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Comparative Analysis Of Drilling Operation Parameters In Die Steel (H13) Using Hss And Carbide Coated Drills

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Abstract: ***Comparative analysis signifies the optimization of Drilling operation parameter and surface roughness of H13 die steel using HSS and Carbide coated HSS drills. Taguchi design of experiments was implemented for analyzing the process parameter of Drilling process on H13 steel plates. The drilling parameters, spindle speed (rpm) and feed rate (mm/min) are optimized via response performance characteristic of surface roughness of H13 die steel plates. H13 steel play an important role in many applications such as Shaft, axle, gears and fasteners due to their strength to weight ratio. The process parameters, spindle speed and feed rate influences the machining accuracy during drilling process. The main objectives of optimization have been identified by getting the lower surface roughness during drilling process of H13 steel plates. Orthogonal array (L18) of Taguchi Design of experiments and Analysis of Variance (ANOVA) are applied to analyze the effect of drilling parameters on Quality of drilled holes. The result of experiment indicate is a dominating parameter of surface roughness of H13 steel plates in Drilling process and indicates the suitable drill bit for Die Steel H13.***
Keywords: H13, Drilling Parameters, Taguchi, Drill bit, ANOVA, Surface roughness, Optimization..

1. INTRODUCTION

Drilling is a machining operation in which a drill is fed in a rotating axis direction in axial direction to the tool with single or multiple cutting edges parallel to the axis of rotation to the feed direction of tool forming a helix. This is called the drill bit cutting edges are called flute. Mostly circular holes or oval holes are created by drilling. It is accomplished by a rotating tool the chip is formed in a twisted shape .H13 is a versatile chromium molybdenum hot work steel that is utilized in hot working die tooling application. H13 resist more thermal fatigue and cracking that happens as the result of cyclic heating and cooling process in hot work tool and die applications. It has a wonderful combination of high toughness and resistance to thermal fatigue, cracking (also called heat cracking).

H13 provides higher hardenability and higher wear resistance than common alloy steels like H11, H12 materials.

1.1 CHEMICAL AND MECHANICAL PROPERTIES OF H13 GRADE DIE STEEL

1.2 **Table 1 -** Chemical Composition of H13 Grade Steel

C	Mn	p	S	Si	Cr	V	W	Mb	Fe
0.37%	0.71%	0.01%	0.013%	0.94%	4.88%	0.96%	0.17%	1.68%	99.63%

Table 2 - Mechanical properties of H13 Grade steel

Young's Modulus	Poisson's ratio	Density	Bulk Modulus
210 Gpa	0.29	7.8 g/cm^3	150 Gpa

2. EXPERIMENTAL SETUP

Machine details the drilling operations have been carried out on a CNC MILLMT250 Machining Center, (Make-MTAB Educational equipment ltd,(India) is shown in fig1. The CNC vertical machining center equipped with a range of variable spindle speed up to 4000 rpm, and 2HP motor drive was used for experimentation.

2.1 COATED CARBIDE DRILL

Cemented carbide coatings are the most popular and most common high production tool material available today. The increase in need is to boost productivity and to reduce the machining time. To machine more difficult material. To wear resistance. To increase tool life by as much as slow down the wear phenomenon of the cutting tools. This increase in tool life allows better productivity. Reduce the machining time and heat generation. It is manufactured by chemical vapor deposition (CVD) or physical vapor deposition.

Table 3 - L9 orthogonal Array of Coated Carbide

SPINDLE SPEED	FEED	SURFACE FINISH	Snra1
300	0.02	0.89	1.01230
600	0.02	0.82	1.72372
900	0.02	0.49	6.19608
300	0.04	0.85	1.41162
600	0.04	0.89	1.01120
900	0.04	0.84	1.51441
300	0.06	0.64	3.87660
600	0.06	0.79	2.04746
900	0.06	0.84	1.51441

From the table -3 it is identified that the surface finish varies due to the variation in parameter and due to variation in surface roughness, the signal to noise ratio of the Surface Roughness also varied.

From the Fig-2, by graphical interpretation of the above curve, the speed and feed variation will vary the surface roughness.

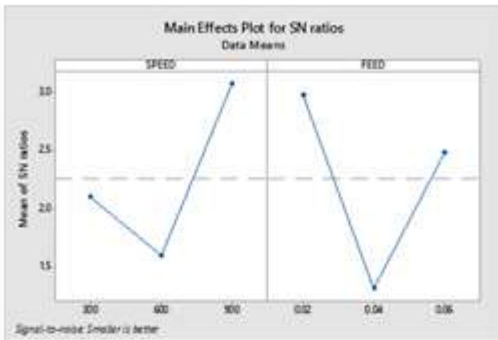

Fig.1. Main effect plot of SN ratio in Carbide coated drill

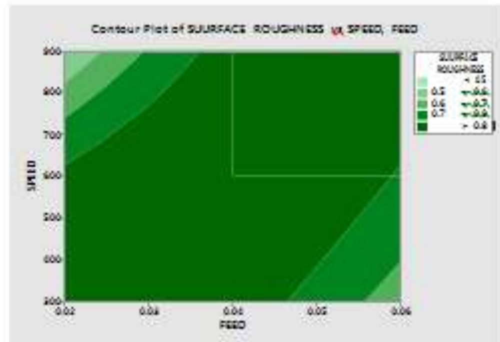

Fig.2. Contour plot of Surface roughness with respect to speed and feed

For 2nd speed and 2nd feed the surface roughness value will be low on the basis of the above graphical representation in the fig-2.

From the above contour plot of fig-3, it is identified that the surface roughness varies in the above graphical manner on the surface based on the different combination of speed and feed. From the above table it is identified that the variation in surface roughness will be more in feed rate since the F value of the feed is more

Table 4 - Response Table for Signal to Noise Ratio

Level	SPEED	FEED
1	2.100	2.977
2	1.594	1.313
3	3.075	2.479
Delta	1.481	1.665
Rank	2	1

Table 5 - Analysis of Variance for Surface Roughness of H 13 Die Steel Using Coated Carbide Drill

Source	DF	SS	MS	F	P
SPEED	2	0.01860	0.009300	0.39	0.701
FEED	2	0.02727	0.013633	0.57	0.606
Error	4	0.09573	0.023933		
Total	8	0.14160			

From the above Table-4 we can identify that the surface roughness of the material on machining at 2nd speed and 2nd feed will produce the smoothest hole among the different combinations that are demonstrated.

2.2 HSS DRILL

High speed steel is a form of tool steel which is harder enough to machine the H13 die steel.

Table 6 - L9 orthogonal array of HSS drill bit

SPINDLE SPEED	FEED	SURFACE FINISH	Snra1
300	0.02	6.02	15.5919
600	0.02	5.12	14.1854
900	0.02	3.20	10.1030
300	0.04	4.41	13.0062
600	0.04	5.01	13.9968
900	0.04	2.94	9.3669
300	0.06	6.78	16.6246
600	0.06	4.86	13.7327
900	0.06	4.92	13.8923

From the Table-6 it is identified that the surface finish or the roughness of the surface changes on different feed and speed parameter variation.

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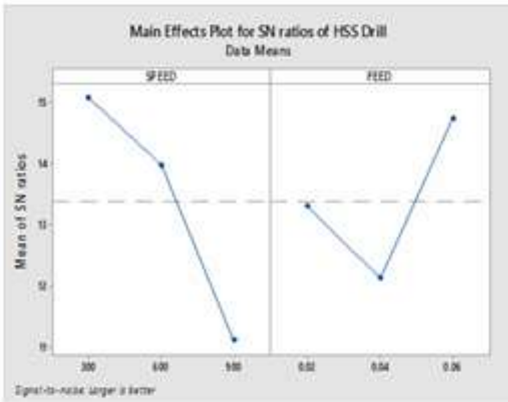

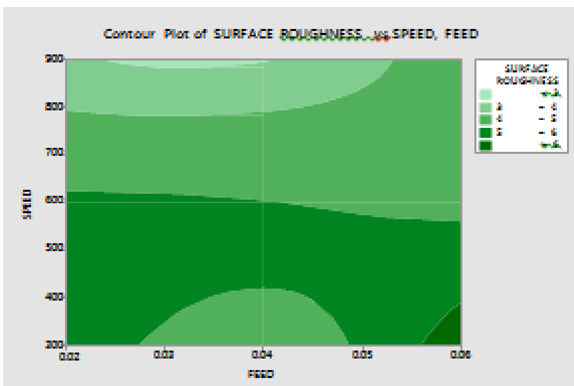

Fig.3. Main effects of SN ratio of Hss Drill

Fig.4. Contour Plot of Surface roughness with respect to speed and feed

From the Fig-4 it is identified graphically that the 3rd spindle speed and 2nd feed rate is lowest among the different speeds and feeds noted to produce the smooth surface in the hole. From the above contour graph in the fig -5, it is identified that the HSS drill will produce rough surface, since the graph interpret in that manner.

Table 7 - Response Table for Signal to Noise Ratios

Level	SPEED	FEED
1	-15.07	-13.29
2	-13.97	-12.12
3	-11.10	-14.73
Delta	3.97	2.61
Rank	1	2

Table 8 - Analysis of Variance of Surface Roughness HSS Drilled H13 Die Steel

Source	DF	SS	MS	F	P
SPEED	2	6.579	3.2893	5.82	0.065
FEED	2	2.862	1.4308	2.53	0.195
Error	4	2.260	0.5650		
Total	8	11.700			

In the above Table-6, we can interpret that the table is the response sheet of signal to noise ratio. From the above table we can identify that the 3rd spindle speed and 2nd tool feed are the lowest and the combination of this speed and feed will produce a smooth surface.

From the above table-6 we can identify the variance in the Surface Roughness and we can interpret that the spindle speed is the Dominating value since it has higher F value.

3. COMPARATIVE ANALYSIS OF H13 DIE STEEL BY L18 ORTHOGONAL ARRAY

Table 9 -L18 Orthogonal analysis of H13 Die Steel

SPINDLE SPEED	DRILL TYPE	FEED	SURFACE FINISH	Snra1
300	A	0.02	6.02	-15.5919
600	A	0.02	5.12	-14.1854
900	A	0.02	3.20	-10.1030
300	A	0.04	4.41	-13.0062
600	A	0.04	5.01	-13.9968
900	A	0.04	2.94	-9.3669
300	A	0.06	6.78	-16.6246
600	A	0.06	4.86	-13.7327
900	A	0.06	4.92	-13.8923
300	B	0.02	0.89	1.0122
600	B	0.02	0.82	1.7237
900	B	0.02	0.49	6.1961
300	B	0.04	0.85	1.4116
600	B	0.04	0.89	1.0122
900	B	0.04	0.84	1.5144
300	B	0.06	0.64	3.8764
600	B	0.06	0.79	2.0475
900	B	0.06	0.84	1.5144

From the above table-9 it is identified that the surface roughness of the material will vary extremely, and from the snra1 value it is identified that the carbide drill bit is more perfect that the HSS drill, The term A represents Hss drill and term B represents Carbide coated Drill.

4. CONCLUSION

From this comparative analysis we can identify that the best combination of spedeand feed are 300 rpm and 0.06 mm/rev in the use of carbide tool. And the roughness value will be very less in this combination. So the coated carbide drill must be used in order to improve the surface smoothness of the drilled hole in H13 die steel.

REFERENCES

[1] Paul, A.; Kappor, S.G. & Devor R.E. (2005). Chisel Edge and Cutting Lip Shape Optimization for Improved Twist Drill Point Design, International Journal of Machine Tools & Manufacture, 45, pp.421431.
[2] RP Rampersad, Hareland, G., and Boonyapaluk, P.: "Drilling Optimization Using Drilling Dataand Available Technology," paper SPE 27034 presented at the SPE LAPEC Conference, Buenos Aires, 27-29 April, 2009.
[3] B.Y. Lee, H.S. Liu and Y.S. Tarng, (2006). Modeling and Optimization of Drilling Process. Department of Mechanical Manufacture Engineering, National Huwei Institute of Technology, Huwei, 632, pp. 1-9.
[4] C. Sanjay, M.L. Neema and C.W. Chin, (2005). Modeling of Tool Wear in Drilling by Statistical Analysis and Artificial Neural Network, Journal of Materials Processing Technology, 170, pp. 494–500.
[5] Chandrasekharan V., Kappor S.G. and DeVor R.E, A Mechanistic Approach to Predicting the Cutting Forces in Drilling: with Application to Fiber- Reinforced Composite Materials, ASME J. Eng. Ind., (117),559–570.
[6] Paul, A.; Kappor, S.G. & Devor R.E. (2005). Chisel Edge and Cutting Lip Shape Optimization for Improved Twist Drill Point Design, International Journal of Machine Tools & Manufacture, 45, pp.421431.
[7] RP Rampersad, Hareland, G., and Boonyapaluk, P.: "Drilling Optimization Using Drilling Data and Available Technology," paper SPE 27034 presented at the SPE LAPEC Conference, Buenos Aires, 27-29 April, 2009.
[8] B.Y. Lee, H.S. Liu and Y.S. Tarng, (2006). Modeling and Optimization of Drilling Process. Department of Mechanical Manufacture Engineering, National Huwei Institute of Technology, Huwei, 632,pp. 1-9.
[9] Kadam M.S., Pathak S.S.Experimental Analysis and Comparative Performance of Coated and Uncoated Twist Drill Bit Dry Machining International Journal of Research in Mechanical Engineering and Technology Vol. 1, Issue 1, Oct. 2011.
[10] S.A. Jalali and W.J. Kolarik, (2001). Tool life and Mach Inability Models for Drilling Steels, International Journal of Machine Tools & Manufacture, 31 (3), pp. 273–282.