International Journal of Technical Research and Applications e-ISSN: 2320-8163,
www.ijtra.com Volume 1, Issue 5 (Nov-Dec 2013), PP. 103-105

VEGETABLE OIL AS AN ALTERNATE CUTTING FLUID WHILE PERFORMING TURNING OPERATIONS ON A LATHE MACHINE USING SINGLE POINT CUTTING TOOL

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Abstract— **Ecological and environmental aspects in machining while using cutting fliud is to be considered, due to its impact on machinist health and environment. The use of Biodegradable oil can be an alternative source of lubricant .This paper reports the experimental results of using Mustard oil (vegetable oil) with MQL as an alternative cutting fluid while performing Turning operations on a Centre lathe machine using single point cutting tool of H.S.S. Results on tool life and tool wear were compared against other conventional coolants such as (10%Boric acid +SAE-40 Base oil) and (10% MoS2 +SAE-40 Base oil). Machine trial were performed on a solid cylindrical workpeice of mild steel at constant rotation of 250 rpm and with a single point cutting tool of high speed steel(H.S.S) . Experimental result shows that during the operation the vegetable oil performed a great cooling effect and lubrication similar to other coolants. The vegetable oil easily removed heat produced during the operation and gives proper lubrication, thus reducing friction and wear , hence improving tool life and surface finish.**

Index Terms—**Minimum Quantity Lubrication (MQL), Cutting Fluids, Centre Lathe, Machine, Turning Operations, Mustard Oil (Vegetable Oil) Coolant, Thermocouple.**

I. INTRODUCTION *(HEADING 1)*

As in all metal working operations, the energy dissipated in cutting operation is converted into heat, which , in turn , raises the temperature in cutting zone (fig:1).Knowledge of temperature rise in cutting is very important , because rise of temperature:

- Adversely affect the strength, hardness and wear resistance of cutting tool.
- Cause dimensional changes in the part being machined, making control of dimensional accuracy difficult, and
- Can reduce thermal damage to the machined surface, adversely affecting the properties and service life.

In addition, the machine tool itself may be subjected to temperature gradients cause distortion of the machine.

Because of the work done in shearing and in overcoming friction on the rake face of the tool, the main sources of heat generation are primary shear zone and the tool chip interface. In addition, if the tool is dull or worn, heat is also generated by the tool tip rubbing against the machined surface.

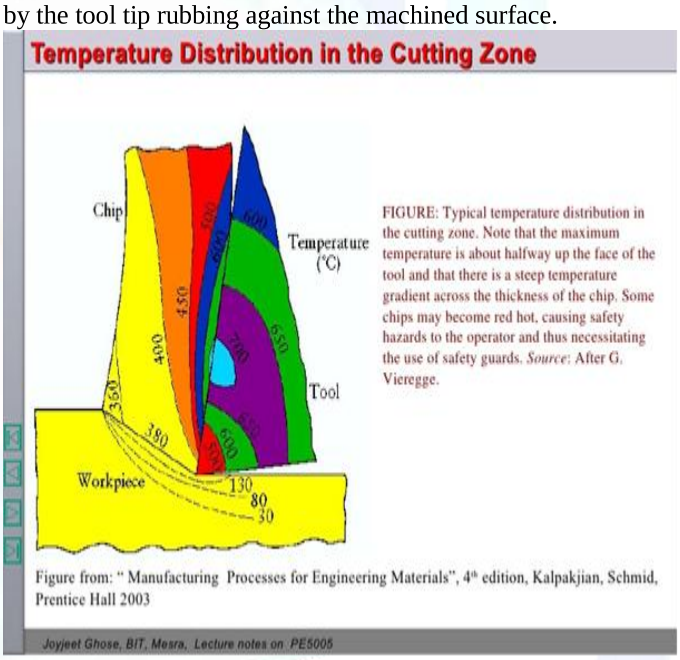

Figure: 1

The high contact stress between the tool rake face and the chip causes severe friction at the rake face, as well as, there is friction between the flank and the machined surface. The result is variety of wear patterns and scars which can be observed at the rake face and the face:

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

Recommended wear land size for different tool material and operations.

Wear (in)	Tool Material	Remarks
0.030 (0.76 mm)	Carbide	Roughing passes
0.010-0.015 (0.25-0.38 mm)	Carbide	Finishing passes
0.060 or total destruction(1.25 mm)	H.S.S.	Roughing passes
0.010-0.015 (0.25-0.38 mm)	H.S.S.	Finishing passes
0.010-0.015 (0.25-0.38 mm)	Cemented oxides	Roughing and finishing passes

Figure: 2

Effects of the tool wear on technological performance measures:

- Increase the cutting force
- Increase the surface roughness
- Decrease the dimensional accuracy
- Increase the temperature
- Vibration
- Increases the cost of production.

For a certain limits easiest and the most economical solution to the above problem is the use of a proper Lubricant.

II. LUBRICANTS

A Lubricant is a substance (often a liquid) introduced between two moving surfaces to reduce the friction between them, improving efficiency and reducing wear.

Lubricants perform the following key functions

- Keep moving parts apart.
- Reduce friction.
- Transfer heat.
- Carry away contaminants and debris.
- Transmit power.
- Protect against wear.
- Prevent against wear.
- Seal for gases.
- Stop the risk of smoke and fire of objects.

The cutting fluid can interchangeably be a coolant and a lubricant and this depends upon the temperature, the cutting speed and type of machining operation .Generally at high cutting speed it acts as a coolant thus cools the cutting zone and at low cutting speed operation such as broaching and tapping, it acts as a lubricant thus reduces the formation of Built-up-edge (BUE) and increases the surface finish.

Lubricants generally used are classified in four categories:

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

There are many adverse effects of such cutting fluids on the health of machinist and environmental such as: Health impacts associated with exposure to cutting fluids range from irritation of the skin, lungs, eyes, nose and throat to more severe conditions such as dermatitis, acne, asthma, hypersensitivity pneumonitis, irritation of the upper respiratory tract, and a variety of cancers. Health and environmental impacts of cutting fluids are discussed in [1-5], and others. Another big problem is associated with cutting fluids disposal [6-8]. Cutting fluids disposal can impact the environment due to hazardous metal carry-off, hazardous chemical constituents, oxygen depletion, oil content and nutrient loading. Therefore, optimal selection of cutting fluids based on health and environmental risks is an effective path to reduce occupational diseases of employees and minimize the environmental pollution, which will improve also the costs.

Due to the increasing number of laws and directives governing industrial safety and environmental protection, the use of cutting fluids is putting intense economic pressure on manufacturing companies because cutting fluid is an important source of health and environmental risks.

The traditional selection of a cutting fluid is mostly based on the type of machining operation, material being machined, cutting tool material and machining conditions. Innovative methodologies for decision support in the cutting fluids selection process must consider the environmental, health and safety characteristics, too.

Thus vegetable oil can be an alternative to the other conventional lubricants and is economical as well.

III. EXPERIMENTAL DETAILS

MQL (Minimum Quality Lubrication) technique is used in experiment which is alternative coolant technique developed towards the ‘green machining’ it is nearly dry machining. It refers to total use, without residue, applying lubricant between 10 to 100ml/h. (Klocke, F, and Eiseblatter,G.,1997).

Mustard oil (Vegetable oil) is used as a coolant during the machining. From the view point of environmental safety, Health ,performance and cost , High biodegradability, High viscosity index and good thermal stability(Ilija,G.,2003).The vegetable based oil could produce better result than the mineral reference oil in view of increased machining performance as well as renewable source (Belluco,W.,Chiffre,L.D,2004).

K Type thermocouple is employed for the calculation of mean temperature at the tool chip interface with hot junction is the cutting zone and the cold junction is cold part of the single point cutting tool.

Turning operations were performed on centre lathe Machine one after the other.

Single point cutting tool of High Speed Steel and a **Solid Cylindrical Workpeice** of Mild Steel was used.

IV. OBSERVATIONS

Machine Operation:	Turning
Constant Cutting Speed:	250 rpm
Feed rate:	0.06mm/rev
Depth of cut:	0.2mm
Tool Nose Radius:	0.8mm

Tool Temperature at the end of Operation (in Centigrade)			
Dry cutting	**Conventional Coolant**		**Mustard Oil as Coolant with MQL technique**
	10% MoS2 + SAE-40 Base oil	***10% Boric acid + SAE-40 Base oil***	
Nearly 300	**200 - 230**	**180 - 200**	**200 - 250**

V. CONCLUSSION

Vegetable oil can be used as a lubricant in the Turning operation of as an effective alternative to other conventional cutting fluids for environmental and health aspects. On further experiments it is observed mustard oil is very efficient both at high feed rate as well as at low feed rates.

ACKNOWLEDGMENT

I am extremely thankful to the Principal, University Polytechnic, and Integral University for his kind allowance and permission to perform my experiment in the workshop of the polytechnic and providing me other assistance.

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