International Journal of Engineering Applied Sciences and Technology, 2020
Vol. 4, Issue 11, ISSN No. 2455-2143, Pages 263-266
Published Online March 2020 in IJEAST (http://www.ijeast.com)

REVIEW ON TURNING OPERATION USING NANO COOLANT AND MINIMUM QUANTITY LUBRICATION (MQL)

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Abstract - In the recent years industry grows up and they wants a better surface finish products. During the turning operation there is a heat generation between tool and work piece and this affects the surface finish. To reduce or minimize this heat conventional flood cooling technique is used but the conventional flood cooling is not as eco-friendly and not economically. The conventional cooling technique large amount of coolant is used in various operations like drilling, turning, milling, etc. but these fluid creates some major problems to the workers and increasing the machining cost. To reduce this problems a new cooling technique is used named as MQL (Minimum Quantity Lubrication). MQL technique reduces the problem which occurs on flood cooling technique. Another technique to reduce the heat is use of Nano coolant it was observed that the surface finish is better in MQL with Nano fluid as compare to conventional flood cooling system hence it is very important to select proper cooling technique to get better surface finish. This paper presents a literature review on types of cooling technology. The study mainly explains the mechanism of MQL technique and Nano coolant.

Keyword - **Turning operation, Surface roughness, MQL, Nano coolant**

I. INTRODUCTION

Machining is an important part in the manufacturing industry at the recent time. In machining the excess material is removed from the material in the form of chips. The device which removes the material is known as tool, In conventional machining process there are different types of machining such as drilling, turning, boring, milling, bronching and many more.

Today is the world of automation and technology changes rapidly. Turning is one of the most common and unique metal cutting technology used in industry. In the modern machining the industries are trying to achieve high surface finish, high quality, dimensional accuracy, high production rate along with reduced environmental impact. In turning process the material is removed in the form of chip.

During the turning operation there is heat generated between tool and workpiece due to that some problems may occur such that tool life & surface finish, it is also affected on the sharpness of the tool and the use of blunt tool outcomes in poor surface finish and more power consumption. Therefore, it is required to minimize the heat generation at the cutting area. Conventionally, cutting fluids is used as lubricants and coolants to reduce these problems. There are numbers of cooling technology are used in turning process as shown in fig.1 [1].

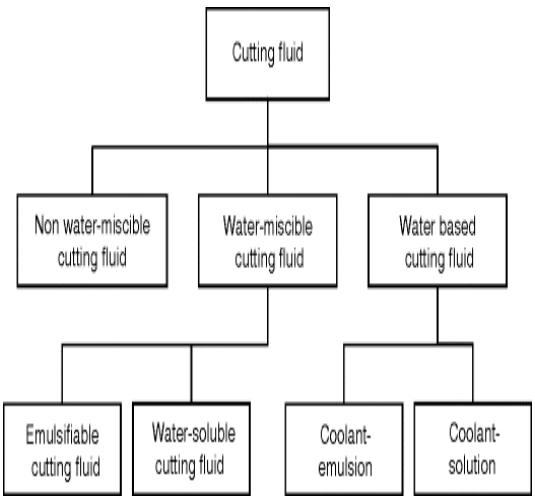

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Fig. 1. Types of cooling technology used in turning process

Generally conventional cooling is the best choice to deal with this heat generation during the turning process in the industries. Coolant can increase the tool life, surface condition of work piece, it is really helpful in machining process.

But the pay jun liew and his team [2] says (2017) that in there review conventional cutting fluids are not eco-friendly, such as they effect on environmental pollution, dermatitis to operator, water pollution and soil contamination. As in the point of economic aspect the cost of conventional coolant is quite minimum, but they are not eco-friendly.

The alternative concept of cutting fluid is use of nano coolant. In the recent years, eco-friendly lubricants are being used very much. Many researchers studied in the area of eco-friendly sustainable minimum quantity lubricant. Nano fluid is the new class of cooling system. It is a mixture of nano particles and base fluid. Base fluid generally use as water, ethylene glycol, and oil, and the nano materials are two types first is metallic nano materials which included Fe, Cu, Au, Ag, etc. and the another type is non metallic nano particles or compound they are Fe3O4 (Iron oxide), Al2O3 (Alumina), CuO, TiO2, SiC, WO3 (Tungusten trioxide), ZrO2 (Zicroma), ZnO, SiO2, etc (2014) [3]. As per vendor's specification the average size of nano level is 80 mm & the micro particles size of 150 µ (2018)[4]. Nano fluids have higher thermal conductivity compared to the conventional coolants. Nano coolants are eco-friendly as well as preferable to the industries, as in conventional cooling techniques liters of coolant were use but in nano coolant only few amount of coolant is use.

II. COOLANT

The main role of Coolant is reduce the heat generation during turning operation. Generally eco-friendly coolant are made from vegetables oil like Rapeseed, corn or soya bean oil, ester etc.

III. MINIMUM QUANTITY LUBRICATION (MQL)

In MQL system a very lesser amount of coolant/ nano coolant is mixed with air, and it is sprayed in the cutting area with very high pressure with the help of nozzle. MQL technique can minimize the manufacturing cost as well as environmental hazards also. In MQL system the cutting fluid were supplied at **30°** angle, and the distance between nozzle and insert tip was constant at 11mm, according to supply direction and the distance of the cutting tip (2018) [5]. In the conventional flood cooling method 120 L/h fluid is used, as in compared less than 500mL/h fluid is used in MQL method (2018) [6]. The experimental setup of MQL is as shown in fig. 2. (2011)[7]

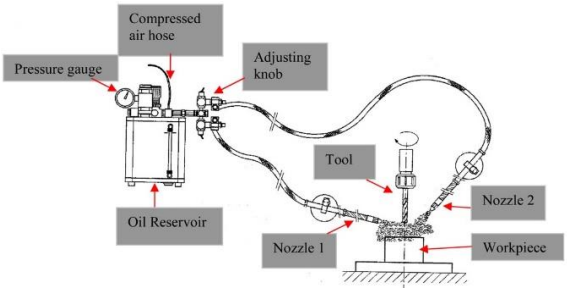

Fig. 2. Schematic setup of MQL system

In the research Radoslaw W. Marudaa, Grzegorz M. Krolczykb, Eugene Feldshteina, Piotr Nieslonyb, Bozena Tyliszczakc, Franci Pusavecd (2016) use crystalline MoS2 powder as a nano coolant particals in MQL system and use material AISI 1045 carbon steel and check the tool wear [8]. In the another research Rukmini Srikant Revuru and his team (2018) check that surface roughness, cutting force and cutting temperature of AISI 1040 steel material using a MQL technique [9]. Munish Kumar Gupta, P.K. Sood, Vishal S. Sharma (2016) use aluminum oxide (Al2O3), molybdenum disulfide (MoS2) as a nano coolant and vegetable oil as a base fluid and check cutting force, tool wear and surface roughness of titanium alloy [10]. Patole P. B., Kulkarni V. V. (2018) use AISI 4340 material and check that surface roughness and tool wear using a nano coolant as a Multiwalled Carbon Nano Tube in MQL system [11].

IV. NANO COOLANT

Nano coolant is a eco-friendly coolant, nanoparticles are solid colloidal particles ranging from 1nm to 100 nm (nanometer) in size . Nano word derives from the Greek word "nanos", which means extremely small. Nanoparticles are different in size like
Coarse particle – smaller than10 µm
Fine particle – smaller than 2.5 µm
Ultrafine particle – smaller than 0.1 µm (100nm).

In the research K.Ch. Sekhar, V.V. Rama Reddy, S. Srikiran, M. Daniel. S. Kumar (2016) use MoS2 nanoparticles as a coolant and check the surface roughness, and they found that surface roughness values are smallest when the weight percentage is taken as 0.5% [12]. In the another

research using a SiO2 as a Nono coolant Murat Sarıkaya and Abdulkadir Gullu (2014) check that the tool wear and surface roughness and they conclude that to increase the cutting productivity and to decrease the negative effects on environment and health the Minimum quantity lubrication is a good tool in machining operation [13]. Mozammel Mia and his team (2018) use SiO2, MoS2 as a Nono coolant and check the surface roughness of the material, chip formation and tool wear and in dry cutting environment it is unable to improved the machining performance, but in MQL found better than the dry and nitrogen gas assistance, especially in reducing VB max and Ra -a reduction as high 60% was attainable [14]. Mohd Sayuti and his co-workers (2014) use Silicon dioxide as a nano coolant and check the tool wear, surface roughness, and oil consumption and they conclude that the minimum tool wear is obtained with a 0.5% wt nanoparticles concentration in the mineral oil, 2 bar air stream pressure and a 60° nozzle orientation angle [15].

V. CONCLUSION

This paper has presented a review of important published researches in turning operation under a various cooling technique. According to review there are differnent types of cooling techniques this techniques gives a better product and this technique is eco-friendly also.

The following conclusion may drawn from the literature review

- Surface roughness is the most important in turning operation.
- The most effective factor that affect the roughness is heat generation and the cutting speed.
- Use of nano coolant reduces the heat generation during operation and hence better surface finish obtain.

VI. ACKNOWLEDGEMENT

This work was carried out within the project Experimental investigation of turning operation on CNC machine by using Nano fluid and Taguchi method. The authors would like to thank the organization J.D. college of Engg. & Management for supporting this work.

VII. REFERENCE

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