International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 06 Issue: 11 | Nov 2019 www.irjet.net p-ISSN: 2395-0072

Improving the Performance of M42 Twist Drill Tool

Mr. S. S. Ghuge[1], Prof. V. S. Aher[2]

[1]M.E. (Design) Student, Mechanical Engineering, AVCOE Sangamner.
[2]Asst. Professor, PG Coordinator, Mechanical Engineering, AVCOE Sangamner.

Abstract - *This paper discusses optimization of heat treatment process by applying Taguchi methods to improve the quality and consistency in the performance of HSS 4241 drill bits T4241 steel is used as the work piece material for carrying out the experimentation to optimize the heat treatment process parameters. In this project work we are going to increase tool life of twist drill tool by its optimization. we changed existing material molybdenum high speed steel (M2) of ground flute twist drill and suggesting best suitable material molybdenum series high speed steel alloy (M42) which performs better than existing material. We select heat treatment cycle to find optimum result. Also for further enhancement we study effect of spindle speed and point angle on twist drill tool. And find optimum spindle speed and point angle. After optimization we increases hardness, improved the tool life and reduces cost per component of twist drill tool.*

Key Words: Taguchi method[1], Twist Drilling tool[2], Heat Treatment Cycle[3], Point Angle[4], Spindle Speed[5].

1. INTRODUCTION

Drilling is one of the basic machining processes used to create satisfactory surface quality cylindrical holes and it is essential for ship building, automobile, off-highway equipment, railway aerospace 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. Various types of drill bits are available depending on performance characteristics, surface finish, spindle speed, and accuracy of operation. The spindle of the drill press clamps to the shank of the drill bit via the chuck, allowing transfer of rotation and cutting force/pressure to the drill bit to create a hole via the drill point. During the drilling process, as the interconnections of material particles are destroyed during cutting, the drill bit is exposed to mechanical, thermal, and chemical influences, or wear. The durability and lifetime of the drill bit depends on the drill bit material, the work piece material, operating modes, and, most importantly, the cutting speed. Commonly, a lubricant is used during drilling to dissipate the heat generated during the cutting process.

1.1 Drilling Machine

A Drilling Machine (also known as a pedestal drill, pillar drill, or bench drill) is a style fixed of drill that mounted on the workbench. 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 A Drilling Machine consists of a base, column (or pillar), table, spindle (or quill), and drill head is driven by motor. The Drilling Machine size is typically measured in terms of swing. Swing is to be called as twice the distance of throat, which is the distance from the center of the spindle to the edge which is to be closed to the pillar.

1.2 Twist Drill Tool

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.

Fig -1: High Speed Steel (HSS) drill tool

1.3 Literature Survey

Qamar (2009)analysed results of mechanical testing performed on various heat treated H11 steel samples, to arrive at an optimum heat treatment strategy for hot work applications. The tensile and impact test specimens were fabricated utilizing precision milling and EDM. These samples were subjected to hot heat treatment sequences, consisting of annealing, hardening, air and oil quenching, and tempering at different temperatures. Heat treated samples were mechanically tested for hardness

(Rockwell), impact toughness (Charpy), and tensile properties (yield strength, ultimate strength, ductility). He concluded that mechanical testing of H11 samples revealed that with incrementing temperatures hardness first increases to a maximum and then gradually decreases; impact toughness first decreases to a minimum and then increases; yield strength first decreases, and then increases again; ultimate strength first increases to a maximum and then steadily decreases; and ductility (% elongation) gradually decreases till 600ºC, and then increases rather sharply.

Liu et al (2005), studied the effects of heat treatment on two cobalt-predicated alloys, T-400 and T-200. These two alloys were heated in different conditions. The phases and microstructures of the alloys before and after the heat treatments were analyzed utilizing x-ray and scanning electron microscopy. The mechanical and tribological properties of the alloys were investigated utilizing a Nano-indentation technique and a pin-on-disc tribometer, respectively. The Laves intermetallic phase is so abundant (35–70 vol. %) in these alloys that its presence governs all of the material properties. Heat treatment alters the volume fraction, the size/shape, and the distribution of the laves phase in the microstructures as well as the phase and structure of the cobalt solid solution, thus influencing the mechanical and tribological properties of the alloys.

Balakumaran(2015) studied the methodology of modified Taguchi optimization method for simultaneous minimization and maximization of surface roughness (Ra), according to him machining time and material removal rate of EN31 alloy steel affect the aesthetical aspect of the final product and hence it is essential to select the best combination values of the CNC drilling process parameters to minimize as well as maximize the responses. The experiments were carried out as per L9 orthogonal array with each experiment performed under different conditions of such as speed type of drilling tool, and feed rate. He used Taguchi method and analysis of variance (ANOVA) which was employed by utilizing MINITAB-15 software to identify the calibre of consequentiality of the machining parameters on surface roughness (Ra), machining time and material removal rate (MRR). In his experimental investigation, the Taguchi technique and ANOVA were used to obtain optimal drilling parameters in the drilling of EN31 steel under wet conditions. The experimental results were evaluated utilizing ANOVA.

Yogendra Tygil (2012) has analyzed 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.

2. PROBLEM DEFINITION & OBJECTIVES

The productivity, cost and quality are the three factors which must be optimally managed in order to sustain in today's competitive world. The customers are always attracted towards a product having competitive cost and good quality. In today's DIY (Do it yourself) the consumers are more conscious about product cost. In drill manufacturing the only way to bring down the cost of the product is to substitute the raw material with the one having lesser cost per unit and at the same time can also give adequate performance.

The objective of this project is as follows

- 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.
- To evaluate the best possible heat treatment to get an optimum performance of the drills manufactured from HSS4241.
- Selection of alternative raw material for M2 having lesser cost per unit and having desirable metallurgical composition so as to yield desirable properties after heat treatment cycles.

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.

3. EXPERIMENTIATION

3.1 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.

Fig -2: Photograph of Pin Specimen

Fig -3: Pin on disc wear test apparatus

Wear Test is conducted on Pin on disc Apparatus as shown in fig-3.

Input Parameters are as follows: Speed – 200 RPM, Load – 10 Kg & Time – 10 Minutes.

3.2 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
M2 (used)	0.9	4.1	5	1.8	6.4	_
M35	0.8	4	5	2	6.5	5
-M42	1.1	3.9	9.2	1.2	1.4	7.8

3.3 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. Following are the performance test parameters:

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

Fig -4: Performance testing machine

4. RESULTS & DISSCUSSION

Table -2: Values of Maximum Wear & Temperature

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

According to wear test analysis maximum wear and temperature of M42 pin samples is less than the other materials. So M42 material is best wear resistant material among the three selected materials.

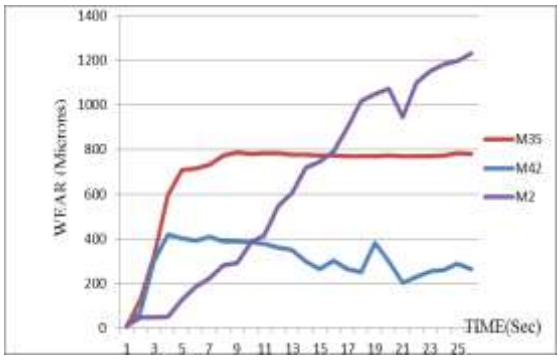

Chart -1: Comparison of Wear rate

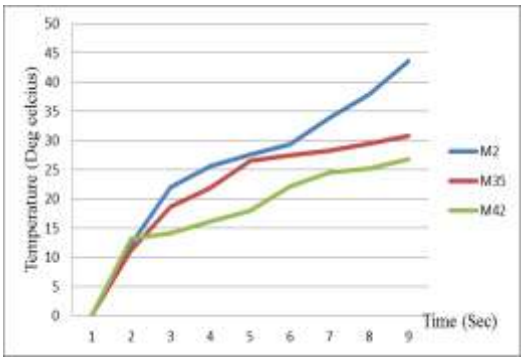

Chart -2: Comparison of Temperature

5. 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. 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.

Table -3: 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

6. CONCLUSION

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. We also studied the effect of spindle speed and point angle on performance of twist drill tool. And concluded that as we increases point angle thrust force on tool increases; optimum point angle is 118 ˚for M42 materials. And at 750 RPM spindle speed tool performs better.

ACKNOWLEDGEMENT

I express my sincere gratitude to my guide V. S. Aher (Asst. Professor, Mechanical Engineering, AVCOE Sangamner) and Tajane Sumit Sir (Drill Quality Assurance, JKFIL, Pvt Limited, Chiplun) for their technical support which made this Project possible. Their constant encouragement, suggestions and ideas have been in valuable to this work. I immensely appreciate the time they devoted reviewing my writing and vastly improving my technical writing skills. Their thoroughness, discipline and work ethic are laudable and worthy of emulation.

REFERENCES

[1] V. Balakumaran, C. Parthasarathy (2015), "Optimization of Drilling Parameters on EN31 Steel with Chromium Coated Drill Bit by Using TAGUCHI Method." Journal of asian review of mechanical engineering, Vol. 4 No. 2, pp. 18-22S.Z.

[2] Qamar (2009.), "Effect of Heat Treatment on Mechanical Properties of H11 Tool Steel", Volume, 35 Issue 2, pp. 51-57

[3] Liu. et. Al.(2005) , "Effects of Heat Treatment on Mechanical and Tribological Properties of Cobalt-base Tribaloy Alloys." Journal of material engineering and performance, Volume 14, Issue 5, pp. 634–640

[4] T. Senthilkumar and T. K. Ajiboye (2012), "Effect of Heat Treatment Processes on the Mechanical Properties of Medium Carbon Steel", Journal of Minerals & Materials Characterization & Engineering, Vol. 11, No.2 pp.143-152, 2012

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

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

BIOGRAPHIES

Mr. Sampat Sudam Ghuge.
M.E.(Design) Student, Mechanical Engineering, AVCOE, Sangamner