OPTIMIZATION IN PARAMETERS OF CNC FLAME CUTTING MACHINE

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Abstract *Most recent forty years there is colossal research in machining and advancement in innovation. With increment in rivalry in advertise and to accomplish high exactness now a days the non-traditional machining are moved toward becoming help of any industry. A standout amongst the most imperative non-customary machining strategies is CNC fire Machining. Its high precision, completing, capacity of machining any hard materials and to create mind boggling shape builds its request in showcase. In proposal work writing has been examined in setting to parametric improvement of CNC fire Machining. With a specific end goal to achieve target and ideal outcomes, Taguchi technique utilized. The fitting orthogonal cluster has been chosen according to number of components and there levels to perform least experimentation. The work bits of mile Steel materials were utilized for explore reason. The ideal esteem has been resolved with the assistance of fundamental impact plot and ANOVA table. The Regression condition for MRR and Surface Roughness (Ra). Affirmation test have done to affirm the esteem evaluated through the perception. The composition of MRR run is finish by utilizing the setting of 5.0 bar, 150 A, 600 mm/min and 4.0 mm. The ideal parameter level for Surface Roughness are 6.0 Bar (Gas Pressure), 150 A (Current), 400 mm/min (Cutting Speed) and 2 mm (Arc Gap). Test comes about are given to affirm the viability of this approach.*

***Key Words*: Flame Cutting Machine, Cutting Torch, Taguchi Method, O_2 & LPG gas, etc.**

1. INTRODUCTION

The topic for this thesis writing is to Analysis the Process Parameters of CNC Flame Cutting Using Design & Experiment Techniques. The focus on this project is to obtain an optimum condition (setting) to obtain mini MRR and minimum the surface roughness (SR). A person does not need to be a physicist & chemist to understand the CNC Flame Cutting and Gouging process. There are four states in which physical matter may be found solid, liquid, gas. Changes from one physical state to another occur due to, by supplying or subtracting energy, in the form of heat. Water can be used as an example of these four states of matter. In the solid state it is ice at temperatures of 0 degrees Celsius or colder. With the addition of heat the ice melts and changes to water, the liquid state. The addition of more heat to temperatures of 212 degrees F. (100 degrees C.) or hotter) converts this liquid to its gaseous state, steam.

If you happen to be reading this by the light emitted by a fluorescent lamp you see flame in action. Within the glowing tube of the lamp is flame consisting of low pressure mercury or sodium vapor. It is ionized by a high voltage across electrodes at the ends of the tube and conducts an electric current which causes the flame to radiate which in turn causes the phosphor coating on the inner surface of the tube to glow. For many years, oxy-acetylene cutting was often the process of choice for quickly cutting through steel plate. From the last few years plasma cutting has pretty much taken over, for some very good reasons to perhaps most importantly. A plasma cutter will cut through any metal that is electrically conductive. That means that one unit will cut steel, stainless steel, aluminum, copper, bronze, and brass etc.

1.1 PROBLEM DEFINATION

CNC fire circular segment cutting can be described as far as two unmistakable paces. At cutting rates over, the fire stream does not slice through metal plate. At speeds beneath, the liquid metal from the kerf adheres to the base of the plate, framing the purported dross and how to legitimately choose a fire cutting framework. Fire can cut in an extensive variety of cutting parameters (streams, metal thicknesses and spout opening widths) for plasma circular segment cutting of stainless steel materials

The CNC fire cutting procedure utilizes a fire burn with an exceptionally limit bore to create an exchanged curve to the work piece at a normal current thickness of inside the drag of the light. The vitality and energy of the high-speed fire fly produced by the fire burn softens, vaporizes and expels the metal from the district of impingement of the spout. Others issue is:

a. What kind of metal is to cutting?

b. What is essential info control when cutting procedure?

c. How thick is the metal need to cut?

d. Traditional method for cutting takes a ton of time.

e. The powerful approach to lead the cutting procedure for mellow Steel.

f. The most vital variables that impact the cutting procedure?

g. What are the best conditions to accomplish ideal exhibitions?

2. PRICIPLE OF FLAME CUTTING

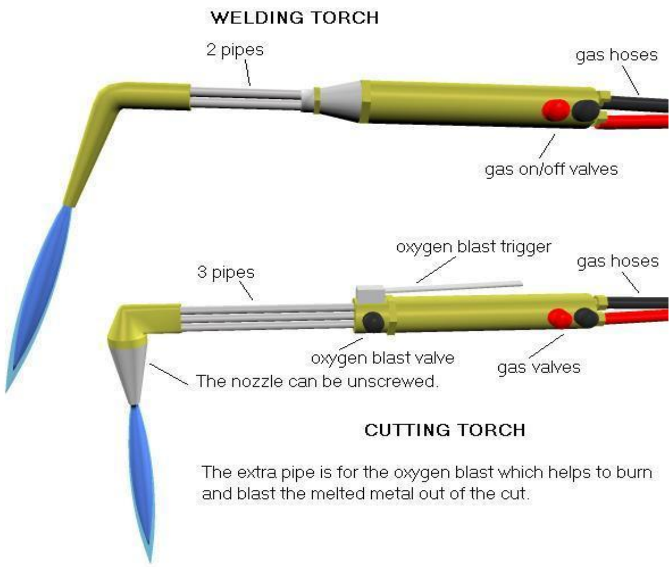

Figure No. 2: Flame cutting Machine

Oxy-fuel welding and oxy-fuel cutting are forms that utilization fuel gases and oxygen to weld and cut metals, individually. French specialists Edmond Fouché and Charles Picard turned into the first to create oxygen-acetylene welding in 1903.[1] Pure oxygen, rather than air, is utilized to expand the fire temperature to permit confined dissolving of the workpiece material (e.g. steel) in a room situation. A typical propane/air fire consumes at around 2,250 K (1,980 °C; 3,590 °F), a propane/oxygen fire consumes at around 2,526 K (2,253 °C; 4,087 °F),[3] and an acetylene/oxygen fire consumes at around 3,773 K (3,500 °C; 6,332 °F). Oxy-fuel is one of the most established welding forms, other than fashion welding. Still utilized as a part of industry, in late decades it has been less broadly used in modern applications as other particularly conceived advances have been received. It is still generally utilized for welding funnels and tubes, and in addition repairs work. It is likewise as often as possible appropriate, and supported, for manufacturing a few kinds of metal-based fine art. Also, oxy-fuel has favorable position over electric welding and cutting procedures in circumstances where getting to power (e.g., by means of an additional line or convenient generator) would show challenges; it is more independent, and, henceforth, frequently more compact In oxy-fuel welding, a welding light is utilized to weld metals. Welding metal outcomes when two pieces are warmed to a temperature that creates a mutual pool of liquid metal. The liquid pool is by and large provided with extra metal called filler. Filler material relies on the metals to be welded. In oxy-fuel cutting, a light is utilized to warm metal to its fuel temperature. A surge of oxygen is then prepared on the metal, consuming it into a metal oxide that streams out of the kerf as slag.

3 CONSTRUCTION

Figure No. 3 : Mass cutting machine

3.1 Bed

It is heavy duty massive construction to provide stiffness to sustain large cutting dynamic force, load of other elements etc. It is made of high quality granite and it acts as foundation for all other parts of the machine.

Figure No. 3.1 : Bed

3.2 Gas bang

A 2-phase approach is developed to solve the tool magazine arrangement and operations sequencing related problems. The overall aim is to minimize the total manufacturing cost by utilizing the benefits of tool sharing concept and loading duplicate tools due to a possible decrease in tooling and operating cost of tool while maintaining the viability in terms of priority, tool magazine capacity, tool life covering and tool availability constraints due to tool contention among the operations for a limited number of tool types, because the absence of such crucial constraints may lead to infeasible results. Furthermore, the proposed approach can provide an effective decision making tool for the short term operational decisions of FMS.

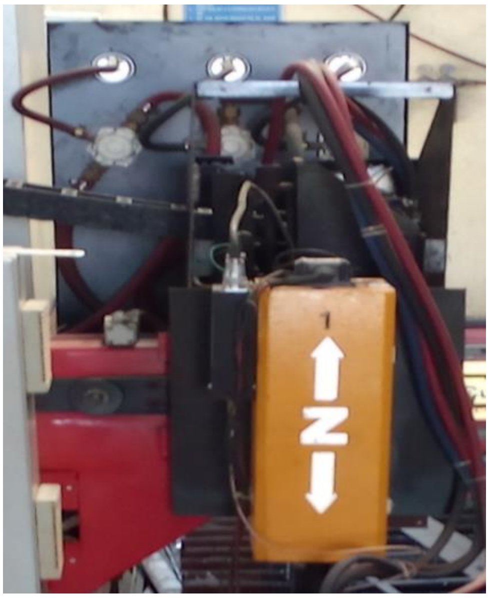

Figure No. 3.2: Gas bang

3.3 Controller

Figure No.3.3 :Control Panel

The control panel is essential component or part of any CNC machine because it has various switches on it. That are used to control the various parameter of machine. By the control panel of CNC flame cutting machine we can control the nozzle movement, flame velocity, gas pressure, air gap as per our need, due to this various switches we can improve accuracy and also save our time.

Sample	Thickness	Size
Mild Steel	5 mm	200mmX200mm
Mild Steel	5 mm	200mmX200mm
Mild Steel	5 mm	200mmX200mm
Mild Steel	5 mm	200mmX200mm

4 METHODOLOGY

Aim: optimization in process parameter and material removal rate on CNC flame cutting machine

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Problem Definition: Different machine supplier and nozzle provider suggest different operating parameter to use machine cutting

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Existing Problem: Machine do not work properly on exiting parameter as provider suggest for new machine

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Solution: as the continues use of machine and different part of machine such as nozzle were out due to use as machine provider and nozzle provider suggest the parameter is useful for the new machine as our aim to optimize parameter as per machine use.

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Analysis:-
1) sample cutting with machine provider parameter
2) sample cutting with Nozzle provider parameter
3) sample cutting with company provider parameter
4) sample cutting with industrial expert provider parameter

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Result

5 Machine Parameters:

5.1 Operating Parameter used by kalpak industry thickness (5mm):

Table No. 5.1: Operating Parameter (kalpak industry)

Kalpak industry used parameter				
Sample no	Cutting Speed (mm/min)	O_1 (bar)	LPG (bar)	Air Gap (mm)
1	400	0.12	0.11	1.5
2	500	0.12	0.12	1.6
3	600	0.11	0.13	1.8
4	700	0.13	0.14	1.9

5.2 Operating Parameter (Mass cutting machine provider) 5 mm thickness:

Table No. 5.2: Operating Parameter(Mass cutting system)

Mass cutting system machine supplier parameter

Sr. No.	Cutting Speed (mm/min)	O_1 (mpa	LPG (kpa)	Air Gap (mm)
1	400	0.10	0.111	1.2
2	500	0.12	0.12	1.5
3	600	0.13	0.12	1.6
4	700	0.12	0.12	1.8

5.3 Operating Parameter (Nozzle provider (ESAB)) 5 mm thickness:

Table No. 5.3: Operating Parameter (ESAB)

Esab Nozzle provider

Sr. No.	Cutting Speed (m/min)	O_1 (bar)	LPG (bar)	Air Gap (bar)
1	400	0.12	0.111	0.13
2	500	0.12	0.12	0.12
3	600	0.12	0.12	0.12
4	700	0.12	0.12	0.1

5.4 Operating Parameter (R & D optimized parameter) 5 mm thickness:

Table No. 5.4: Operating Parameter (R&D Dept)

Parameter taken by (operator and company expert as per expertise)

Sr. No.	Cutting Speed (m/min)	O_1 (bar)	LPG (bar)	Air Gap (bar)
1	400	0.12	0.11	1.3
2	500	0.12	0.11	1.3
3	600	0.11	0.10	1.2
4	700	0.10	0.09	1.1

5.5 Machine Operating Conditions:

- Air Pressure – 110 bar
- Air Filter – 110 bar
- Cooling System - 18^0 C
- Environmental Temperature – 22^0C
- Current – 227 V
- Vacuum Pressure – 110 bar

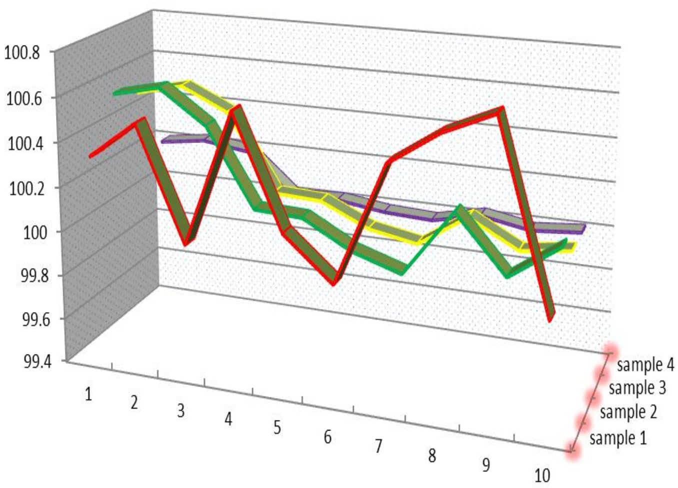
6 RESULT

6.1 DIMENSIONAL ANALYSIS REPORT

Reading no	Sample 1	Sample 2	Sample 3	Sample 4
1	100.33	100.55	100.50	100.20
2	100.50	100.60	100.55	100.23
3	99.99	100.45	100.45	100.20
4	100.60	100.10	100.10	100.01
5	100.10	100.09	100.09	100.02
6	99.91	99.97	99.99	99.99
7	100.45	99.90	99.95	99.98
8	100.60	100.20	100.10	100.03
9	100.70	99.95	99.98	99.99
10	99.89	100.11	100.01	100.01
Mean	100.307	100.192	100.172	100.066

6.2 Comparative statement graph

Dimensional Analysis Report



CONCLUSION

From the discussion so far it has been concluded that R&D parameter is better material cutting than other parameter. Al will help in reduction in material removal rate burr, plain surface finishing and better cutting quality than other parameter like machine provider, nozzle provider etc. material Removal rate minimization techniques can be easily implemented in material. The overall conclusions from the investigations are:

• Burr reduction with optimize parameter speed.
• Better surface finish with optimize parameter.
• Significant reduction of exit burr with properly constructed system.

REFRENCES

[1] Subbarao Chamarthi, "Investigation Analysis of Plasma arc cutting Parameters on the Unevenness surface of Hardox-400 material", Assistant Professor Department of Mechanical Engineering, Vardhaman college of engineering, 501218, A.P., India.,2013,pp.854-861.

[2] Renangi Sandeep, "Multi objective optimization of process parameters in plasma arc cutting of SS 420 using Grey-Taguchi analysis", Assistant Professor, Department of Mechanical, Siddartha Institute of Science and Technology, Puttur, Karnataka,2015, pp. 45-52.

[3] Mr. Maulik K. Bhalodiya, "The Effects of Plasma Arc Cutting Process Parameters on Cutting Quality of Steel", P.G. Student Department of Mechanical Engineering, Nobel Engineering College, Junagadh, India,2016, pp. 257-259.

[4] Sukani Sunny, "Optimization of various gases cutting process by changing various parameters", Department of Mechanical engineering, S.T.B.S. College of Diploma Engineering, Surat.2015, pp. 67-73.

[5] Vinay Kumar, "Taguchi Based Parametric Analysis and Optimization of Power Consumption and Kerf in Plasma Arc Machining", Masters (Auto-Engineering/MBA)Dept. of Renewable Engg/Electric machines, HTW university of science Beuth University of Science, Berlin, Germany Berlin, Germany,2015,pp.12-16.

[6] Joseph C. Chen, Ye Li. "Taguchi Based Six Sigma Approach to Optimize Plasma Arc Cutting Process: an Industrial Case Study". International Journal of Advanced Manufacturing Technology 41, 2009, pp.760-769.

[7] Asiabanpour Bahram."Optimizing the automated Plasma process by design of experiments" .Int.J. Rapid Manufacturing, Vol 1, No. 1, 2009.

[8] Mahapatra S S, Patnaik Amar, "Optimization of wire electrical discharge machining process parameters using Taguchi method". International Journal of Manufacturing Technology 2006

[9] Abdul Kadi Gullu, UmutAtici, Investigation of the Effects of Plasma Arc Parameters on the Structure Variation of AISI 304 and St 52 Steels. International Journal of Material and Design 27: 1157-1162. 2006.

[10] K. Ranaetal.Optimization of PAC by Taguchi method. International Journal of Enhanced Research in Science Technology & Engineering, ISSN: 2319-7463Vol. 2 Issue 7, July-2013, pp: (106-110)

[11] Dr.Rachayya.R Arakerimath, Dr.V A Raikar. Productivity improvement by SA and GA based MOO in CNC- machining. International journal of mechanical engineering and technology (IJMET), ISSN-0976 – 6340, ISSN 0976 – 6359(online) volume 3, issue 1, January (2012), © IAME.

[12] Users Manual, MITUTOYO Surftest SJ-400 [6] Sijo M.T and Biju N, 2010, "Taguchi method for optimization of cutting parameters in Turning Operations" AMAE.2010.01.536pp-103-105.

[13] E. Brinksmeimer, H.K.Tonshoff , C.Czenkusch and C. Heinzel (1998) "Modeling and Optimization of grinding process". Journal of Intelligent Mnufacturing pp303-314.

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