 15.7% and the cutting speed 19%.Maity K.P et al (2014) studied the effect of process parameters on AISI 316 stainless steel of plasma arc cutting and optimized the feed rate, current, voltage and torch height when machining stainless steel by plasma.R. Adalarasan et.al. (2014) the quality uniqueness of the cut surface were examined by measuring the surface roughness and kerf width though cutting the 304 L stainless steel. The experimental trials were planned by Taguchi's L18 orthogonal array different design used with conventional response surface methodology (RSM), and an included approach of Grey Taguchi-based response surface methodology (GTRSM) was shown for predict the best achievable combination of cutting parameters. A lower value of arc current was found to produce better responses as the increase in thermal content of the arc at higher amperage (60A) was identified to destroy the surface finish and raise the kerf width. Similarly, a lower level of stand-off distance (2 mm) was identified to produce an improved cut surface.YahyaHısmanCelik (2013) The current and arc voltage for thin sheets must be low and cutting speed must be high to get the greatest surface roughness, reduce hardness increase. The current increased, and the arc voltage decreased as the thickness of the material to be cut increases. At lesser cutting speed conditions, the surface being cut is showing under high temperature for a longer time. Especially, the results that we obtained surface roughness can decrease by reducing cutting speeds. HAZ increases when cutting speeds decrease.SubbaraoChamarthiet.al(2013) Cutting speed increase or decrease inversely proportional thickness of plate. The cutting speed reduces results in an unnecessary amount of molten metal which cannot be entirely removed by the thrust of the plasma jet. the arc voltage is main parameter and it influence all the aspect connected with the cut quality sooner than the outcome on the arc power, further than the arc voltage the cutting speed showed a evident effect.R. Bhuveneshet.al(2012) the SR values are inversely proportional to the MRR values. The dimensions of the dross decide the quality of plasma arc cutting in terms of surface roughness. M.I.S. Ismail and Z. Taha (2011), The surface

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roughness in plasma arc surface hardening prove that the arc current is most dominant factor, which confirm a contribution rate of 66.91 %. The second is the carbon content at 20.76 %, and scanning velocity at 11.44 %.

3.RESULT AND DISCUSSION

Many researchers studied the Plasma Arc Machining process with different process parameters, different material and different mathematical methods. Some of them are listed below:

Table .1 Parameters and responses

S.No.	Paper title	Year	Parameters	Material	Responses
1.	Experimental Analysis of Plasma Arc Cutting Process for SS 316l Plates	2017	cutting speed, arc voltage and gas pressure	Stainless Steel 316L 4 mm, 8 mm and 12 mm	Kerf
2.	A grey – fuzzy evaluating for the surface roughness of material removal rate	2016	cutting speed, feed and depth	AA6082T6	surface roughness, material removal rate and average roughness
3.	Experimental Investigation and Optimization of Process Parameters in Plasma Arc Cutting Process	2016	cutting current, cutting speed and torch height	SS420 170x170x10 thickness	surface roughness (Ra) and material removal rate (MRR)
4.	Multi objective optimizationof processparameters in plasma arccutting of SS 420 usingGrey-Taguchi analysis	2015	cutting current, cutting speed and Torch height	stainless steel (SS) 420 of 10 mm thickness	Surface roughness (Ra) and Material removal rate (MRR)

5.	Optimization of process parameters forplasma arc welding of austenitic stainlesssteel (304 L) with low carbon steel (A-36)	2015	Current, Speed	stainless steel SS-304 L and low carbon steel A-36100x50x2mm	Heat Affected Zone
6.	Effect of process parameters on cut quality of stainless steel of plasma arc cutting using hybrid approach	2014	current, voltage, feed rate and torch height	AISI 316 stainless steel	Kerf,chamfer,surface roughness and MRR
7.	On the multi – parameter optimization of CNC plasma-arc cuttingprocess quality indicators using Taguchi Design of Experiments	2014	cutting speed, arc ampere, pierce height, and torch standoff distance	St37 mild steel plates	surface roughness
8.	Optimization of MRR and surface roughness in PAC of EN 31 steel using weighted principal component analysis	2014	gas pressure, arc current and torch height	10mm thick EN31	material removal rate (MRR) and surface roughness parameters
9.	Application of Grey Taguchi-based response surface methodology(GT-RSM) for optimizing the plasma arc cutting parametersof 304L	2014	Arccurrent, torch stand-off, cutting speed and gas pressure	304L stainless steel 600 mm×600 mm×5 mm	surface roughness and kerf width

10.	INVESTIGATION analysis of plasma arc cutting parameters on the unevenness surface of Hardox 400 material	2013	cutting speeds, plasma flow rate, and voltage	Hardox 400 materials (12mm thick)	The arc voltage is main parameter and it influences all the aspects related with the cut quality rather than the effect on the arc
11.	Investigation Analysis of Plasma arc cutting Parameters on theUnevenness surface of Hardox-400 material	2013	Cutting speed, Plasma Flow rate, Voltage	12mm thick hardox-400	Surface
12.	Use of the taguchi method and grey relational analysis to optimize turning operation with multiple performance characteristics	2013	Cutting speed, feed rate and depth of cut		
13.	Surface Roughness and MRR Effect on Manual Plasma Arc Cutting Machining	2012	Air pressure, Cutting current, Cutting speed, Arc gap.	AISI 1017 Steel of 200 mm x100 mm x 6 mm	surface roughness
14.	Experimental Design and Performance Analysis in Plasma Arc Surface Hardening	2011	arc current, scanning velocity and carbon content of steel	ASSAB 618, ASSAB DF3 60 x 40 x 10 mm	surface roughness

4. Conclusion:

Many researches are being carried in the area of plasma arc machining. But still there is scope for improvement seen. It is studied that the output response is influenced by the process parameters. It is observed that the current has maximum effect on the process. Moving speed of torch, airpressure and stand-off distance have minimum effect on the process. PAC can be used to even cut ceramic which results in less

cost and high accuracy. Current, cutting speed, arc height and pressure are varied to obtain less roughness and high hardness properties with less machining time. Also it is observed thatlower value of arc current produces good responses as the increase in thermal content of the arc at higher amperage (60A) is seen to affect the surface finish and increasese the kerf width.

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