

Review on MQL System for Straight Turning Operation on CNC Lathe Machine

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Abstract: Minimum Quantity Lubrication (MQL) is used as an alternate method to flood or excess lubrication by using mixture of compressed air and specific lubricating oil for the material. Flood lubrication is majorly used for the machining process in CNC lathe machine. But the use of flood type lubrication leads to rise in cost of material machined, use of MQL is more ecofriendly and economical which helps in drawing manufacture's attention. MQL technique can fulfill the high productivity demands of machined material. High productivity of material in limited time leads to high cutting velocity and feed rate which develops undesired high temperature. This undesired temperature have adverse effect not only on tool or insert life but also on the material to be machined. Built up edge between the tool and work piece interface can be avoided by use of MQL. This review paper based on MQL shows reduction in surface roughness, improvement in tool life, comparatively less temperature developed.

Key Words: Minimum Quantity Lubrication (MQL), EN-31, metal cutting fluid, carbide cutting tool, Taguchi method

1. Introduction

Machining is the process of removal of the material from the work piece to get the desired product. Machining involves drilling, facing, turning, boring, and milling etc. machining is one of the important part of the production Industry. In the current scenario almost every Industry use the CNC lathe machine for the machining operation. In production industry continuous lubricating systems are used in CNC lathe machine with increases the cost of the product. During the machining process large amount of heat is generated between the tool and work piece which effects undesirable property change in the work piece and can also result in early tool failure.

Machining are done in this following methods: Dry cutting and flood cutting. In Dry cutting, as per the title itself it conclude that no lubricant is used between the tool and work. Due to this method we can observe, high heat generation, built up edges, high surface roughness and thermal property change on work piece. In Flood cutting traditional cutting fluid act as both coolant and lubricant, and also helps in chip flow. Moderate surface roughness (lesser than that in dry cutting), comparatively less temperature developed. But use of excess lubrication creates problem in operator's health and also environmental pollution. By using the flood cutting method, the estimated cost of cutting fluid ranges from 8% to 16% of the total cost which is required for machining a work.

Minimum Quantity Lubrication

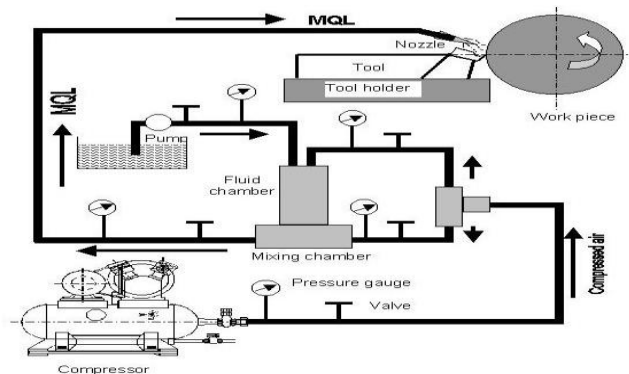
Why to use MQL method for machining process in Industries?

Main objective of the MQL is to minimize the use of lubricant used as a coolant or cutting fluid. In MQL very small amount of fluids blend with the air which flow towards the cutting zone to reduce the friction between cutting tool and work piece. This process are also termed as semi-dry lubrication or micro lubrication. The mixture is sprayed at tool chip interface as an aerosol. MQL is best of its kind, oppose to the traditional flooding technique. The concept of MQL suggests usage small amount of cutting fluid in the range of 50-300 ml per hour as compared to flood cooling which consumes 5 to 50 liters of cutting fluid per hour. A very important parameter which is considered is cooling effect. By the use of suitable lubrication for the material (EN-31) thermal cracks which leads to the failure of the tool can be avoided and can be worked under high cutting speed. MQL technique leads to improvement in dimensional accuracy of work, minimum surface roughness and minimum tool wear. And it will also improve the dimensional accuracy of machined work piece. The cutting fluid is selected by the type of machining process, types of work material, and types of cutting tool material.

2. Methodology

The MQL needs to be supplied at high pressure and at high speed through the spray painting gun on the cutting zone. Considering the condition required for uninterrupted supply of MQL at a constant pressure of 6 bars over a long cut, a MQL delivery system is designed, fabricated and used. The

Simple principle as shown in figure. The mixing of air and cutting fluid is done in the fluid chamber.. The pressure of the air is controlled by control valve and the cutting fluid is pumped with the help of hydraulic pump which is placed over the storage tank. In MQL system the compressed air along with the cutting fluid is impinged on the cutting area in a form of spray through the spray painting gun to reduce the heat generated between the chip tool interfaces.



This operation is performed in following three condition:

- Dry cutting
- Flood cutting
- MQL cutting

Checking the following parameters in tool:

- Temperature
- Surface roughness
- Tool wear
- Chip formation

3. Process plan

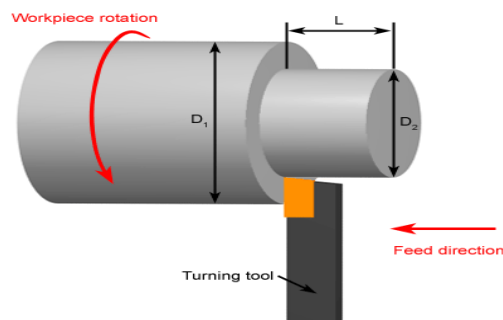
Process plan for perform experiment on taper turning operation in MQL system as follows:

- 1) Selection of material
- 2) Testing of material
- 3) Performing taper turning operation in Dry, Flood & MQL condition
- 4) Determine temperature & surface roughness in cutting condition
- 5) Implementation of experiment by taguchi method.

Straight turning:

Straight turning sometimes called cylindrical turning, is the process of reducing the work diameter to a required dimension as a carriage moves the tool along the work.

In straight turning cross feed are used to determine the depth of cut, which will removes a desired amount of material from the work piece. The reduction in diameter of work piece in a constant dimension is known as straight turning.



4. Taguchi method

Taguchi method are statically method or sometimes it also known as robust design method develops by genichitaguchi to improve of quality manufacturing goods and more recently also applied to engineering, biotechnology, marketing and advertising. The taguchi method is based on orthogonal arrays to minimize the number of experiments and to effectively improve product quality.

Steps

1. Selection of design parameters.
2. No. of levels of design parameters.
3. Conduction of experiments based on arrangement of orthogonal arrays.
4. Analysis of result using S/N ratios.
5. Selection of optimal level of design parameter.
6. Verification through conformation experiment

5. Conclusion

Since the purpose of this study is to optimize value of temperature of tool and work piece interface, to minimize the surface roughness, tool wear & type of chip formation. In this experiment MQL generate e a significant amount of mist compared to flood cooling. With these technologies in place however, machining is safe for both operators and the environment, particularly when vegetable based lubricants are used.

6. References

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