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Optimization of Twist Drill Tool

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ABSTRACT

Metal cutting processes are very important for high metal removing rate and best product quality. The cutting tool is one of the most essential elements in realizing full potential out of any metal cutting operation. The major problem in achieving high productivity and high quality is short life of tool. For increase life of cutting tool new materials with different heat treatment and different tool geometry are used. In this paper we are going to discuss optimization of drilling tool .we changed existing material of ground flute twist drill and suggesting best suitable material which performs better than existing material. We select different heat treatment cycles to find out optimum heat treatment cycle.

Keywords: Drilling Tool, Heat Treatment, Wear Test, Tool Geometry, Performance Test**.**

I. INTRODUCTION

Drilling is one of the basic machining processes of making holes and it is essential for automobile, aerospace, ship building, off-highway equipment, railway etc. In drilling, material is removed in the form of chips. Drilling tool is used for drilling operation. Drills are basically used in woodworking, different type of metalworking. Specially designed drills are also used in space missions and other applications. Drill bits are available with lot of variety depending on performance characteristics, spindle speed, surface finish and accuracy of operation.

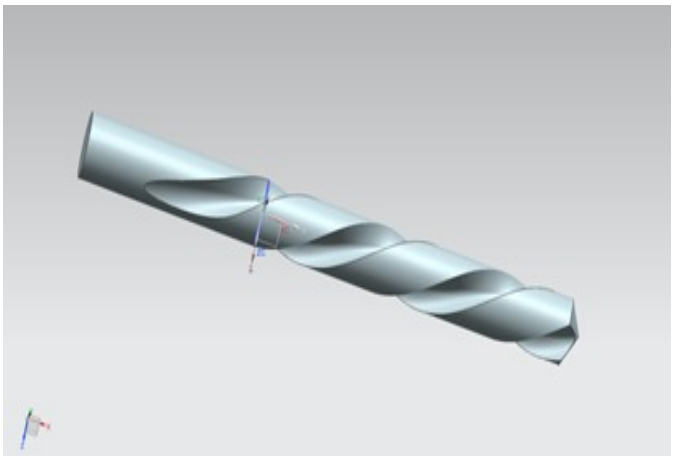

Figure 1. Ground Flute Twist Drill Tool

A. Literature Survey

Luis Miguel Durao et al. (2014), analysed the characteristics of carbon fiber reinforced laminates has widen their use from aerospace to domestic appliances. In many of the possible applications laminates need to be drilled for assembly purposes. Drilling process that reduces drill thrust force can decrease the risk of delamination. In his work, damage assessment method based on data extracted from radiographic images are compared and correlated with mechanical test results, bearing test, delamination onset test and analytical model. The result demonstrates the importance of adequate selection of drilling tools and machining parameters to extend the lifecycle of these laminates to enhance reliability.

Kadam and Pathak (2011), analysed experimental investigation was conducted to determine the effect of the input machining parameters such as cutting speed, feed rate, point angle and diameter of drill bit on Hass tool room Mill USA made CNC drilling machine under dry condition. The change in chip load, torque and machining time are obtained by series of experiments. The comparative performance of commercially available single layer titanium nitride and HSS tool for T105CR EN31 steel under dry condition is done. This paper also gives the results of analysis of variance to confirm the validity and correctness of the established mathematical

models for depth analysis of effect of finish drilling process parameters on the chip load, torque and machining time.

Anil Jindal (2012), analysed tool wear rate in drilling operation using scanning electron microscope. High production machining and drilling with high cutting velocity feed and depth of cut is associated with generation of large amount of heat and high cutting temperature. Such high cutting temperature reduces dimensional accuracy as well as tool life. In this case high pressure coolant is very effective to reduce temperature. He added that Ti is generally used for parts requiring the great reliability and resistance of wear, and therefore high hole quality must be maintained. He concluded that the formation of chip under HPC condition is more favourable in compare to dry condition because of high lubricant capacity. HPC presented better quality.

Yogendra Tygil (2012) has analysed drilling of mild steel with CNC drilling machine by using high speed steel tool by applying Taguchi methodology (DOE approach). A L9 array, Taguchi method and analysis of variance (ANOVA) are used to formulate the procedure tried on the change of parameter. Design offers systematic method of optimization surface finish as well as high material removal rate.

B. Objectives

Objectives of our project work are as follows:

- We use different combinations of materials and heat treatment cycles for getting optimum result.
- Performance of drill depends upon wear rate, before taking actual trial we select different material and different heat treatment cycle and using wear test we select optimum combination develop tool as per specification.
- To enhance further performance of drill tool we use again different combinations of different spindle speed and point angle, to find better performance of drill on same condition.

By this project work and analysis, we can optimize the drilling tool by considering the factors such as drilling tool material, heat treatment cycle, Spindle speed, tool geometry

C. Selection of Materials

We are select high speed steel grade material for our project work. Chemical composition of different steel grade material is as below.

TABLE 1. CHEMICAL COMPOSITION OF MATERIAL

Material	C	Cr	Mo	V	W	Co
Molybdenum HSS - M2 (used)	0.9	4.1	5	1.8	6.4	_
Cobalt steel-M35	0.8	4	5	2	6.5	5
Molybdenum series HSS alloy-M42	1.1	3.9	9.2	1.2	1.4	7.8

II. WEAR TEST

We conducted wear test to find out best wear resistance material among all our selected materials. For that we prepare 9 pin samples 3 of each material and use different heat treatment cycles for optimum results as shown below.

Wear Test is conducted on Pin on disc Apparatus as shown below.

Figure 2. Pin on disc wear test apparatus

A. Heat Treatment Cycles

Table 2. Different Soaking Temperature And Soaking Time For Hardening

Sr. No	Material	Soaking Temperature (^{0}C)	Soaking Time (Sec)
1	M2-A	1190	225
2	M2-B	1205	245
3	M2-C	1210	265
4	M35-A	1190	225
5	M35-B	1205	245
6	M35-C	1210	265
7	M42-A	1190	225
8	M42-B	1205	245
9	M42-C	1210	265

Tempering is always followed by hardening process. Following tempering cycle is used.

Table 3. Tempering Cycle

1st Tempering	2nd Tempering	3rd Tempering
560°C *2 hour	555˚C *1.5 hour	555˚C *1.5 hour

B. Wear Test Results

We conducted wear test for 9 pin at same input conditions.

Input Parameters are as follows:

Speed – 200 RPM

Load – 10 Kg

Time – 10 Minutes

Results of wear test are as shown below.

Table 4. Results of Wear Test

Sr No.	Pin	Maximum Wear (Micrometres)	Temperature(˚C)
1	M2-A	1250	47
2	M2-B	1207	44
3	M2-C	1232	46
4	M35-A	781	33
5	M35-B	780	30
6	M35-C	783	35
7	M42-A	264	27
8	M42-B	250	26
9	M42-C	277	29

We are considering optimum heat treatment cycle at which pin shows high wear resistance for comparison between three materials

We take values of wear and temperature for following heat treatment cycle

TABLE. 5 OPTIMUM HEAT TREATMENT CYCLE

Soaking Temperature (˚C)	Soaking Time (Sec)
1205	245

As material shows high wear resistance at above hardening cycle. We are considering wear values at this optimum cycle for comparison of materials

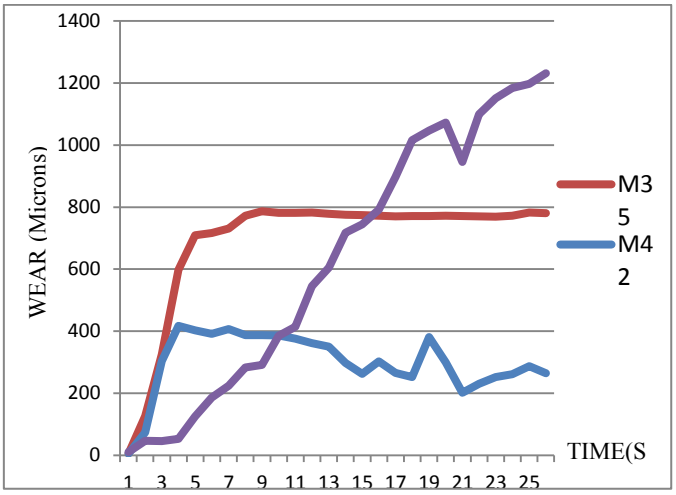

Figure 3. Graph of comparison of wear of selected materials for optimum heat treatment cycle

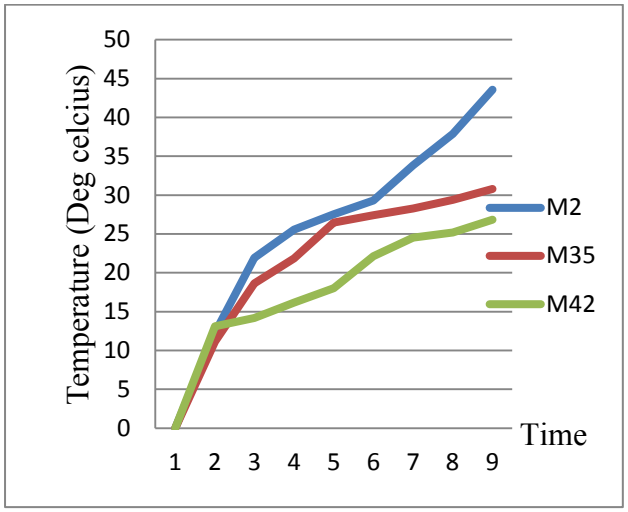

Figure 4. Graph of comparison of temperature

According to wear test results M42 is best material which performs better at above mention heat treatment cycles. So we manufactured Ground flute twist drill of M42 material for further experimentation.

III. PERFORMANCE TEST

Performance test is conducted on endurance testing machine which is available at JK Files India Private Limited, Chiplun,. We calculate performance of Existing material of twist drill tool (M2) and our best selected material (M42) in terms of number of holes.

Figure 5. Performance testing machine

Following are the performance test parameters:

1. Column Drilling M/C
2. Cutting Speed- 500 RPM
3. Cutting Feed- 100 mm/min
4. Depth of Hole- 48 mm
5. Test Bar- EN9 (C:0.45%-0.65%
6. Testing Block Hardness- 229 BHN

Results of performance test is as shown below.

Table 6. Result of Performance Test

Size (mm)	Performance (No. of Holes)	
	M2(Exiting)	M42(New)
14mm	37.1	62.5

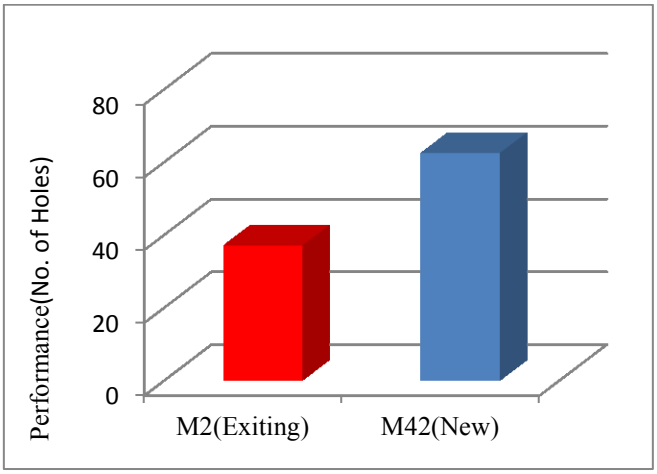

Figure 6. Comparison between existing and new material

We improved the performance of ground flute twist drill tool 1.68 times of existing tool.

IV. FURTHER ENHANCEMENT

For further increase in performance of drilling tool we are taking trial at different Spindle speed and point angle combinations to find out optimum results for M42 material drill tool.

We manufactured three ground flute twist drills of different angles such as 90˚, 118˚, 135˚ respectively and take again performance test to study effect of spindle speed and point angle on twist drill tool.

Table 7. Performance Test Results At Different Spindle Speed And Point Angle

Size mm	Material	Spindle Speed(RPM	Point Angle(Deg)	Performance (No of holes)
14	M42	500	90	51.2
			118	62.5
			135	55.2
		750	90	53.2
			118	65.2
			135	54.5
		1000	90	54.5
			118	61.3
			135	53.8

From the results of performance test we concluded that Tool performance is low at 90˚ point angle because of delamination (mode of failure) is high. And at 135˚ point angle thrust force is more so drill performance is less .So optimum point angle is 118˚.

Effect of spindle speed on performance of tool is negligible. But it effects on surface finish of drill because material remove per revolution is less for same feed rate. So for high spindle speed surface finish is better.

V. CONCLUSIONS

In this way we performed experiments for optimization of ground flute twist drill tool by changing its existing material and heat treatment cycle. And we suggest best suitable material and optimize heat treatment cycle which gives optimum results and perform better than existing material.

Also we studied effect of spindle speed and point angle on the performance of twist drill tool by taking performance test at different spindle speed and appoint angle combinations.

VI.REFERENCES

[1] Luis Miguel P Durao, Joao Manual R S Tavares, Victor Hugo C de Albuquerque, Jorge Filipe S Marques and Oscar N G Andrade (2014),"Drilling Damage in Composite Material", Materials, Vol. 7, pp. 3802-3819

[2] Kadam M S and Pathak S S (2011), "Experimental Analysis and Comparative Performance of Coated and Uncoated Twist Drill Bit Dry Machining", IJMERT, Vol.1, pp 33-37

[3] Anil Jindal (2012), "Analysis of Tool Wear Rate in Drilling Operation using Scanning Electron Microscope",JMMCE Vol. 11, No. 1, pp.43-54

[4] Yogendra Tyagi, Vedansh Chaturvedi (2012), "Optimization of Drilling machining Process using Taguchi Design and ANOVA approach ",IJETAE, Vol. 2, Issue 7,pp.18-22

[5] Wong F R, Shari S, Kamdani K and Rahim E A (2008), " The Effect of Drill point Geometry and drilling Technique on Tool Life when Drilling Titanium Alloy, TI6AL-4V", International conference on Mechanical & manufacturing Engineering , May 21-23, pp.26-33

[6] Thomas G. Digges, Samuel J. Rosenberg, and Glenn W. Geil, "Heat Treatment and Properties of Iron and Steel", National Bureau of Standards Monograph 88, Issued November 1, 1966.

[7] H.E. Boyer, Chapter 1, Practical Heat Treating, 1st ed., American Society for Metals, 1984, PP 1–16.

[8] George Krauss, 'Steels Processing, Structure, and Performance, 2005,ASM International.

[9] Alan M. Bayer and Bruce A. Becherer, Teledyne Vasco, 'High Speed Tool Steel", ASM Handbook, Volume 16: Machining, Page : 51-55