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Vegetable Oils as Cutting Fluids in lathe machine

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ABSTRACT

The incidence of device wear in machining is a herbal phenomenon that purpose failure. The deformation during slicing on the interface between the tool face and workpiece has a tendency to generate excessive reducing temperature. The software of flood coolant to reduce the friction on the tool-work piece might also create numerous environmental troubles. The introduction of Minimum Quantity Lubrication (MQL) as an alternative approach that is the manner of pulverizing a very small amount of oil (< 30ml/h) may be appeared as alternative of dry machining at the same time as it can additionally be considered as an opportunity to flood cooling. The impact of vegetable oil lubricant and slicing velocity on tool put on and floor integrity had been the studies scope. Three gadget velocity; one hundred twenty, 141, and 174 m/min have been used inside the experimental setup on mild metallic and carbon metal on paintings fabric the use of cemented carbide tools. The end result of surface roughness and device wear the usage of canola oil mixing with 2 weight percent (wt%) of Zinc-dialkyl-dithio-phosphate (ZDDP) had been compared against synthetic oil coolant. Comparison effects show that canola oil blend can carry out higher examine to the synthetic oil coolant in time period of floor finish. From tool wear angle, canola oil mix display 26.Five% smaller location evaluate to the synthetic oil coolant.

INTRODUCTION

The upward push in costs and the confined sources of petroleum primarily based and mineral merchandise and their effects on the environmental infection lead to analyze opportunity and no contaminant fluids for commercial and manufactured functions . In latest years, it has been shown that the usage of vegetable oils as reducing fluid has surely advanced the machining performance. In fact, as mentioned with the aid of Debnath et al. , these oils notably enhance the performance, in ecological phrases, compared to mineral cutting fluids, to dry tactics and machining tactics with minimal amount lubrication (MQL). Kalawole et al. In their study investigated on the use of Peanut oil and palm oil as a slicing fluid and as compared their outcomes with the mineral-oil reducing fluids at some stage in the machining process. Their investigation proven that the peanut oil has better fluidity and quicker cooling capability than other oils. Moreover, the use of peanut-oil cutting fluids within the machining procedure indicates a clean floor morphology of the pieces.

Vegetable oil

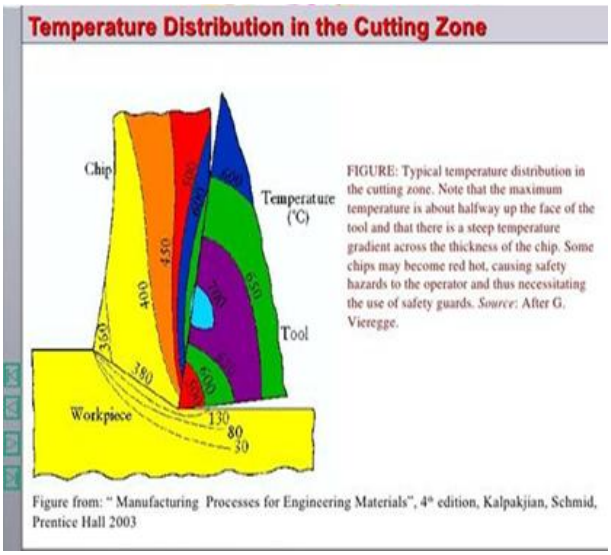
Vegetable oil as an alternate cutting fluid whileperformingturning operations on a lathemachine using single point cuttingtool
As in all metallic operating operations, the energy dissipated in reducing operation is converted into heat, which , in turn , increases the temperature in reducing sector .Knowledge of temperature upward thrust in cutting could be very critical , because rise of temperature:

- Adversely have an effect on the power, hardness and wear resistance of reducing tool.
- Cause dimensional adjustments within the part being machined, making manipulate of dimensional accuracy tough, and
- Can lessen thermal damage to the machined floor, adversely affecting the residences and provider lifestyles.

In addition, the device tool itself can be subjected to temperature gradients cause distortion of the machine.
Because of the work carried out in shearing and in overcoming friction at the rake face of the device, the primary assets of warmth generation are primary shear quarter and the tool chip interface.

The high contact pressure among the device rake face and the chip reasons severe friction at the rake face, as well as, there may be friction among the flank and the machined surface. The result is type of wear styles and scars which can be discovered at the rake face and the face:

- Crater wear
- Flank wear
- Notch put on
- Vibrations and chattering.



Effects of the device put on on technological performance measures:

- Increase the slicing force
- Increase the surface roughness
- Decrease the dimensional accuracy
- Increase the temperature
- Vibration
- Increases the value of production.

For a certain limits simplest and the maximum budget friendly option to the above hassle is using a right Lubricant.

I. LUBRICANTS

A Lubricant is a substance (frequently a liquid) brought among shifting surfaces to lessen the friction between them, enhancing efficiency and decreasing put on.

Lubricants carry out the following key capabilities

- Keep shifting components aside.
- Reduce friction.
- Transfer warmness.
- Carry away contaminants and particles.
- Transmit strength.
- Protect against put on.
- Prevent against wear.
- Seal for gases.
- Stop the threat of smoke and hearth of items.

The reducing fluid can interchangeably be a coolant and a lubricant and this relies upon upon the temperature, the cutting speed and form of machining operation .Generally at high cutting velocity it acts as a coolant as a result cools the cutting zone and at low cutting pace operation which includes broaching and tapping, it acts as a lubricant accordingly reduces the formation of Built-up-facet (BUE) and will increase the surface end.

Lubricants normally used are classified in 4 categories:

- Straight oils (mineral or petroleum oil)
- Synthetic fluids (alkaline inorganic compounds)
- Soluble oils (mineral + water)
- Semi artificial fluids (synthetic +soluble oil)..

EXPERIMENTALDETAILS

MQL (Minimum Quality Lubrication) approach is utilized in experiment that's alternative coolant technique advanced toward the 'inexperienced machining' it's miles almost dry machining. It refers to total use, without residue, making use of lubricant among 10 to 100ml/h. (Klocke, F, and Eiseblatter,G.,1997).

Mustard oil (Vegetable oil) is used as a coolant throughout the machining. From the view point of environmental safety, Health ,performance and cost , High biodegradability, High viscosity index and correct thermal balance(Ilija,G.,2003).The vegetable primarily based oil ought to produce better end result than the mineral reference oil in view of multiplied machining overall performance in addition to renewable source (Belluco,W.,Chiffre,L.D,2004).

K Type thermocouple is hired for the calculation of suggest temperature at the tool chip interface with warm junction is the reducing zone and the bloodless junction is cold a part of the unmarried factor reducing tool.

Turning operations have been performed on centre lathe Machine one after the opposite.

Single factor reducing device of High Speed Steel and a Solid Cylindrical Workpeice of Mild Steel became used.

Result :

Experimental end result suggests that in the operation the vegetable oil completed a extremely good cooling effect and lubrication just like different coolants. The vegetable oil easily removed warmth produced in the course of the operation and gives proper lubrication, accordingly decreasing friction and wear , hence improving device life and floor finish

I. The Significant Study of using Vegetable Oil as a Cutting Lubricanton Conventional Lathe Machine

This have a look at consists of four stages that worried to investigate whether the vegetable oil will deliver any fine end result to this study. The take a look at starts with selection of vegetable oil. The canola oil was selected based totally on numerous literature evaluate that were performed associated with this study.

A. Experimental Setup

In this experiment cemented carbide have been used. Cemented carbide is pretty a not unusual device bit used that been used in the industry. This test only makes a speciality of single sort of device towards the vegetable oil coolant and the synthetic coolant to perceive the tool wear. Four faces tool bit of cemented carbide were used on this test for both vegetable oil and synthetic coolant; two facets for the vegetable oil coolant and other facet for the artificial coolant. The usage of those tool bit facet is divided as consistent with Figure 1 and Table 1.

In this degree, the traditional lathe system parameter could be set into the parameter that assigned. The unique slight metallic diameter is 50 mm. During the going through process the mild metallic and carbon steel paintings material were machined to 30mm diameter. Turning process had been machined on slight metallic and carbon steel become from a hundred mm to35 mm length. The manner had been repeated 3 instances on moderate metallic and carbon metallic for each parameter in Ta

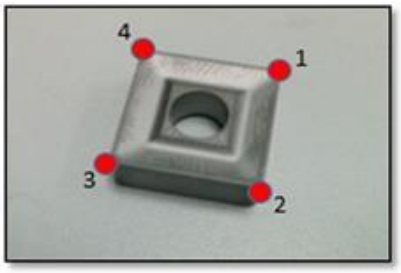


Figure1. Cementedcarbidetoolbit

Table1. Toolbitside

Side	Material	CuttingLubricant
1	MildSteel	SyntheticOilCoolant
2	MildSteel	CanolaOil+2wt% ZDDP
3	CarbonSteel	SyntheticOilCoolant
4	CarbonSteel	CanolaOil+2wt% ZDDP

Table2. MachineParameter

CuttingSpeed(m/min)	FeedRate(mm/rev)	DepthofCut(mm)
120	0.10	1.0
141	0.10	1.0
174	0.10	1.0

Aftertheexperiment wascompleted,twotestshadbeendoneontheworkmaterialandcementedcarbidetool;surfaceroughness andtoolweartest.

Result and Discussion

This section presents obtained results and the following by discussion.

A.SurfaceRoughnessTest

Surface roughness test has been done by using Mitutoyo Surftest SJ-401 to determine thesmoothness of the surface of the part after being machined using same tool bit with different type oflubricant. Below is the end result and the comparison of mild steel that are being machined with syntheticandcanola oil.

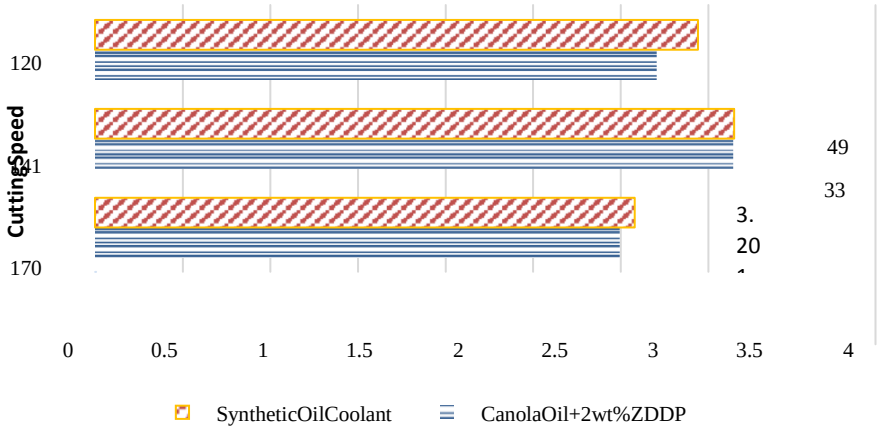
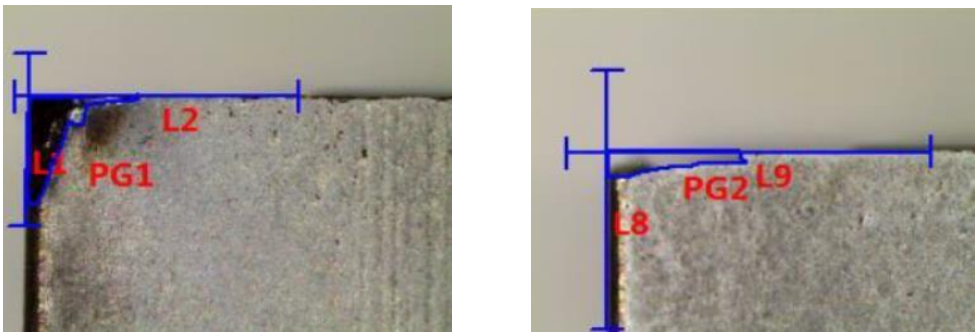


Figure2.Result of surface roughness on different Cutting Speed using mildsteel

Figure 2 and Figure 3 indicates that canola oil + 2 wt % ZDDP can carry out higher than the artificial oil coolant. This display that, canola oil can perform better evaluate to the synthetic oil coolant in time period of floor finish. Even though the one of a kind is small among these two coolants, however average, canola oil can carry out as correct as synthetic oil coolant for machining method. Based on Figure 3, the best surface finish is achieved at 174 m/min with cost of 4.697 uμm on carbon steel work cloth. While the cost of surface roughness on slight steel paintings fabric, acquired at 174 m/min with fee of 2.990 uμm. Theoretically, each machining process with high spindle pace, can get a terrific surface finish evaluate to the gradual one. But in time period of coolant that use in machining manner, canola oil + 2 wt % ZDDP can get a smoother floor finish compare to the artificial oil coolant.

B. Tool Wear

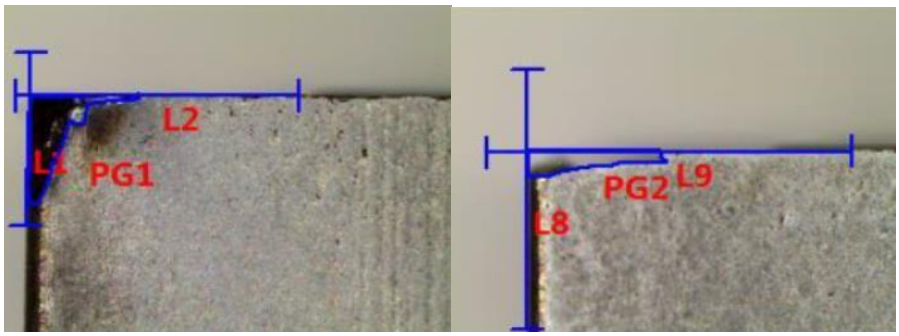
Tool put on is ordinary occurrence in a slicing tool after going thru a machining system. Tool put on situations also shaped because of the distribution of stress. Tool wear typically appear because of the friction in between a slicing device place and the workpiece material itself. Tool put on may be measure the use of a tool wear tester, and for this look at optical microscope Nikon Measuring Microscope MM-800 with exceptionally specification was used to reap the wear and tear of cemented carbide cutting device.



Material:MildSteel
Typeofoil:Syntheticoilcoolant
Areaofwear(mmxmm):0.6702mm2Length:5.276mm

Material:MildSteel
Type of oil: Canola Oil + 2 wt % ZDDPAreaofwear(mmxmm)=0.4050mm2Length= 3.9875mm

Figure4.Toolwear area



Material:CarbonSteel
Typeofoil:Syntheticoilcoolant
Areaofwear(mmxmm):1.8762mm2Length:13.6112 mm

Material:CarbonSteel
Type of oil: Canola Oil + 2 wt % ZDDPAreaofwear(mmxmm)=1.1834mm2Length= 9.2743mm

Figure4.Toolweararea(cont.)

The result in Figure four indicates the area of wear and tear for canola oil + 2 wt % ZDDP have lower region of wear evaluate to the artificial oil

coolant. This suggest that the usage of coolant additionally performs a prime function to make certain durable device existence. Canola oil + 2 wt % ZDDP have about 26.5 % smaller region of wear and tear compare to the artificial oil coolant. This proves that components inclusive of ZDDP able to extend the tool lifestyles with the capability to lessen device wear. As for carbon steel, Figure five also indicates that canola oil + 2 wt % ZDDP have decrease vicinity of wear as compared to the artificial coolant oil. Canola oil + 2 wt % ZDDP is 69.3 % lower than synthetic oil coolant wear.

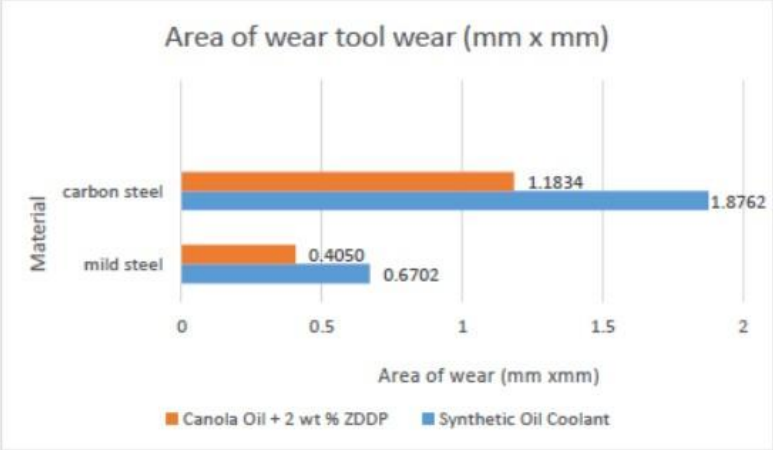


Figure5. Comparisonofareatool wear

Figure 5 indicate that the bottom location of damage may be received when the use of moderate metal because the material and canola oil + 2 wt % ZDDP because the cutting lubricant to perform the machining method. This is due to mechanical homes of moderate steel this is much less stiff as compared to carbon steel. That is why the device wear on carbon metal is greater than mild steel. Overall, canola oil + 2 wt % ZDDP can perform better in device existence. Cutting lubricant used in the machining manner plays an critical in tool lifestyles length beside the set feed fee. In this test, feed charge and intensity of cut are consistent variable that's 0.1 mm/rev for feed charge and 1 mm for depth of cut however cutting conditions and machining parameter may even affect the output. The cutting touch degree stress additionally will be the purpose of the reduced region of wear..

III Influence of the non-edible vegetable based oil as cutting fluid on chip, surface roughness and cutting force during drilling operation of Mild Steel

Machining is a technique designed to change the dimensions, shape, and floor of a material through removal of substances that might be accomplished by means of straining the material to fracture or via thermal evaporation. Machining offers critical blessings including incredible dimensional tolerances, sharp corners, grooves, fillets, various geometry, and properly surface end. The three precept machining strategies are turning, drilling and milling. Other operations falling into miscellaneous categories encompass shaping, planning, dull, broaching and sawing.

been brought and implemented over one hundred years. Cutting fluids are used in metallic machining for a variety of motives inclusive of improving device lifestyles, reducing work piece and thermal deformation, improving surface end and flushing away chips from the cutting area. Practically cutting fluids are categorized into 4 classes which include Straight oils, Soluble oils, Semi synthetic fluids, Synthetic fluids.

Due to the importance of cutting fluids, substantial troubles have been raised of their application, recycling and disposal. Proper selection and application can reduce production fee and enhance productiveness alternatively, production failure and wastes can be experienced via misuse of slicing fluids. And concerning to the environmental impacts and fitness risks by way of slicing fluids, recycling and disposal of cutting fluid also are of first rate significance. Improper disposal actions can reason severe health and environmental issues. These problems gave provision for the introduction of mineral, vegetable and animal oils. These oils play an vital position in enhancing diverse factors of machining homes, inclusive of corrosion safety, anti- bacterial safety, lubricity, chemical balance or even emulsibility.

Vegetable oils can be categorized in to various approaches depending upon the supply, utility etc.., oils may be fit to be eaten or non-safe to eat in nature. Compared to mineral oils vegetable oils in a trendy possess excessive flash point, high viscosity index, excessive lubricity and occasional evaporative losses.Various researchers have proved the well worth of edible vegetable oils viz., coconut oil, palm oil, soya bean oil and canola oil to be used as eco-friendly fluid in current past. But in gift conditions harnessing suitable for eating oils for lubricants formation restricts the use because of multiplied needs catering the growing populace international and neighborhood availability. Non-suitable for eating vegetable oils and different tree borne seeds can prove to be an effective opportunity, although restricted research has been done on sorts like PongamiaPinnata (karanja), Jatrophacurcas (Ratanjyot) and so on., prominently for biofuel applications and wishes centered attention for pleasing the environmental pleasant lubricant need their full potential. Castor, Mahua and Neem also manner sure properties which makes them a promising candidate for such formulations. Many Non-edible vegetable oils are renewable and biodegradable in nature

Current Status — Non Edible Vegetable Oils

Being a tropical united states of america, India is wealthy in forest assets having a wide variety of bushes, which yield a sizeable amount of oilseeds. India is uploading crude petroleum & petroleum merchandise from Gulf nations. Indian scientists looked for an alternate to petroleum primarily based lubricant to preserve global environment and to resist economic crisis. Some Non-Edible Vegetable Oils Available in India.

Application of vegetable oil-based reducing fluids in numerous Machining operations

Many researchers have worked on various vegetable oils as reducing fluid on unique paintings material. S.A.Lawalet.Al [1] executed a evaluate on the applicability of vegetable oil primarily based metal operating fluids in machining of ferrous metal. The creator targeted at the overall performance and environmental impact of those vegetable oils as emulsion and immediately oils for diverse substances and machining conditions. Finally concluded that Coconut oil confirmed the pleasant performance when compared to mineral oil on turning of AISI 304 austenitic stainless-steel. When vegetable oil become carried out to turning of AISI 9310 alloy metal using MQL mode of application, there was high-quality improvement of metal elimination charge (MRR). High productiveness approach that higher feed charge become done while vegetable-oil-based totally metalworking fluid become used.

SharafadeenKunleKolawaleet.Al Evaluated performances of palm oil and floor nut oil when in comparison with that of mineral oil based reducing fluid for the duration of machining operation of slight metal. Palm oil gave the overall highest thickness of 0.27mm probable because of its better lubricating belongings. Based on those results, floor nut oil and palm oil are being endorsed as variable alternative lubricants to the mineral oil at some stage in machining of moderate metal. It changed into discovered that Viscosity of groundnut oil-based pattern turned into lowest and the variety turned into closest even at very excessive temperature. Low viscosity means high viscosity index and the tendency to be fluidic at excessive price of working temperature.

Jitendra Kumar Chandrakaret.Al showed that lubricants provide smooth operation between movable parts of all machines. It keeps the reliability of gadget functions and reduces the threat of screw ups. Vegetable bio lubricants are non-toxic, degradable, and renewable additionally own appropriate lubricating properties. The writer reviewed papers on suitable for eating oils as reducing fluids. While in few papers non-fit to be eaten oils consisting of castor, Karanja, Mahua have been used and proved to have a super capability as lubricant for some of the machining operations.

Ahmad Fairuz Mansoret.Al Investigated Chip Formation and device wear in drilling Process using diverse styles of vegetable-Oil based Lubricants. This studies paper represents the machinability of the use of numerous feasible vegetable oils as cutting fluid in term of chip formation and tool wear throughout drilling operation on chrome steel, AISI 316. The performance of the vegetable oils; palm, sesame, olive and coconut oils have been in comparison below minimal quantity lubrication (MQL) method. The end result pronounced that the coconut oil shows the best machinability in time period of maximum and uniform chip thickness and least put on at the drill bit under same condition with others. These performances are accompanied by using palm, olive and sesame oil. In extra, the viscosity size shows that coconut oil has the lowest value that can possesses better fluidity and faster cooling capacity than other oils. Overall, coconut oil is recommended as possible alternative lubricants all through drilling of stainless steel.

EmelKuram,et.Al studied the Effects of vegetable-primarily based slicing fluids on the wear and tear in drilling. This work focused on each formulation of vegetable-primarily based slicing fluids (VBCFs) and machining with vegetable-primarily based slicing fluids. Performances of three VBCFs evolved from crude sunflower oil, refined sunflower oil, delicate canola oil and industrial semi-artificial cutting fluid are as compared in terms of device wear, thrust pressure and floor roughness at some point of drilling of AISI 304 austenitic stainless steel with HSSE tool. Experimental outcomes show that canola based slicing fluid gives the exceptional overall performance due to its higher lubricant properties with respect to other reducing fluids on the steady cutting situations. M.M.A. Khan et.Al investigated the outcomes of minimal pleasant lubrication (MQL) through vegetable oil based reducing fluid below turning operation of low alloy metal AISI 9310.The outcomes had been in comparison with completely dry and wet gadget in terms of tool- chip interface temperature, chip formation mode, tool put on and surface roughness. Results show that MQL presents environmental friendliness and improves the machinability characteristics.

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1. Experimental setup

2.1. Cutting fluids used

In the existing paintings drilling of mild metal is achieved the usage of the Vegetable based non-fit to be eaten oils as slicing fluids and the effects received are in comparison with SAE 20W40(Petroleum primarily based reducing fluid) and dry reducing effects. The Vegetable primarily based non-

fit to be eaten oils used are Neem, Karanja, Blend of Neem and Karanja i.E. (50% neem-50% Karanja), (33.3percentNeem- 66.6% Karanja), (66.Sixty five Neem- 33.3% Karanja)Table1:Physicalpropertiesofcuttingfluidsused

Sl. No	Typeofcutting fluid	Specific Heat (KJ/Kg.K)	Flash point (°C)	Fire point (°C)	Dynamic Viscosity (N-s/m²)	Adhesiveness (g/m^2)
1)	Neem	1.6817	248	285	0.0345	687
2)	Karanja	1.6761	220	245	0.0266	412
3)	50%Neem50%Karanja	1.6991	256	290	0.01648	359
4)	33.3%Neem66.6%Karanj	1.6703	228	256	0.0135	257
5)	66.6%Neem 33.3%Karanja	1.6789	228	264	0.011271	367
6)	SAE20W40	1.97	210	215	0.02172	319

Selection of correct cutting fluid relies upon on its Viscosity, Flash and Fire Points and Adhesiveness. The cutting fluid should possess excessive flash and fire points, because it should no longer trap fire at excessive temperatures. From the above table, the combination of fifty% Neem and 50% Karanja has got high flash and hearth points of 256
°C and 290 °C respectively, but viscosity also subjects. The viscosity of a lubricant is closely related to its capacity to reduce friction. Generally, the least viscous lubricant which nevertheless forces the 2 transferring surfaces apart is desired. If it's far too viscous, it's going to require a massive amount of electricity to move. From the values received 50% Neem and 50% Karanja has were given greatest Dynamic viscosity of 0.01648 N-s/m² which suits the best for machining. Adhesiveness is a belongings of slicing fluid to stick to the floor of work and device for the duration of machining and maintain a later setting apart each the elements, so that friction is less. Adhesiveness additionally ought to be choicest. From the table 1 the combination of fifty% Neem and 50% Karanja has were given an most useful fee of 359 g/m2. So 50% Neem and 50% Karanja is considered as exceptional reducing fluid.
Selection of desirable reducing fluid relies upon on its Viscosity, Flash and Fire Points and Adhesiveness. The slicing fluid have to own excessive flash and fireplace factors, as it need to no longer catch hearth at excessive temperatures. From the above table, the mixture of fifty% Neem and 50% Karanja has got high flash and fire points of 256
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2.1. Drilling situations and experimental designs:

In this work consistent velocity of 800 rpm, constant feed rate of 10 mm/rev have been taken. Drilling experiments were carried out for one of a kind slicing fluids and the results have been investigated. CNC machine is used for drilling the holes of diameter 13mm to a drilling intensity of 30mm.

(a)

(b)

Figure1:(a)CNCmachineisusedfordrilling(b)continuoussupplyofcuttingfluidduringdrilling

2.1. Work piece substances and cutting gear

AISI 1014 mild metallic bar having diameter of Ǿ25mm with 75mm length changed into taken as paintings piece and drill little bit of HSS with 10% cobalt with diameter of 13mm is used for drilling.

2.2. Chip and work floor Investigation

The chips have been gathered after machining for Neem, Karanja, combo of Neem and Karanja,SAE 20W40 and dry condition is as proven in determine three and the pitch, pitch top and chip period has been measured the use of profile projector. The machined floor roughness is measured the usage of surface finish tester.

1. Results and Discussion

3.1. Study of chips

During Machining, chip formation usually depends on form of steel being machined i.E. Climate ductile or brittle and temperature at the machining sector. This temperature is because of friction that exists among drill bit and the work piece. Chip may additionally spoil due to chattering of labor piece and because of overheating of work surface at some stage in the cutting procedure. The chatter inside the fabric is averted with the aid of sturdy paintings maintaining work element. Due to excessive warmth produced in the course of the machining, floor of work piece cloth gets converted from ductile to brittle and the chip will become discontinuous [7]. This discontinues chips had been discovered for dry condition and while Karanja is used as reducing fluid. With petroleum primarily based oil helped in decreasing the warmth but to a smaller extent. SAE 20W40 has higher specific warmth in comparison to other oils used therefore acts as properly coolant with the aid of soaking up warmth ,but due much less dynamic viscosity and adhesively, the petroleum based totally oil(SAE 20W40) does now not lubricate for this reason friction is extra as visible in paintings piece temperature. Compared to all the oils, it's far determined that for combination of 50% Neem and 50%Karanja longer duration continuous chips of 33mm are shaped indicating that temperature at machining region is much less as shown within the parent 3. This also can be found by means of the shade of the chip, which is not darkish like received for other reducing fluids. The effects show that blends of fifty% Neem and 50percentKaranja has properly lubricating and cooling belongings.

(a)Neem

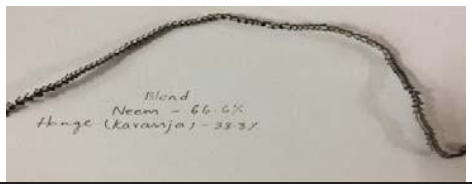
(b)Honge (Karanja)

(c)Dry

(d)Petroleum

(e)50%Neem-50% Karanja

(f)33.3%Neem-66.6%Karanja



(g)66.6%Neem-33.3%Karanja

Overall conclusion

Vegetable oil may be used as a lubricant in the Turning operation of as an powerful opportunity to other conventional cutting fluids for environmental and health components. On further experiments it's miles located mustard oil is very efficient each at excessive feed charge in addition to at low feed fees.

These papers have offered the minimum quantity lubrication method as an alternative approach of dry machining which using very small quantity of oil the use of vegetable oil lubricant. From the consequences, it can be concluded that canola oil blend can carry out better compare to artificial oil coolant in time period of floor end, but from device put on attitude, canola oil blend show 26.5% smaller location examine to artificial oil coolant.

A properly cutting fluid need to have high flash, fire point, particular heat, most desirable dynamic viscosity
and adhesiveness and these types of bodily homes have been received for mixture of fifty% Neem- 50%
Karanja.

The surface of the paintings piece relies upon on the kind of chip shaped in the course of machining; If the chips shaped are uniform and non-stop then the cutting fluid used is excellent ensuing in good floor finish. The continuous chips and uniform have been shaped for the combination of fifty% Neem- 50%
Karanja.

The chips formed for the mixture of fifty% Neem- 50% Karanja were in uncoloured silver indicating that heat carried by means of the chip is less. This also can be located with the aid of the length of the chip which is lengthy and continuous. This kind of chip is fashioned most effective while the slicing fluid used is superb.The reducing force must be less when an amazing slicing fluid is used. The reducing pressure of 169.23Nwas less for the blend of 50% Neem- 50% Karanja

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