

STUDY OF ENERGY CONSUMPTION RATE IN DRILLING OF SS316 BY TAGUCHI AND GRAY RELATIONAL METHOD

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Abstract-Make a circular hole in solid part to join an assembly with help of rotating tool harder than work material is called as drilling operation SS316 is the substance contain 0.15% of carbon make it difficult to drill. It consumes more power. But proper drilling scenario and factor use can predict powers unnecessary use of power. Speed, feed, thrust, torque are the factors influence on the power rate. Using proper range of parameters drilling can be easier and more flexible. This study has been focused on experimental and optimization techniques like Taguchi and gray relational to find influencing factor and range of that factor. With aim of less power consumption and increasing material removal rate. From results and readings of experimentation it found that speed and feed are the most influencing parameter in drilling as low speed low power consumption and low feed low MRR. Hence we conclude that from gray relation and response graph low feed and low speed is the best combination. Level 1 is best for both speed and feed.

Keywords: Drilling, Taguchi, Gray relational, Power consumption, SS316

1. INTRODUCTION

Drilling is the hole making process in solid work material by removing amount of material in the form of chips. Cutting tool use in drilling says drill bit, Drill bit hold by tool holder and fix with a key during machining. Work piece hold by chuck in advance as well as in conventional machining flexible drilling condition can understand by means of feed, speed tooling, lubrication, surface finish, MRR, Machining method and power consumption too.

1.1 Tool and SS316 substance

Tool use in drilling is called as drill bit. Properties that every drilling tool should have is less wear, good strength, changing flexibility.

HSS-high speed steel is best tool suggested by experts for harden steel drilling. Alloy combination

of Ti and molybdenum make HSS suitable for cutting and contain is around 14-15% in HSS tool. HSS also has capacity to predict heat, wear, friction.

SS316-Material with hardness 72HRC use in many application such as petrochemical supply, fabrication, food processing industry. Carbon contain of 0.15% gives higher strength, surface finish of product made from ss316. Specification of ss316 as follow

Table 1.1.1 Chemical properties

Carbon	0.15max
Manganese	2.00max
Silicon	0.75max
Chromium	16-18
Nickel	10-14

Table 1.1.2 Mechanical Properties

Grade 0.2 % Proof Stress MPa (min)	205
Tensile Strength MPa	795

(min)	
Elongation % (min)	35
Hardness (HV) (max)	79



Fig-1.1 SS316

CNC/VMC- CNC stand computer numerical control and VMC stand vertical machining center. Advance machining methods in era of higher productivity. Operating is done by computer code and language use in controls are G and M codes.it full fill production demands in high rate with less timing all control and operation done by sensors. The sensors use in machining are the proxy sensors. Machining is done by planned and well executed computer programs. Tooling flexibility is adoptable as compare to convectional machining,

Taguchi Method-Taguchi method is the method developed for finding influencing factors where multi parameters in account. In production and machining operation like drilling, Milling many parameters like feed, speed, force, torque is used to find suitable conditions of machining Taguchi method is used The set of fixed array L9 and L18 with different levels small, optimal , large is used.

Gray relational method-Combinational method use for multi response purpose where two parameters are influencing on machining. By following steps and formulation include in GRM results can normalized and obtained

1.2. Literature Review-

Puneeth.H.V and Smith.B.S resented a paper on tool life and force in drilling on the basis of tool coating. Tool which they has used TiAl and TiN and drilling is done with convectional machining. Result they were found is coated twist drill has more life than uncoated tool.

Yogendra Singh Chouhan and M.A.Saloda has presented energy consumption on the lathe drilling method they have used is taguchi method and power consumption is measured using Wattmeters. Results they found is power is more influencing factor on power consumption than feed rate.

Majid Tilouei and Ankit Shah has presented a work on methodology development. They conclude that proper define sequence and algorithm of machinig and operation can minimize time.

Adem Cicek, and Turgy Kivak has been highlight the study of taguchi experimental method on RSM. They conclude that feed and speed are more influencing parameters in RMS.

Kunal Sharma and Abhishek Jatav presented work research on machinig parameters of drilling in ss. Method they have used is Taguchi.Results and conclusion as per them is feed is proportional parameter of roughness less feed more prediction to roughness

2.METHODOLOGY

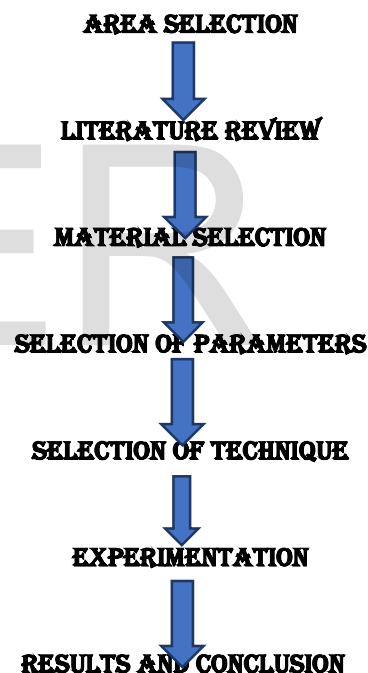


Fig No.2.1 Methodology

3.EXPERIMENTAL WORK

The experiment is conducted on SS316 for finding optimal factors under the aim of predictable rate of power consumption. Tool used in machining is high speed steel tool with dia of 16mm and point angle is 118 degree. Mass of drill bit is around 0.190 kg flute in tool are two. Work piece use for experimental trail is SS316 has thickness of 10 mm. lubrication used in machining is cutting oil that mixed with water. Machining is done on

vertical machining center termed as VMC part of CNC machining has running speed capacity around 2000 rpm. Sensors used in machines are the proxy sensors. Inserts are SPMT and XPMT for tool. To conduct experimental trail Taguchi method use and the array is L9. Level of parameters had been set as per the small, optimal and large. Parameters use in machining are feed, Speed, depth of cut, tool angle, MRR, Power consumption. Input parameters gives to machine are rpm 750 rpm, 1000rpm and 1200rpm, Feed at which material is removed are 0.03, 0.08 and 0.12.

Table no3.1 Machining parameters

Speed Rpm	Feed mm/rev	Depth of mm	Tool angle Degree
0.03	750	10	118
0.08	1000	10	118
0.12	1200	10	118

3.1 Power Consumption

Power consumption can be calculated by any equation of power and instrument use to measure power is wattmeter the factors required to find power consumption is speed, feed, thrust, torque, feed velocity

$$\text{Total power required} = 2 \times 3.14 \times \text{RPM} \times M / 60$$

RPM = Speed of drill in rpm

M = Torque acting on drill

3.2 Results Power consumption, Feed velocity and Material removal rate by taguchi L9 method

EXPERIMENT	FEED rev/mm	SPEED rpm	V _c mm/min	POWER KW	MMR mm ³ /min
1	0.03	750	22	0.401	4529
2	0.08	750	60	0.80	12063
3	0.12	750	90	1.236	18095
4	0.03	1000	30	0.583	6031
5	0.08	1000	80	1.26	16084
6	0.12	1000	120	1.7	24127
7	0.0	1200	36	0.7	7238
8	0.08	1200	96	1.56	19301
9	0.12	1200	144	2.14	28952

3.3 Gray Relational Results

Sr no.	N Power	N of MRR	Z _{ij} Power	Z _{ij} MRR	C _{ij} Power	C _{ij} MRR	AVG C _{ij}
1	1	0	1	0	1	0.33	0.66
2	0.77	0.30	0.23	0.7	0.68	0.41	0.54
3	0.51	0.55	0.49	0.45	0.50	0.52	0.51
4	0.89	0.06	0.11	0.94	0.81	0.34	0.57
5	0.50	0.47	0.5	0.53	0.50	0.48	0.49
6	0.25	0.80	0.75	0.2	0.4	0.71	0.55
7	0.52	0.11	0.48	0.89	0.51	0.35	0.43
8	0.33	0.60	0.67	0.4	0.42	0.55	0.48
9	0	1	0	0	0.33	1	0.66

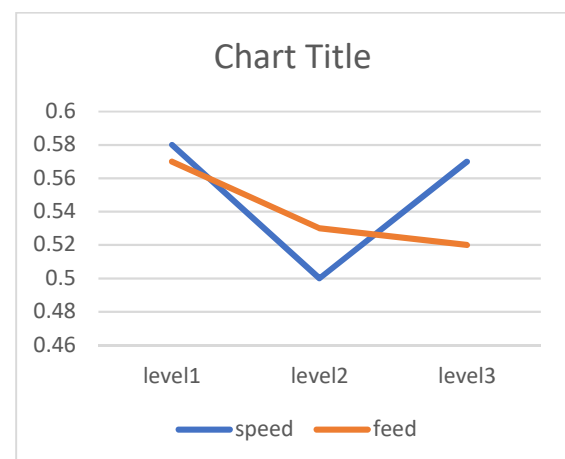


Fig No.3.1 Work Piece

3.4 Ranking of GRA

Level	Feed	Speed
1	0.58	0.57
2	0.50	0.53
3	0.57	0.52

3.4 Response Graph



4. CONCLUSION

- 1.From result it was found that drilling on VMC can analysed by feed velocity V_e .
- 2.Feed and speed are most impacting factor.
- 3.As speed increases, Feed increases more power consumption was found, but at same condition Material rate also more.
- 4.In this study from gray analysis it concluded that Level1 is the best combination for speed and feed.
- 5.From response graph line of speed and feed is meet closely at level1 hence it is the predictable level.

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