International Journal of Advance Research in Science and Engineering
Vol. No.6, Issue No. 07, July 2017
www.ijarse.com
IJARSE
ISSN (O) 2319 - 8354
ISSN (P) 2319 - 8346

A Review on Application and Comparative Performance Evaluation of Minimum Quantity Lubrication with and Without Additive in Turning of Alloy Steel EN8 K

Kadam K.P.[1], Mundhe V.L.[2]

[1]*Department of Mechanical Engineering, BIT Barshi,Solapur (India)*

[2]*Head of Department of Mechanical Engineering, BIT Barshi, Solapur (India)*

ABSTRACT

Minimum quantity lubrication (MQL) has increasingly found its way into the area of metal cutting machining and in many areas, has already as an alternative to conventional wet processing. In contrast to flood lubrication, minimum quantity lubrication uses only a few drops of lubrication (approx. 5 ml to 50 ml per hour) in machining. Today, the enormous cost-saving potential resulting from doing almost entirely without metalworking fluids in machining production is recognized and implemented by many companies.Earlier method of lubrication uses the coolant pump to circulate cooling fluid using coolant pump this method proved costly and so also the machine environment conditions were affected namely floor becoming slippery etc, hence it was decided to implement the minimum quantity lubrication on the machine. MQL technique Consists in atomizing a very small quantity of lubricant in airflow directed towards the cutting zone.Due to use of MQL with additives maximum surface finish, close dimensional tolerance and better tool life can be obtained This papers deals with the study of Application of minimum quantity of lubrication (MQL) and comparative performance evaluation of minimum quantity lubrication with and without additive in turning of alloy steel EN8K.

Keywords: Minimum quantity of lubrication (MQL), additives, Surface finish, EN8K

I. INTRODUCTION

Minimum quantity lubrication (MQL), as its name implies, uses the smallest amount of metal working fluid (MWF) to achieve lubrication during machining processes. MQL has demonstrated in multiple worldwide plants with better quality, higher productivity, minimal environmental impact, lower operation health issues, reduced water and greenhouse gas emission, and reduced energy consumption, which result in lower overall costs. Minimum quantity lubrication is a total-loss lubrication method rather than the circulated lubrication method used with emulsions. This means using new, clean lubricants that are fatty-alcohol or ester based. Additives against pollution, e.g. biocides and fungicides, are not necessary at all, since microbial growth is possible only in an aqueous phase. The extreme reduction of lubrication quantities results in nearly dry work pieces and chips. This greatly reduces health hazards caused by emissions of metalworking fluids in breathed-in air and on the

International Journal of Advance Research in Science and Engineering
Vol. No.6, Issue No. 07, July 2017
www.ijarse.com
IJARSE
ISSN (O) 2319 - 8354
ISSN (P) 2319 - 8346

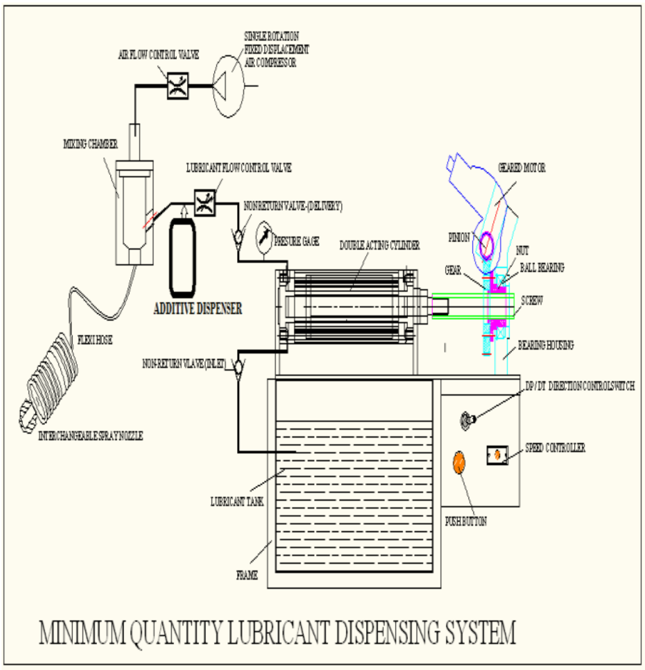
skin of employees at their workplaces. Metalworking fluids do not spread throughout the area around the machine, thus making for a cleaner workplace.There are various kinds of MWF, which include oil, oil-water emulsions, aerosols (mists) gels, pastes, air and other gases. Usually, the oil-water emulsions MWF are widely used in the machiningindustries. The microbial growth from MWF emulsions of oil and water creates environmental and occupational health problems. In order to overcome this problem, biocide is used as an additive to control the microbial growth. Additives are also being used to control the forming of foam and corrosion from the metals and other organic constituents that become
entrained in the fluids during use.

II. MQL SET-UP

The MQL system comprises of following parts

a) Lubricant tank &frame: These are fabricated structural components of the MQL with primary functions of tank to hold the MQL lubricant and the frame to support the entire assembly of the MQL system

b) Dispenseractuator: The dispenser actuator is a double acting hydraulic cylinder with 32mm bore and 100 mm stroke, thus the dispenser volume is 80 cc ,ie in one stroke of the dispenser it is possible to dispense 80 ml of MQL lubricant. The rate of displacement of the dispenser piston is thus important to determine the minimum quantity of oil dispensed per min.



c)DispenserActuator driving mechanism : The forward stroke of the displacer piston is used for the dispensing activity where as the return stoke charges the dispenser. The to and fro motion of the piston is achieved using a power screw and nut arrangement. The power screw is held in a nut supported in ball bearing in a bearing housing. The nut carries an spur gear driven by an spur pinion mounted on the geared motor. The geared motor under consideration is specified below

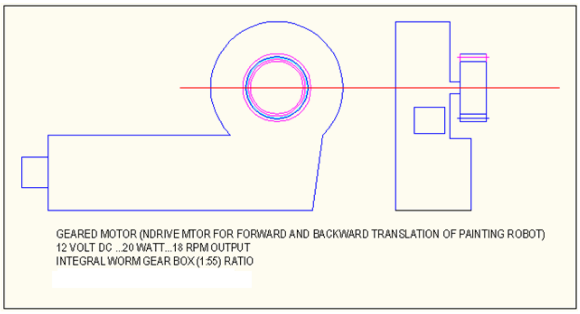
Motor is an 12 volt DC motor , with following specification:

IJARSE
ISSN (O) 2319 - 8354
ISSN (P) 2319 - 8346

Voltage : 12 Volt DC

Power = 20 watt

Mounting : Face mounted



Motor rotates in clockwise and counter clockwise directions to effect the forward and reverse motion of the screw and thereby the piston. Motor speed is regulated by speed regulator where as the direction control is done using a direction control 2 pole -2 way switch

d) Inlet circuit to dispenser : The inlet circuit to the dispenser uses a non return valve opening into the cylinder side and closing on the tank side. This allows lubricant flow from the lubricant tank to the cylinder during suction stroke where as prevents reverse flow from the cylinder to tank during dispensing stroke.

e) Dispensing Circuit : Dispensing circuit connects the outlet of cylinder to the mixing chamber. The circuit comprises the an non return valve opening into the mixing chamber side and closing on the cylinder side. This allows lubricant flow from the cylinder to mixing chamber during dispensing stroke where as prevents reverse air flow from the mixing chamber to cylinder during suction stroke. Circuit also has flow control valve for fine adjustments of flow rate of lubricant to mixing chamber, and pressure gage indicates the pressure in the delivery line.

f) Mixing chamber: Mixing chamber is the device that mixes the MQL lubricant and the compressed air to create lubricant mist to be directed onto the cutting action area to serve a threefoldpurpose;

i) Lubricate the tool tip and job contact area during cutting to minimize the friction between them, thereby reducing the heat produce. Misty nature of the lubricant ensures effective application of lubricant and better heat extraction.

ii) The second advantage of using compressed air mist that, it helps chip evacuation from the cutting area which is one of the major reasons of development of ‘built-up-edges ‘ on tool tip leading to reduced tool life and improper surface finish on job.

iii) The compressed air offer other advantage that , fumes that are likely to be developed due to burning of the lubricant are not developed due to the high velocity of the lubricant particles (they do not reach flash point).

g) Flex hose with interchangeable nozzle : The flex hose connects the mixing chamber and the nozzle , two set of spray nozzle with tip diameters1.5 and 2.0 mm are provided for spraying.

IJARSE
ISSN (O) 2319 - 8354
ISSN (P) 2319 - 8346

III. WORKING:

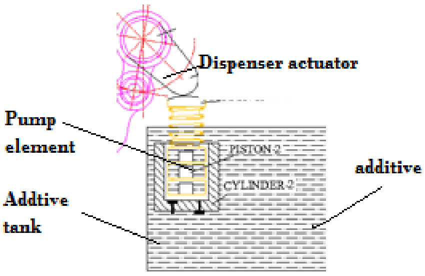
A) Dispenser Charging Cycle:

Motor is rotated in clockwise direction that rotates the nut in counter clockwise direction due to spur gearing , nut rotate and screw is constrained to translate hence it moves back thereby moving the piston in backward direction thereby effecting the suction stroke. The inlet circuit to the dispenser uses a non-return valve opening into the cylinder side and closing on the tank side. This allows lubricant flow from the lubricant tank to the cylinder during suction stroke where as prevents reverse flow from the cylinder to tank during dispensing stroke.

B) Dispenser Delivery Cycle:

Motor is rotated in counter-clockwise direction that rotates the nut in clockwise direction due to spur gearing , nut rotates and screw is constrained to translate hence it moves forward thereby moving the piston in forward direction thereby effecting the delivery stroke. Dispensing circuit connects the outlet of cylinder to the mixing chamber. The circuit comprises the an non return valve opening into the mixing chamber side and closing on the cylinder side. This allows lubricant flow from the cylinder to mixing chamber during dispensing stroke where as prevents reverse air flow from the mixing chamber to cylinder during suction stroke. Circuit also has flow control valve for fine adjustments of flow rate of lubricant to mixing chamber, and pressure gage indicates the pressure in the delivery line.

C) Additive Dispenser Cycle:



The additive dispenser cycle is used during second test where in pumping element 1- R-D of following specifications is used:

Technical specification

Designation	Pumping Element for 11R / 12R
Design	Plunger type, Valve controlled.
Mounting	Face mounting.
Interface	Factory standard.
Speed range	300 to 2000 rpm.
Hydraulic medium	Mineral oil.
Viscosity range	10 to 100 cSt.
Optimum Viscosity range	16 to 32 cSt.
Temperature range	-10 °C to +80 °C. (Do not exceed viscosity limits at extreme temperatures
Fluid cleanliness requirement	As per ISO Code 16/13.
Performance	Refer Table No. 1.
Mass	0.7 kg.

IJARSE
ISSN (O) 2319 - 8354
ISSN (P) 2319 - 8346

IV. SCOPE OF EXPERIMENT:

A) Design and Development:

1) System design as to the number of components required, their sizes as per machining conditions

2) Selection of following parts:

a) Double acting hydraulic cylinder / non return valves/piping/connectors

b) Pneumatic atomizer chamber /Flow control valve selection.

c) Design of oil mist application nozzle as per cutting requirements.

d)Derivation of tank size and other considerations on operational features

e) Design of square threaded screw arrangement / nut / bearing selection.

f) Prime mover motor selection

g) Selection of additive dispenser.

B) Manufacturing of Set-Up

1) Manufacturing of square thread screw /nut/bearing housing/holder/guide mechanism etc.

2) Manufacturing of pneumatic atomizer mist chamber

3) Fabrication of tank and frame arrangement

4) Hydraulic circuit

5) Pneumatic circuit

V. TESTING OF SET-UP:

Test will be conducted using minimum quantity lubrication on Lathe for the following conditions and materials:

a) Turning of EN8K material under following conditions – with MQL

1. Variation of cutting speed (v m/min)

2) Variation of feed (f mm/rev)

3) Variation of depth of cut (d mm)

5.1 Results to Study (Analysis)

1) Dimensional tolerances

2) Surface finish

3) Machining time

Graphs :

a) Surface finish VS speed/ Surface finish VS feed/ Surface finish VS depth of cut---with MQL

b) Machining time VS speed / Machining time VS feed / machining time VS depth of cut---with MQL

c) Graphical plotting of tolerance zone with MQL

d) Comparative study will be done using above graphs for EN8K material and results discussion will lead to recommendation of MQL parameters for various Speed/feed/depth of cut for optimal performance.

b) Turning of EN8K material under following conditions – with MQL and additive

1. Variation of cutting speed (v m/min)

2) Variation of feed (f mm/rev)

IJARSE
ISSN (O) 2319 - 8354
ISSN (P) 2319 - 8346

3) Variation of depth of cut (d mm)

5.2 Results to Study (Analysis)

1) Dimensional tolerances

2) Surface finish

3) Machining time

5.3 Graphs :

a) Surface finish VS speed/ Surface finish VS feed/ Surface finish VS depth of cut---with MQL and additive

b) Machining time VS speed / Machining time VS feed / Machining time VS depth of cut---with with MQL and additive

c) Graphical plotting of tolerance zone with MQL and additive

d) Comparative study will be done using above graphs for EN(8k) material and results discussion will lead to recommendation of MQL+ additive parameters for various Speed/feed/depth of cut for optimal performance.

VI. EXPERIMENTALVALIDATION:

1. Application of Statistical techniques to determine coefficient of correlation between volume rate of mql coolant and measured parameters as surface finish and dimension tolerance.
2. Application of Statistical techniques to determine coefficient of correlation between volume rate of mql coolant + additive and measured parameters as surface finish and dimension tolerance.
3. Prediction of probability of Ra value for given volume rate of MQL coolant
4. Prediction of probability of Ra value for given volume rate of MQL coolant

VII. EXPECTED RESULTS FROM PROJECT :

1. Effect on MQL on parameters such as dimensional tolerance, surface finish and machining time
2. Effect of MQL with additive on parameters such as dimensional tolerance, surface finish and machining time
3. Coefficient of correlation between volume rate of mql coolant and measured parameters as surface finish and dimension tolerance.
4. Coefficient of correlation between volume rate of mql coolant + additive and measured parameters as surface finish and dimension tolerance.
5. Probability of Ra value for given volume rate of MQL coolant
6. Prediction of probability of Ra value for given volume rate of MQL coolant+additive

VIII. CONCLUSION

- The machining performance can be enhanced by using MQL with additives
- Due to use of MQL with additives maximum surface finish, close dimensional tolerance and better tool life can be obtained
- Due to the elimination of coolant pump the cost on lubrication system can be reduced

IJARSE
ISSN (O) 2319 - 8354
ISSN (P) 2319 - 8346

- MQL is less polluted, environmental friendly andlabour costs are reduced while disposal.

REFERENCES

[1] Ali, S.M., Dhar N.R., Dey, S.K.(2011) “Effect Of Minimum Quantity Lubrication (Mql) On Cutting Performance In Turning Medium Carbon Steel By Uncoated Carbide Insert At Different Speed-Feed Combinations”Advances In Production Engineering & Management 6 (2011) 3, pp. 185-196

[2] Mr. Patil P.R., Prof. Potdar V.V.(2014)”Minimum Quantity Lubrication With Timer Based Control In Machining Of En9 Material” International Journal Of Emerging Engineering Research And Technology Volume 2, Issue 4, July 2014, pp. 392-410

[3] AnuragGoyal, Jasvir S. Tiwana, AmritPal(2014) “A Review Study On Minimum Quantity Lubrication In Machining” International Journal Of Recent Development In Engineering And Technology Vol.2,pp. 37-40

[4] K. Weinert, I. Inasaki, J. W. Sutherland, T. Wakabayashi (2004) “Dry Machining And Minimum Quantity Lubrication”University of Dortmund, Germany.Annals of CIRP, 53(2), 511-537.

[5] NourredineBoubekri, VasimShaikh(2015)”Minimum Quantity Lubrication (Mql) In Machining: Benefits And Drawbacks” Journal Of Industrial And Intelligent Information Vol.3,pp. 205-209

[6] GokulGopan, Smitha G. Nair (2016)“Case Study On Effect Of Cutting Fluids In Turning Operation” International Journal Of Mechanical And Industrial Technology Vol. 3, Issue 2, pp. 79-84

[7] NourredineBoubekri, VasimShaikh (2012) “Machining Using Minimum Quantity Lubrication: A Technology For Sustainability” International Journal Of Applied Science And Technology Vol. 2 pp. 111-115

[8] E. A. Rahim,, M. R. Ibrahim, A. A. Rahim, S. Aziz, Z. Mohid (2015)“Experimental Investigation Of Minimum Quantity Lubrication (Mql) As A Sustainable Cooling Technique” 12th Global Conference On Sustainable Manufacturing procediacirp 26 (2015) pp. 351 – 354

[9] N.R. Dhar, M.T. Ahmed, S. Islam (2007) “An Experimental Investigation on Effect of Minimum Quantity Lubrication In Machining Aisi 1040 Steel” International Journal Of Machine Tools & Manufacture 47 (2007) pp. 748–753

[10] Bruce L. Taia,, David A. Stephenson,Richard J. Furness,Albert J. Shih(2014) “Minimum Quantity Lubrication (Mql) In Automotive Powertrain Machining” 6th Cirp International Conference On High Performance Cutting, Hpc2014 Procedia Cirp14(2014) pp. 523 – 528

[11] Nor AzwadiCheSidik, SyahrullailSamion,JavadGhaderian,Muhammad Noor AfiqWitri Muhammad Yazid(2017) “Recent Progress On The Application Of Nanofluids In Minimum Quantity Lubrication Machining: A Review”International Journal Of Heat And Mass Transfer 108 (2017) pp. 79–89

[12] T.I. Zohdi(2013) “Short Communication On The Reduction Of Heat Generation In Lubricants Using Microscale Additives” International Journal Of Engineering Science 62 (2013) pp. 84–89