International Conference on Recent Trends in Mechanical Engineering
International Journal of Scientific Research inScience,
Engineering and Technology
Print ISSN: 2395-1990 | Online ISSN : 2394-4099 (www.ijsrset.com)

Influence of Nano graphite based Vegetable oils as Cutting Fluids for Mild Steel Drilling

Viraja Deshpande[1], P.N. Jyothi[2]

[1]Research Scholar VTU, R&D Mechanical Engineering, KSSEM, Bengaluru, Karnataka, India

[2]Professor, Department of Mechanical Engineering, KSSEM, Bengaluru, Karnataka, India

ABSTRACT

In last decades, a considerable attention is received by non-edible vegetable oils as Bio lubricant due to their eco-friendly products, increased remarkable improved tribological characteristics and as they are renewable sources. In this work, different vegetable oils namely Neem, sunflower, coconut, Karanja (Honge) and Neem oil (50% Neem & 50% Karanja) blend are used as cutting fluid for the drilling of Mild steel. The same vegetable oils with addition of Nano graphite powder are also used as Nano based bio-oils in the second stage experimentation. The effect on parameters of these cutting fluids like cutting temperature, cutting force, tool wear, chip formation, drilled hole surface roughness are studied. The results obtained are compared with petroleum based cutting fluids and at dry conditions. From the results, it is observed that the blend of 50% Neem and 50% Honge and sunflower oil is the best cutting fluid compared to other cutting fluids used in this work, more over these oils are environmentally friendly, non-hazardous ,bio-degradable and economical.

Keywords: Mild Steel, Neem, sunflower, coconut, Karanja (Honge) and Neem oil (50% Neem & 50% Karanja) blend, Nano graphite powder

I. INTRODUCTION

During machining operation, relative motion between work piece and cutting tool produces the friction, resulting to generation of high temperature at the interface between tool- work piece and tool-chip. The heat generated decreases tool life, increases surface roughness and decreases the dimensional sensitiveness of work material. This case is more important when machining difficult-to-cut materials as heat would be observed. Various methods have been reported to protect cutting tool from the generated heat. Choosing coated cutting tools are an expensive alternative and generally it is a suitable approach for machining some materials such as titanium alloys, heat resistance alloys etc. The application of cutting fluids is another alternative that can be used to increase the tool life and also higher material removal rates can be achieved which is as shown in figure 1.

Figure 1. Application of cutting fluids on drilling

They are used to provide lubrication and cooling effects between cutting tool and work piece and cutting tool and chip during machining operation resulting in lesser amount of heat generation. As a result, important benefits would be achieved such longer tool life, easy chip flow and higher machining quality in the machining processes using cutting fluids. A review was carried out by Lawal [1] on Application of vegetable oil-based metalworking fluids in machining ferrous metals. In the review, the advantages and performances of metal working fluids with respect to surface finish of the work piece, tool wear, cutting force and temperature at the cutting zone have been observed. The major focus is given on the performance and environmental impact of this vegetable oil as emulsion and straight oils for various materials and machining conditions. The effects of MQL on vegetable oil based cutting fluid under turning operation of low alloy steel AISI 9310 was investigated by Khan [2] .The results of dry and wet machining in terms of chip formation mode, tool- chip interface temperature, tool wear and surface roughness were compared. The Results showed that MQL provides improved machinability characteristics and environmental friendliness. A detailed work has been carried out on metal working fluids that are widely employed to increase the machining productivity and quality of metal cutting by Vaibhav Koushik [3], but the usage poses great threat to the ecology health of workers in industry. Therefore, it is needed to identify hazard free and eco- friendly alternatives to convention mineral oil-based material working fluid. An effort has been undertaken to provide highlights of vegetable oils over petroleum-based oils in this review paper. Many research works presented that vegetable oils have capable scope of their emergence as metal working fluids. Shaikh [4] , determined the material removal rate (MRR) and influence of lubricant on surface roughness on AISI D2 Steel using CNC lathe machine. to determining and optimizing operating parameters, Taguchi method was used. The above experimentation results help practitioners to compare and increase MRR, surface finish using more environmentally friendly oil as lubricant. But it was found that, cutting fluid formulation became more complex as cutting operation became more severe. Lawal [5] has carried out research work on the application of vegetable oil based cutting fluids in machining nonferrous metals. The results obtained established that vegetable oil based cutting fluids are good metal working fluid. The formulation of vegetable based cutting fluids and machining with cutting fluids was carried out by Babur Ozcelik Emel kuram [6] . The characterization of chemical and physical analyses of these formulated cutting fluids are carried out. Experimental results show that Canola based cutting fluid gives the best performance due to its higher lubricant properties with respect to other cutting fluids with constant cutting conditions. Again, Babur Ozcelik Emel kuram [7] studied the Effects of vegetable-based cutting fluids on the wear in drilling.

Performances of three VBCFs developed from crude sunflower oil, refined sunflower oil, refined canola oil and commercial semi-synthetic cutting fluid are compared in terms of thrust force, tool wear and surface roughness during drilling of AISI 304 austenitic stainless steel .the HSSE tool was used. Experimental results showed, canola based cutting fluid gives the best performance due to its higher lubricant properties at the constant cutting conditions (spindle speed of 750 rpm and feed rate of 0.1 mm/rev) with respect to other cutting fluids. It maintains the reliability of machine functions and reduces the risk of failures. Lubricants provide smooth operation between movable parts of all machines. Vegetable bio lubricants are non-toxic, degradable, and renewable also possess good lubricating properties. A review has been carried out by Suhane [8], on edible oils as cutting fluids. There are papers, in which study has been done on non-edible oils such as castor, Karanja, Mahua as cutting fluids and proved to have a great potential as lubricant for some of the machining operations.

II. MATERIALS, METHODS AND EXPERIMENTAL DETAILS

The experiments initially started in a medium duty lathe. The work piece is firmly held in a 3- jaw chuck at cutting speed of 775 rpm. The work piece is of AISI 1014 mild steel having diameter of 25mm with 70mm length. For drilling a HSS drill bit of diameter 13mm is used. Before drilling operation, the work piece was faced and turned for finishing in lathe and centring is done for all the work pieces using centre drill. The depth of the hole is 30mm with constant speed and feed. The drilling operation is carried out on a Radial drilling machine at 800 rpm at constant feed 0.1mm using blends of 50% Neem and 50%Karanja, Neem, Sunflower oil and Coconut oil with different percentages Graphite Nano power, petroleum- based oils as cutting fluids and also in dry condition.

Figure 2. Radial Drilling Machine

Cutting fluid is supplied using MQL (Minimum quantity lubrication) method. A drilling tool dynamometer is used while machining in order to find out the cutting force required for the drilling of mild steel using different cutting fluids. The specimen temperature and tool temperature are determined using Infra-Red thermometer by focusing the laser on to the specimen and tool. The chips obtained are collected and parameters are determined for those chips. The physical parameters of the chips are found using profile projector. The roughness of the machined surface is determined using surface roughness tester. The specimens are tested for hardness using Rockwell hardness tester to analyse heat transferred to the specimen during machining.

III. RESULTS AND DISCUSSIONS

A. Study of chips:

Chip formation usually depends on type of metal being machined i.e. whether brittle or ductile and temperature at the machining zone. The temperature generation is due to friction that exists between drill bit and the work piece. There may be breaking of chips due to chattering of work piece and due to overheating of work surface during the cutting process.

The chatter in the material is avoided by taking larger diameter wok piece. the petroleum- based oil (SAE 20W40) lubrication is less, hence friction is more as seen in work piece temperature. Compared to all the oils, it is observed that for sunflower oil and blend of 50% Neem and 50%Honge has longer length continuous chips, indicating that temperature at machining zone is less as shown in the figure 2.

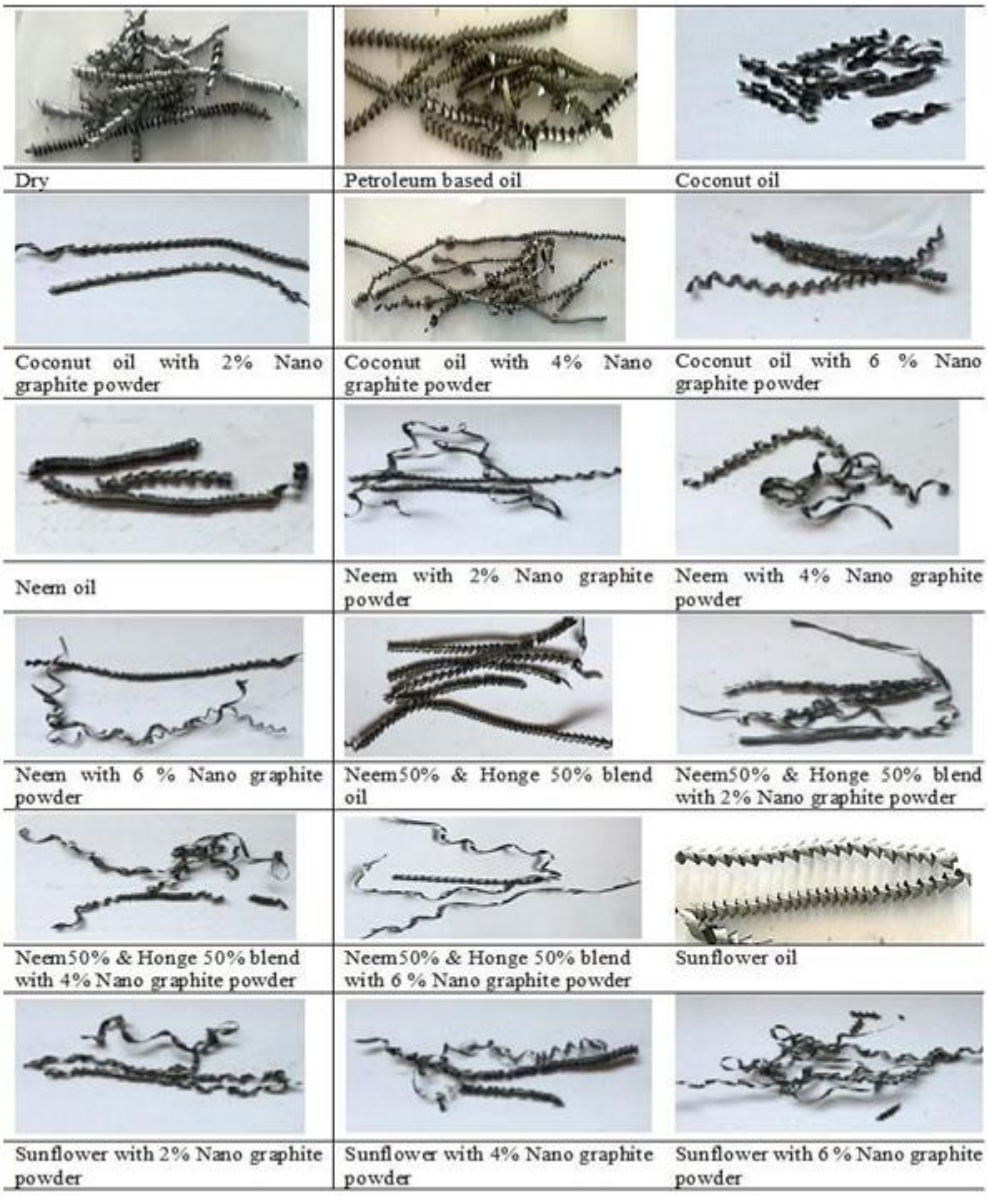


Figure 3.1: Chips formed with different colours by application of different cutting fluid and at dry condition

This can also be observed by the colour of the chip, which is not dark like obtained for other cutting fluids. The results show that sunflower oil and blends of 50% Neem and 50%Honge has good lubricating and cooling property.

During machining at dry cutting condition, the value of pitch height is too large and pitch is smaller amount, because of minimum control of the heat generated during the process. Instead of transferring heat to be the air and due to rotation; a heat zone is generated around the material surface. This has made too difficult in transferring the heat from the material to surrounding. With the use of petroleum based cutting fluids, there was increase in the value of pitch with reduction in pitch height. An improvement in surface finish was observed with this process. Increase in the pitch value and decrease in the pitch height showed that there was some improvement in the surface finish with work piece thickness. Due to excessive heat produced during the machining, surface of work piece material gets converted from ductile to brittle and the chip becomes discontinuous. This discontinues chips were observed for dry condition and when coconut oil is used as cutting fluid. With petroleum-based oil helped in reducing the heat but to a smaller extent. SAE 20W40 has better specific. The details of the chip obtained using different cutting fluids and during dry cutting condition are given in the table 1. Nano graphite powder addition increases the chip length, helps in absorbing more heat generated. Due to which metal surface becomes more soft and ductile resulting in longer continuous chip with less coil diameter and higher pitch length compared to pure oils used as cutting fluids, it is also seen that instead of coiled chip, with increase of graphite percentage from 2%,4% and 6% continuous ribbon chips are produced.

B. Colour of the chip

The colour of the chip represents the measure of the temperature obtained at the tool point. A blue temper colour on the surface of a chip formed in dry cutting represents that the tool point is hotter than chip which is obtained for cutting work piece with a fluid .the colour of the chip is uncoloured silvery. The best uncoloured silvery chip is formed when Neem50% & Honge 50% blend oil and sunflower oil are used as cutting fluid as shown in the Figure 3.1. For dry condition the chips are completely burnt i.e. dark colour indicating that maximum heat is transferred to work piece during machining. Chip details are tabulated in table 1.

C. Surface roughness of machined surface:

Surface finish usually depends on machining parameters like speed, depth of cut & feed, also on also on type of material being machined, type of cutting fluid used and also on type of tool material. In the present work all, the elements are constant but only cutting fluid used are been varied. The surface obtained after drilling using sunflower oil, coconut oil, Neem oil and Blend of 50% Neem and 50 % Honge oil and petroleum based SAE 20W40 as cutting fluids and also for dry drilling condition are shown in the Fig 3.2 (a). the effect of pure oils and addition of graphite nan powder in varying percentage of 2%, 4%, and 6 % to these oils as cutting fluid on the work surface can be observed clearly . From Fig 3.2(a) it can be seen that surface roughness obtained using pure sunflower oil and 50% Neem and 50 % Honge blend is very less with values as 1.664 and 1.663 respectively compared to other surfaces. Fig

3.2 (b) shows variation of surface roughness with application of different cutting fluids. Addition of graphite powder has not improved the surface finish even though it is soft and is been used as solid lubricant, but instead

as percentage of graphite powder is increased from 2%, 4% and 6%, the surface roughness is also increasing as compared to surface obtained using pure oil. This may be due to formation of brittle layer by the graphite powder at the cutting temperature. Therefore as graphite percentage is increased, brittle ness of the surface also increases resulting to rough surface. From the measured value and from the figure 3.2, it can be observed that surface roughness obtained for sunflower oil and 50% Neem and 50 % Honge blend is very less compared to other vegetable oil, Nano based vegetable oil and SAE 20W40 oil used as cutting fluids.

Table 1: Details of chips formed during drilling operation on Mild steel with different cutting fluids

Sl . No	Type of cutting fluid	Length (mm)	Thickness (mm)	Coil Diameter (mm)	Pitch length (mm)
1	Coconut oil	3	0.16	6.03	128
2	Coconut oil with 2% Nano graphite powder	3.97	0.3	5.68	185
3	Coconut oil with 4% Nano graphite powder	4.00	0.39	5.57	110
4	Coconut oil with 6 % Nano graphite powder	4.15	0.34	5.33	160
5	Neem oil	2.30	0.35	6.99	180
6	Neem with 2% Nano graphite powder	2.38	0.41	6.84	175
7	Neem with 4% Nano graphite powder	2.65	0.32	6.18	174
8	Neem with 6 % Nano graphite powder	3.19	0.36	6.23	123
9	Neem50% & Honge 50% blend oil	4.27	0.35	6.08	85
10	Neem50% & Honge 50% blend with 2% Nano graphite powder	4.83	0.38	6.59	120
11	Neem50% & Honge 50% blend with 4% Nano graphite powder	4.86	0.45	6.72	213
12	Neem50% & Honge 50% blend with 6 % Nano graphite powder	4.88	0.44	6.92	213
13	Sunflower oil	4.06	0.57	6.06	195
14	Sunflower with 2% Nano graphite powder	4.38	0.42	6.08	120
15	Sunflower with 4% Nano graphite powder	4.43	0.41	5.99	133
16	Sunflower with 6 % Nano graphite powder	4.27	0.35	5.95	157
17	Petroleum based oil	1.9	0.25	6.4	513
18	Dry Condition	1.1	0.21	4.45	266

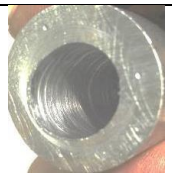
		
Dry	Petroleum based oil	Coconut oil
		
Coconut oil with 2% Nano graphite powder	Coconut oil with 4% Nano graphite powder	Coconut oil with 6 % Nano graphite powder
		
Neem oil	Neem with 2% Nano graphite powder	Neem with 4% Nano graphite powder
		
Neem with 6 % Nano graphite powder	Neem50% & Honge 50% blend oil	Neem50% & Honge 50% blend with 2% Nano graphite powder
		
Neem50% & Honge 50% blend with 4% Nano graphite powder	Neem50% & Honge 50% blend with 6 % Nano graphite powder	Sunflower oil
		
Sunflower with 2% Nano graphite powder	Sunflower with 4% Nano graphite powder	Sunflower with 6 % Nano graphite powder

Figure 3.2(a): Worn surface of machined Specimen with different cutting fluids and at dry condition

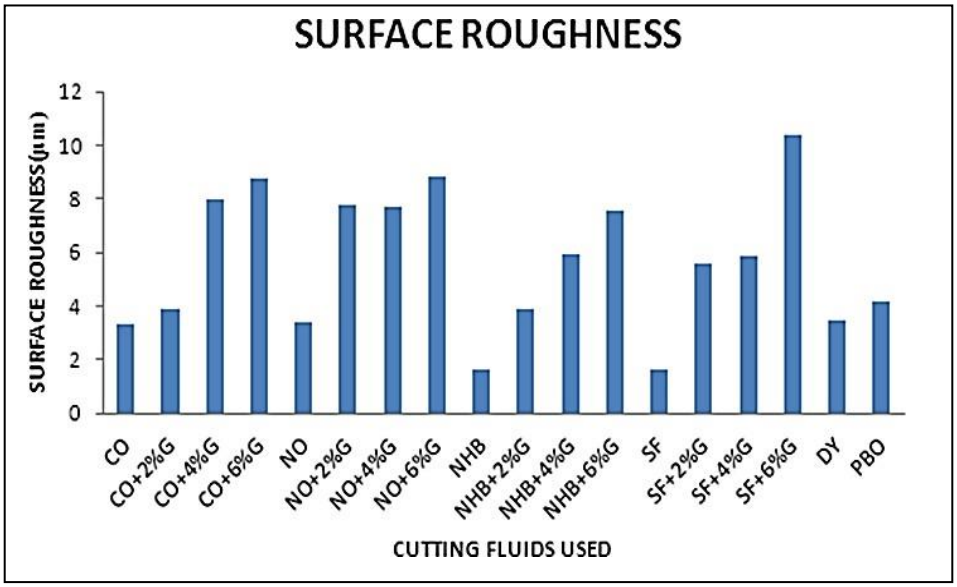


Figure 3.2 (b): Graph of surface roughness measured using different cutting fluids and at dry condition

D. Cutting Temperature

To increase tool life, there should be decrease in heat absorption by the tool. This can be achieved by use of good cutting fluid which absorbs maximum heat from the machining zone, giving very less heat to tool and the work piece. Due to heat generation, the machining accuracy will also be affected along with varying the properties of work piece. Figure 3.3 shows, Temperature measured at tool and work piece interface using different cutting fluid and at dry cutting condition. For dry condition temperature of tool and work piece is 122 0C which is very high. This is due to the transfer of heat generated to tool and work piece as no coolant is used and also due to high friction between tool and work piece as no lubricant is used. the temperature measured for both tool and the work piece For SAE 20W40 oil are 101°C, which is less compared dry cutting but higher than non-edible oils used, this due to its lower adhesiveness and lower dynamic viscosity. For 50%Neem, 50%Honge blend and sunflower oil, the cutting temperature 74°C which is less compared to other measured values obtained using other vegetable and Nano graphite-based vegetable oils. This is due high specific heat, high adhesiveness and higher dynamic viscosity. Indicating that, sunflower oil and blend of 50% Neem and 50% Honge oil has better cooling and good lubricating property. Graphite addition with varying percentage of 2%, 4% and 6% has not reduced the cutting temperature but instead it increases slightly with increasing percentage. From Fig 3.3 it can be seen that as graphite percentage increase temperature also increasing slightly this may be due to properties of graphite. Graphite is good lubricant but not a good coolant.

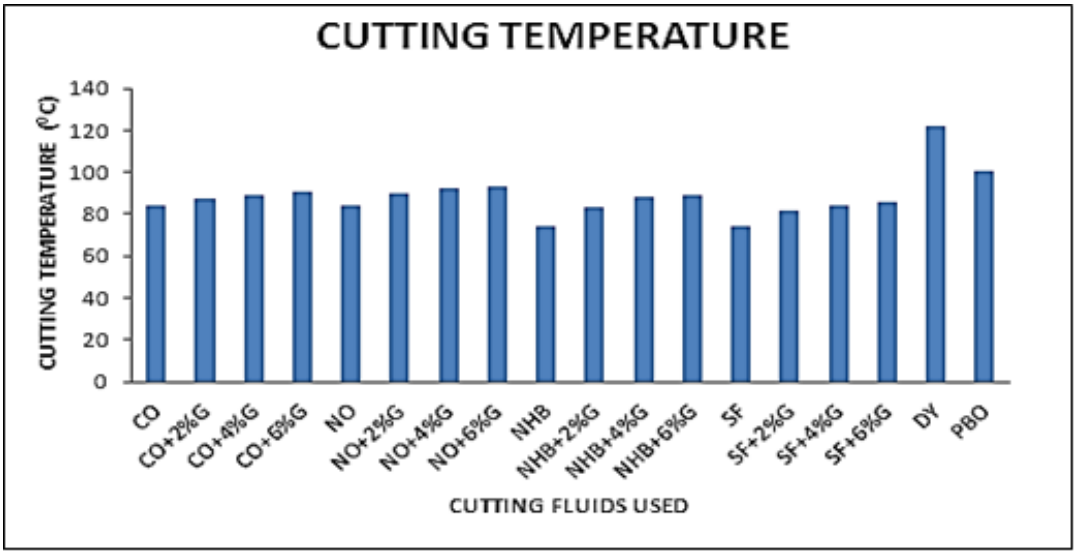


Figure 3.3: Graph of cutting temperature measured using different cutting fluids and at dry condition

E. Hardness Test

Hardness can be determined by forcing an indenter on to the surface. The resultant deformation in steel is both elastic and plastic. The hardness values of all the specimens before drilling and after drilling operation using different cutting fluids are determined using Rockwell hardness tester and the results are tabulated in the table 2.

If cutting fluid is not used, the Heat generated during drilling operation due to friction between the work piece and drill bit is given out to tool, chip and work piece. If the maximum heat is given to tool, then the tool wear is observed leading to reduction in tool life and if it is given to work piece then the mechanical properties will be affected. The function of good cutting fluid is to absorb and carry away the heat generated in the machining zone. From table 2, it can be observed that hardness measured on the work surface before drilling is 79HRB. For dry condition temperature given to work piece is more due to which after drilling hardness value measure is 84 HRB. This is very high compared to hardness value measured before drilling, which indicates that the metal surface has become very brittle increasing its hardness because it has absorbed more heat during machining. Lowest hardness value is measured for work material drilled using sunflower and Neem-Honge blend followed by coconut and Neem and petroleum based oil.

Addition of graphite powder to pure vegetable oil has slightly increased hardness. From the table 2, it can be observed that as graphite percentage is increased from 2%, 4% and 6% hardness value is slightly increased. This may be due to graphite acting as lubricant but not as coolant resulting to higher heat transfer to work-piece making surface brittle.

Table 2: The hardness values of all the specimens before drilling and after drilling operation using different cutting fluids and at dry condition

Sl..No	Type of cutting fluid	Hardness before drilling	Hardness after drilling
1	Coconut oil	79	82.5
2	Coconut oil with 2% Nano graphite powder	79	82.6
3	Coconut oil with 4% Nano graphite powder	79	82.3
4	Coconut oil with 6 % Nano graphite powder	79	83.3
5	Neem oil	79	83
6	Neem with 2% Nano graphite powder	79	83.3
7	Neem with 4% Nano graphite powder	79	83.3
8	Neem with 6 % Nano graphite powder	79	82.6
9	Neem50% & Honge 50% blend oil	79	82
10	Neem50% & Honge 50% blend with 2% Nano graphite powder	79	82.3
11	Neem50% & Honge 50% blend with 4% Nano graphite powder	79	82.6
12	Neem50% & Honge 50% blend with 6 % Nano graphite powder	79	83
13	Sunflower oil	79	82
14	Sunflower with 2% Nano graphite powder	79	82
15	Sunflower with 4% Nano graphite powder	79	83
16	Sunflower with 6 % Nano graphite powder	79	83
17	Dry	79	84
18	Petroleum Based oil	79	82.6

F. Cutting Force

In the present work different types of cutting fluid are been used keeping cutting speed, feed as constant parameters. to know the efficiency of cutting fluid used, Cutting force is considered as one of the measuring parameter. With respect to work piece, cutting force is the measure of resistance offered by the work piece during machining process. Cutting force is less if drill bit enters work-piece smoothly. Therefore a good cutting fluid should reduce the cutting force during the machining operation resulting in lesser mechanical stress in the work piece. Figure 3.5 below shows the cutting force measured during drilling of mild steel at constant speed and feed using Drill tool dynamometer.

During machining process, cutting force depends on the friction between the tool and work piece. More cutting force accumulates more heat in the work material and makes it soft for further processing. Cutting force refers to the force applied by the tool to shear the work- piece, greater the force greater will be the power consumption and lesser will be the tool life. It depends on type of material being machined, type of cutting fluid used, type of tool material and machining parameters. In the present work since all the elements are kept constant and only cutting fluid is changed, cutting force measured will be based on cutting fluid used. Figure 3.5 gives cutting force measured during drilling using sunflower oil, coconut oil, Neem oil and Blend of 50% Neem and 50 % Honge oil and petroleum based SAE 20W40 as cutting fluids and also for dry drilling condition

also with addition of graphite Nano powder in varying percentage i.e. 2,4, 6%. It is observed from Figure 3.5 that force required for shearing the work piece material in case of sunflower oil (220N) and 50% Neem and 50 % Honge blend (223N) is less compared to other vegetable oil, SAE 20W40 oil used as cutting fluids and also for dry cutting condition, next followed by Neem oil. It is being observed that, during dry machining, the cutting force was increased because oexcess of heat generation by the friction. it is observed that the cutting forces were reduced gradually during petroleum based (SAE20W40) oil based machining due to the interface of petroleum based lubricant in between tool and work piece and in this process the petroleum based oil acts as coolant but not as lubricant. Graphite powder addition to these bio oils in varying percentage of 2%, 4% and 6%, reduces the force required by the tool for shearing. This may be due to softness of graphite powder which makes the tool to move in to the work piece very smoothly and with lesser force. As the graphite powder percentages increases the cutting force required gets reduced. Hence it is used as solid lubricant.

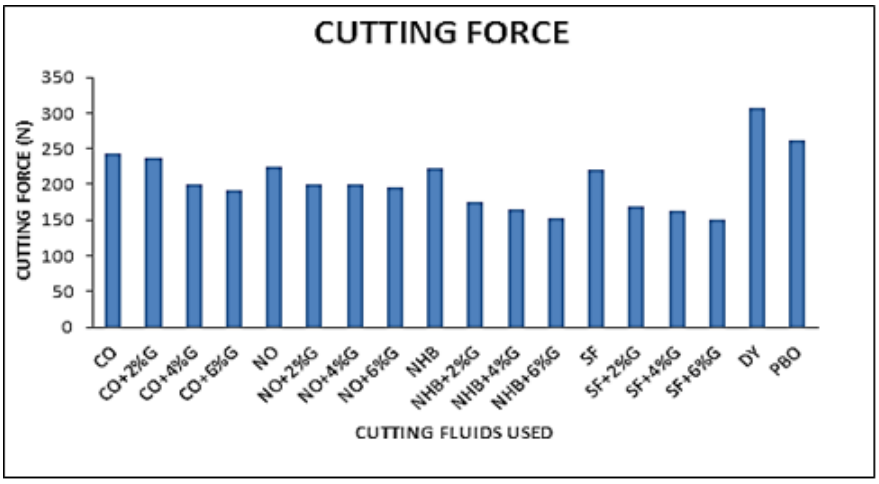


Figure 3.5: Graph of cutting force measured using different cutting fluids and at dry condition

G. Tool Wear Studies

Removal of material from the tool surface due to abrasive action is called as wear. Wear may be due to friction between two contacting surfaces of materials such as micro-ploughing, micro cutting, fracture, plastic deformation and melting, welding and chemical interaction. Various forms of tool wear on the drill tools are crater wear, flank wear, chisel edge wear and chipping. Wear on the flank of a cutting tool is caused by friction between the newly machined work material surface and the contact area on the tool flank. The width of the wear land is usually taken as a measure of the amount of wear. The wear pattern is irregular along the edge of the tool. The chipping wear leads to a catastrophic failure early in the life of the tool which masks the failure mode. Mechanical issues such as part fixture or machine spindle vibration will contribute to chipping wear. Higher loads on the tool will cause chipping.

Tool wear depends on type material machined; machining parameters like feed, speed and depth of cut; cutting fluids used, working and tool holding devices and so on. In the present work all the elements are kept constant and only the cutting fluids are changed. Wear of the drill bit depends on only the cutting fluids used as only cutting fluids are variable in the present work keeping all other elements constant. Figure 3.6 shows worn out surface of drill bit at chisel edge and drill bit point. For dry cutting condition, drill point is worn out as heat generated is high due to the friction between tool and work piece. Whereas in case of Petroleum based oil, loss

of material at drill point is less compared to dry condition. Tool wear is less when sunflower oil and 50% Honge and 50% Neem blend is used as cutting fluid and not much wear is observed when pure oils is used as cutting fluids compared to dry and petroleum based oil. From the Figure 3.6 below it can be observed that Nano graphite powder addition to these vegetable oils with varying percentage of 2%, 4% and 6% results in slight loss of tool material at drill bit chisel edge and also leads to sticking of chip to the tool.

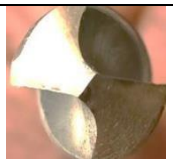
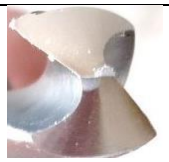
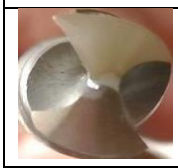
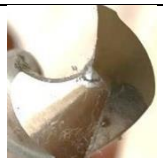
		
Dry	Petroleum based oil	Coconut oil
		
Coconut oil with 2% Nano graphite powder	Coconut oil with 4% Nano graphite powder	Coconut oil with 6 % Nano graphite powder
		
Neem oil	Neem with 2% Nano graphite powder	Neem with 4% Nano graphite powder
		
Neem with 6 % Nano graphite powder	Neem50% & Honge 50% blend oil	Neem50% & Honge 50% blend with 2% Nano graphite powder
		
Neem50% & Honge 50% blend with 4% Nano graphite powder	Neem50% & Honge 50% blend with 6 % Nano graphite powder	Sunflower oil
		
Sunflower with 2% Nano graphite powder	Sunflower with 4% Nano graphite powder	Sunflower with 6 % Nano graphite powder

Figure 3.6 : Tool wear using different cutting fluids and at dry condition

IV. CONCLUSIONS

EXPERIMENTAL RESULTS during drilling of mild steel work piece using sunflower oil, coconut oil, Neem oil, SAE20W40 (petroleum based oil) and blend of 50% Neem- 50% Honge oil, dry cutting condition and also with addition of varying percentage of graphite powder i.e. 2%, 4% and 8% to sunflower oil, coconut oil, Neem oil and blend of 50% Neem- 50% Honge oil given following results and conclusions.

CUTTING FORCE: when sunflower oil is used as cutting fluid, the cutting force measured was 220N and for 50% Neem and 50 % Honge blend it was 223N which is less compared to cutting force measured during dry cutting condition and also using other vegetable oil and SAE 20W40 oil as cutting fluids.

CUTTING TEMPERATURE: the temperature of tool and work piece for dry condition is 1220C which is very high. the temperature measured at tool and work interface For SAE 20W40 oil is 101°C, which is less compared dry cutting but higher than non-edible oils used. Whereas for 50%Neem, 50%Honge blend and sunflower oil, the cutting temperature 74°C which is less compared to other measured values obtained using other vegetable and Nano graphite-based vegetable oils

HARDNESS: For dry cutting condition heat given to workpiece is more due to which after drilling, hardness value measure is 84 HRB which is very high compared to hardness value measured before drilling. Lowest hardness value is measured for workpieces drilled using sunflower and blend of 50% Neem and 50%Honge followed by coconut and Neem and petroleum-based oil.

STUDY OF CHIPS FORMED: when Sunflower oil and blend of 50% Neem and 50%Honge is used as cutting fluid, longer length continuous chips were produced, indicating that temperature at machining zone is less. For other oils used, heat produced during machining converts from the surface from ductile to brittle resulting to discontinuous chips

COLOR OF THE CHIPS: The best uncolored silvery chip is formed when sunflower oil and Neem50% & Honge 50% blend oil are used as cutting fluid, which indicates that sunflower oil and blends of 50% Neem and 50%Honge has good lubricating and cooling property SURFACE ROUGHNESS: surface roughness obtained using pure sunflower oil and 50% Neem and 50 % Honge blend is very less with values as 1.664 and 1.663 respectively compared to other surfaces. Addition of graphite powder has not improved the surface finish even though it is soft and is been used as solid lubricant, but instead as percentage of graphite powder is increased from 2%, 4% and 6%, the surface roughness is also increasing as compared to surface obtained using pure oil.

TOOL WEAR: For dry cutting condition, drill point is worn out as heat generated is high due to friction between tool and work piece. Whereas in case of Petroleum based oil, loss of material at drill point is less compared to dry condition. Tool wear is less when sunflower oil and 50% Honge and 50% Neem blend is used as cutting fluid and not much wear is observed when pure oils is used as cutting fluids compared to dry cutting conditions and when petroleum-based oil and Nano based oils used as cutting fluids.

From the above results it was found that the blend of 50% Neem and 50% Honge and sunflower oil are the best cutting fluid compared to other cutting fluids used in this work, more over it is environmentally friendly, bio-degradable, non-hazardous and economical. The addition of graphite Nano powder to these cutting fluids acts as good solid lubricant but not contributed to decrease surface finish of the work-piece

V. REFERENCES

[1]. A. L. S., "A Review of Application of Vegetable Oil-Based Cutting Fluids in Machining Nonferrous Metals," Indian Journal of Science and Technology, vol. 6, no. 1, pp. 113- 118, 2013.

[2]. M. M. A. Khan, "Effects of minimum quantity lubrication on turning AISI 9310 alloy steel using vegetable oil based cutting fluid," Journal of Materials Processing Technology, pp. 5573- 5583, 2009.

[3]. V. K. A.V, "Vegetable Oil-Based Metal Working Fluids-A Review," International Journal on Theoretical and Applied Research in Mechanical Engineering, pp. 2319- 3182, 2012.

[4]. J. B. Shaikh, "Experimental Investigation and Optimization of Process Parameters in Turning of AISI D2 Steel using Different Lubricant," International Journal of Engineering and Advanced Technology, pp. 189-197, 2014.

[5]. I. C. S.A. Lawal, "Application of vegetable oil-based metalworking fluids in machining ferrous metals—A review," International Journal of Machine Tools and Manufacture, vol. 52, pp. 1- 12, 2012.

[6]. P. E. Babur Ozcelik Emel kuram, "Effects of vegetable-based cutting fluids on the wear in drilling," Indian Academy of Sciences, vol. 38 , no. 4, p. 687–706, 2013.

[7]. P. E. Babur OzcelikEmel kuram, "Effects of vegetable-based cutting fluids on the wear in," Indian Academy of Sciences, vol. 38, no. 4, p. 687–706, 2013.

[8]. J. K. Suhane, "The Prospects of Vegetable Based Oil as Metal working Fluid in Manufacturing Application-A Review," International Journal of Engineering Research and, vol. 3, no. 5, pp. 2196-2202, 2014.