ANALYSIS OF DRILLING TOOL LIFE: A REVIEW

Ms. Hase Anita V.[1], Prof. Patil Amol R.[2]

[1] ME (Design) Student, Mechanical department, Sahyadri valley college of engineering & Tech. Maharashtra, India

[2] HOD, Mechanical department, Sahyadri valley college of engineering & Tech. Maharashtra, India

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 project work we are analyzing drilling tool life by changing existing material of ground flute twist drill and suggesting best suitable material which performs better than existing material also different heat treatment cycle, to find out suitable heat treatment process.

Keyword: *Drilling tool, heat treatment, wear test, tool geometry, Performance test.*

1. 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.

1.1 Tool Geometry

Twist drill is used in high feed rate applications under low spindle speed. The portion of the drill which extends from the extreme cutting end to the shank is called as body. Shank is the portion of drill by which drill is held and driven during working. Flutes are the grooves in the body of the drill which provides lips, permit the removal of chips and allow cutting fluid to reach the lips. The middle portion of drill is situated between the roots of the flutes and extending from the point end towards the shank is called as web. The point end of the web consists of chisel edge.

The point angle which is at the tip of the bit is determined by the material. Harder materials require a larger point angle whereas softer materials require sharper angle. A lip angle determines the amount of support provided to the cutting edge. A greater lip angle will cause the drill tool to cut more rapidly under the same amount of point pressure as a bit with a smaller lip angle. The diameter to length ratio of drill bit is usually 1:1 and 1:10. Much higher ratios are possible, but higher the ratio greater will be the technical challenge of producing good work.

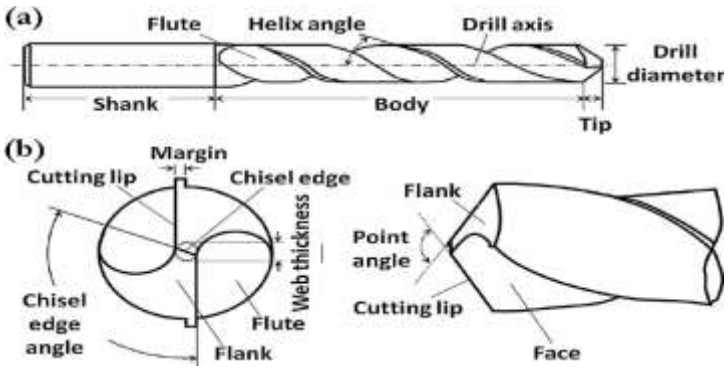

Fig-1 Tool Geometry of twist drill

1.2 Literature Survey

Luis Miguel Durao et al. (2014), analyzed 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), analyzed 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), analyzed 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 favorable in compare to dry condition because of high lubricant capacity. HPC presented better quality.

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.

1.3 Problem Definition

The cutting tool is one of the important elements in any metal cutting operation. Over the years the demands of economic competition have motivated a lot of research in the field of metal cutting leading to the evolution of new tool materials of remarkable performance for an impressive increase in productivity. On drilling tool many problems occurs during operations such as breakage, wear, rough surface finish, short tool life etc. These problems are affects finishing of machined products, life of cutting tool and reduces productivity of drilling. Tool material effects on wear of tool during operation and also tool life.

2. EXPERIMENTATION

2.1 Methodology

In this project work we are going to finding best alterative material for drilling tool. This should give highest achievable performance under given constraints.

- Initially we use different combinations of our selected material and different heat treatment and then analyze wear behavior of our selected material test samples by Pin on disc test rig.
- The Steel grade having best wear resistance will be selected for further experimentation.
- Ground Flute Twist Drill samples to be prepared with the HSS grade steel which is best wear resistant among our selected materials based on wear test result.
- Drilling test will be conducted on EN-9 Steel substrate having hardness of 180-200 BHN to compared performance of existing drills against the drills samples prepared with the new material.
- Finally comparison of results between already used material and our selected material.

2.2 Availability of Testing

1. Heat Treatment
    - Hardening: Available at JK Files (India) Ltd, Chiplun.

Fig2- Auto hardening setup installed at JKFIL, chiplun

- Tempering: Available at JK Files (India) Ltd, Chiplun.

Fig 3- Tempering process setup at JKFIL, chiplun

2. Endurance Testing Machine: Available at JK Files (India) Ltd, Chiplun.

Fig. 4- Performance testing machine

3. Pin on disc apparatus (Wear Test): Available at PDVVP College of engineering Ahmednagar

Fig. 5 Pin on disc wear test apparatus

2.3 Selection of Material

We are selecting 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

3. OBJECTIVES

Objectives of this project work are as follows:

- Using different grade of material and various heat treatment cycles. We use different combinations of material 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 life by considering the factors such as drilling tool material, force on tool surface, drilling rate.

4. FUTURE ENHANCEMENT

By this project work we optimize ground flute twist drill tool by considering following factors,

- Drilling tool life
- Drilling tool material
- Drilling tool geometry
- Spindle speed and feed rate

5. ACKNOWLEDGEMENT

I express my sincere gratitude to my guide Professor A. R. Patil (HOD Mechanical Dept SVCET Rajuri) 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.

6. 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