International Journal of Applied and Structural Mechanics
ISSN: 2799-127X
Vol : 02 , No. 06 , Oct-Nov 2022
http://journal.hmjournals.com/index.php/IJASM
DOI: https://doi.org/10.55529/ijasm.26.1.7

Experimental Study of the Impact of Various Bio Based Cutting Fluid Using Multiple Machining Characteristics during Shaping Operation

Md Osman Gani[1], Arnab Konar[2], Manoj Kundu[3*]

[1]B.Tech Student, DR. B.C Roy Engineering College, Durgapur, India
[2]B.Tech Student, DR. B.C Roy Engineering College, Durgapur, India
[3]Assistant Professor, Mechanical Engineering Department, DR. B.C Roy Engineering College, Durgapur, India*

Email: [1]mdosmanw11@gmail.com, [2]arnabkonar0@gmail.com
Corresponding Email: [3]manoj.kundu@bcrec.ac.in*

Received: 03 July 2022 **Accepted:** 18 September 2022 **Published:** 21 October 2022

Abstract: In machining, the use of cutting fluids in metal machining has several benefits, including increased tool life, less thermal deformation of the work piece, improved surface smoothness, and flushing away of chips from the cutting zone. - Three distinct vegetable-based cutting fluids, such as rice bran oil, almond oil, and sunflower oil, were used in this study to measure the surface roughness during shaping operations. Mild steel, stainless steel, and EN 8. Vegetable cutting oils have been studied for their potential to enhance surface finish during shaping at various speeds and feed rates. Speed, feed rate, and depth were taken into account as machining parameters in the trials. Cutting fluids; cutting fluids made from vegetables. Feed rate, speed, and depth of cut are all different cutting characteristics that are taken into account. Experimental research into surface roughness values is done after the three components are machined using various settings.

Keywords: Tool, Work Specimen, Cutting Fluid, Machining Parameters, Surface Roughness.

1. INTRODUCTION

In the machining process, cutting fluids have been employed to enhance the tribological properties of the work piece-tool-chip system. Cutting fluids help to provide lubrication between the work piece and tool and also help to remove heat produced during the metal cutting process, which increases the efficiency of machining in terms of increased tool life, improved surface finish, improved dimensional accuracy, reduced cutting force, and vibrations. Process efficiency and end surface quality are greatly influenced by the chemical make-up and mechanical attributes of the work piece, the tool, and the cutting fluid. In the

International Journal of Applied and Structural Mechanics
ISSN: 2799-127X
Vol : 02 , No. 06 , Oct-Nov 2022
http://journal.hmjournals.com/index.php/IJASM
DOI: https://doi.org/10.55529/ijasm.26.1.7

current investigation, cutting fluids made from vegetable oil have a strong lubricating ability and are ecologically benign. According on performance comparison data from three cutting fluids, vegetable- based cutting oils outperformed rice bran oil and almond oil. In this study, the effects of several cutting fluids on the thrust force and surface roughness during the machining of stainless steel, mild steel, and EN 8 material were assessed. Several benefits of using cutting fluids in metal machining include increased tool life, less thermal deformation of the work piece, improved surface smoothness, and flushing away chips from the cutting zone [4]. The effectiveness of coconut oil in decreasing tool wear and surface roughness [6]. A single point cutting tool is used often in the machining process known as shaping to remove material off the surface of a spinning cylindrical work piece. High normal and shear stresses come from the removed material, known as the chip, sliding on the tool's rake face.

Experimental Setup:

Shaper machines are production equipment used to create flat and angular surfaces. The single point cutting tools are attached to the work piece, which is stationary, and as the machine is moving forward, the tool cuts the work piece. The term "feed" refers to the relative movement of the work piece in a plane perpendicular to the axis of the arm's reciprocation. In a shaper, feed can be either automated or manual and is often delivered to the work piece. Since there is no cutting during the return stroke, it is stated in mm/double stroke or just mm/stroke. We chose a feed of 0.2 for this shaping machine, and it remains constant for all cutting tools, including those made of mild steel, stainless steel, and EN 8 material. The pace at which the metal is removed by the cutting tool in one minute is the shaper's cutting speed.

Therefore, just the forward cutting stroke is taken into account. Meters per minute are used to measure speed. We obtain the low speed of the gear by connecting the belt to the motor's small diameter wheel and the machine's large wheel diameter, and we obtain the medium speed of the shaping machine by connecting the gear belt to the motor's medium diameter wheel and the machine's medium diameter. We'veused 365.9 feet per minute for the middle speed and 75.42 feet per minute for the low speed. A shaper's cutting tool is a single point cutting tool with lathe-like rake, clearance, and other tool angles. Its tool angles differ from those of a lathe tool. To withstand the stress that the cutting tool experiences at the start of each cutting stroke, shaper tools are significantly more robust and heavy. Three cutting tools—mild steel, stainless steel, and EN8 material—have been used. Cutting fluid is primarily used to minimize friction wear and cutting zone temperature by cooling or lubrication. Understanding machining conditions and different cutting fluid types is crucial for maximizing the effectiveness of cutting fluids in machining operations.

CHARACTERISTICS OF VEGETABLE BASED CUTTING FLUID

Metal Cutting Fluid	pH	Density (g/ml)	Viscosity (sq.mm/sec)	Flash Point (°C)	Refractive Index	Friction Coefficient
Almond Oil	5.5	0.916 (In 20 °C)	34.2	300 °C	1.467	1.01
Sunflower Oil	7.38	0.919 (In 20 °C)	28.74	318 °C	1.473	0.059
Ricebran Oil	6.9	0.913 (In 15 °C)	39.8	323 °C	1.467	0.935

International Journal of Applied and Structural Mechanics
ISSN: 2799-127X
Vol : 02 , No. 06 , Oct-Nov 2022
http://journal.hmjournals.com/index.php/IJASM
DOI: https://doi.org/10.55529/ijasm.26.1.7

Surfaceroughness(Ra)isaparameternormallyusedtoindicatethelevelof surfacefinish.Surfaceroughnessis measured by surface roughness testing machine. Chip thickness is measured by vernier calliper.
Verniercalipers are used to measure length, depth, thickness, inner and outer diameter of cylinders. Theleast count of vernierscale is 0.1


Fig.1 PCE-RT-11


Fig.2 Shaping Machine


Fig.3 LCD display

The chemical composition of workpiece materials are given below:-


Fig.4 Mild Steel


fig.5 EN8


fig.6 Stainless steel

Chemical Composition of Mild Steel					
C %	Si %	Mn %	P %	Fe %	
0.17	0.2	0.54	0.16	98.7	
Chemical Composition of Stainless Steel					
Cr %	Ni %	Mn %	Fe %		
18.66	8.22	1.27	71.85		
Chemical Composition of EN8					
C %	Si %	Mn %	P%	S%	Fe %
0.44	0.4	1	0.05	0.05	98

International Journal of Applied and Structural Mechanics
ISSN: 2799-127X
Vol : 02 , No. 06 , Oct-Nov 2022
http://journal.hmjournals.com/index.php/IJASM
DOI: https://doi.org/10.55529/ijasm.26.1.7

Fig.8 High Speed Steel Tool (HSS)

2. RESULT AND DISCUSION

While measuring the chip thickness of EN 8 material using almond oil at low speed we get chip thickness around 1.02-1.06 mm and at high speed we get minimum chip thickness around 0.4 to 0.6 mm. while measuring the chip thickness for mild steel at low speed using Rice bran oil we get the chip thickness around 0.4mm and at high speed using the sunflower oil we get chip thickness around 0.76 mm. while measuring the chip thickness of stainless steel at low speed using sunflower oil we get the chip thickness around 0.24 to 0.26 and at high speed using sunflower oil and almond oil we get chip thickness of stainless steel around 0.24 to 0.9 mm. In this shaping machining process the temperature remains almost constant around 32 0C to 33 0C.
CF 1 – Almond oil, CF 2 – Sunflower oil, CF 3 – Rice bran oil which are used in different materials to test the changes in surface roughness by changing speed and depth of cut. In this bellow fig.8 we can see the effect of using different vegetable based fluid in different materials.

International Journal of Applied and Structural Mechanics
ISSN: 2799-127X
Vol : 02 , No. 06 , Oct-Nov 2022
http://journal.hmjournals.com/index.php/IJASM
DOI: https://doi.org/10.55529/ijasm.26.1.7

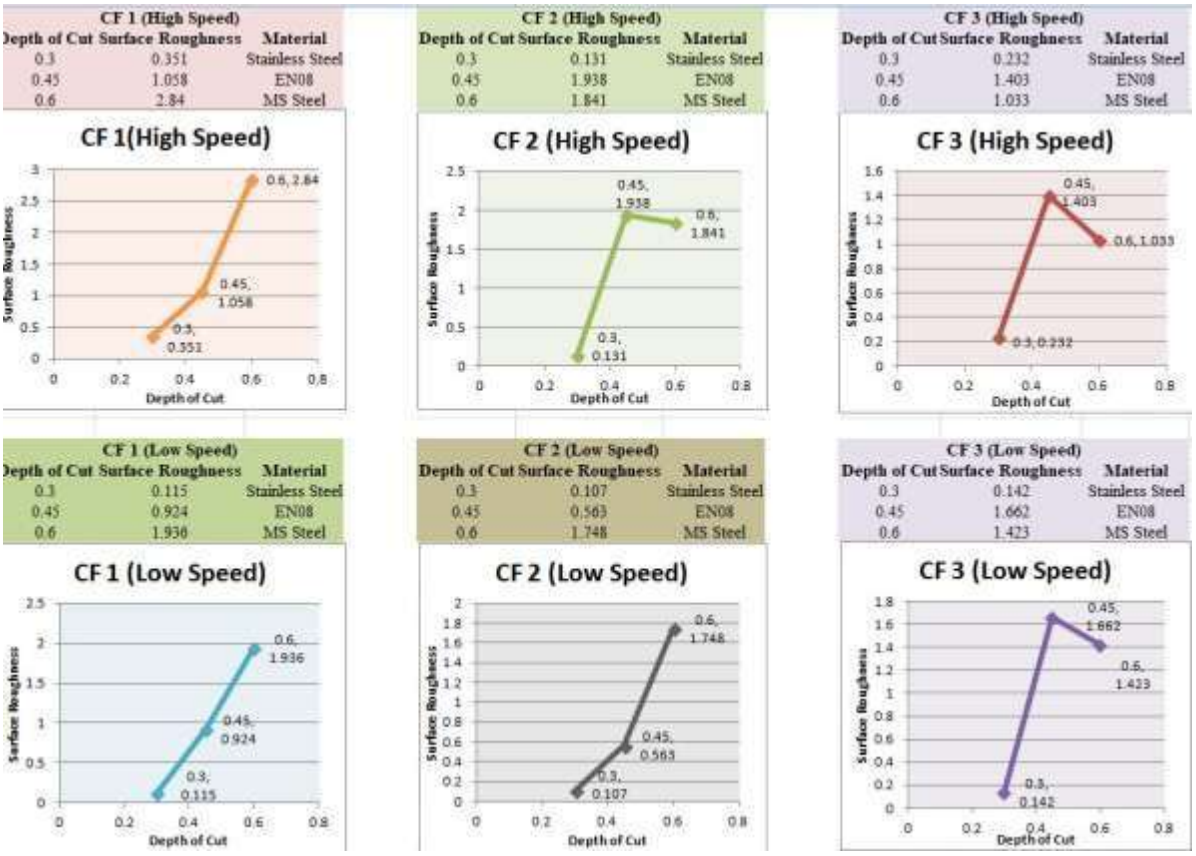

Fig.8

3. CONCLUSION

The surface finish of the machined work piece was strongly impacted by the evaluated machining settings.The impacts of one or more process parameters (spindle speed, feed rate, and depth of cut) on the surface quality of the machined surface have been investigated through experiments.

1) For a feed rate of 0.2 mm per minute, a speed of 75.42 rpm, and a cut depth of 0.6 mm, the surfaceroughness is greater.
2) Based on the experimental findings, EN8 material can be machined with a satisfactory surface qualityat a feed rate of 0.2 mm/min and a speed of 75.42 rpm.
3) It is to clearlyobservedthatbyincreasingthecuttingspeedthesurfacefinishimrovedishighat thecondition of 365.9 rpm than at 75.42rpm.
4) Vegetable oil was the most successful in reducing surface roughness as spindle speed rose, with theleast surface roughness being attained at 365.42 rpm.
5) Finally, the surface finish produced by the trial work on the shaping machine with the cutting tool whileusing vegetable oil is satisfactory for EN8 steel.

International Journal of Applied and Structural Mechanics
ISSN: 2799-127X
Vol : 02 , No. 06 , Oct-Nov 2022
http://journal.hmjournals.com/index.php/IJASM
DOI: https://doi.org/10.55529/ijasm.26.1.7

Future Scope

Tool life of a machining process can be increased by using cutting fluid such as sunflower oil.

Cutting fluid is primarily used to minimise friction wear and cutting zone temperature by cooling or lubrication. Understanding machining conditions and different cutting fluid types is crucial for maximisingthe effectiveness of cutting fluids in machining operations.

Acknowledgement

On this great occasion of accomplishment of our project on EXPERIMENTAL STUDY OF IMPACT OF VARIOUS BIO BASED CUTTING FLUID USING MULTIPLE MACHINING CHARACTERISTICS
DURING SHAPING OPERATION, we would like to sincerely express our gratitude to Dr. Chandan Chattoraj our HOD & I am grateful to our teacher Nath sir who helped us in our project work as well our Prof Dr. Manoj Kundu , who has been supported through the completion of this project.

4. REFERENCES

1. R. F. Ávila, A. M. Abrão, “The effect of cutting fluids on the machining of hardened AISI 4340 steel,”
2. Journal of Materials Processing Technology 2001;119:21-26
3. J. John, M. Bhattacharya, P. C. Raynor, Emulsions containing vegetable oils for cutting fluidapplication,” Colloids and Surfaces A: Physicochem. Eng. Aspects 2004;237:141-150.
4. M. A. Xavior, M. Adithan, “Determining the influence of cutting fluids on tool wear and surfaceroughness during turning of AISI 304 austenitic stainless steel,” Journal of Materials Processing Technology 2009;209:900-909.
5. A. Rivero, G. Aramendi, S. Herranz, L. N. López de Lacalle, “An experimental investigation of the effect of coatings and cutting parameters on the dry drilling performance of aluminium alloys,” Int J AdvManuf Technol 2006;28:1-11.
6. E. Kuram, B. Ozcelik, E. Demirbas, E. Şık, "Effects of the Cutting Fluid Types and Cutting Parameters on Surface Roughness and Thrust Force, "Proceedings of the World Congress on Engineering2010 Vol II WCE 2010, June 30 - July 2, 2010, London, U.K.
7. N. Gopikrishna, M. Shiva Chander, M. Srikiran, "Determining the Influence of Cutting Fluid on Surface Roughness during Machining of EN24 and EN8 steel by using CNC Milling Machine, "Journalfor Research| Volume 01| Issue 11 | January 2016
8. E.Kuram , B. Ozcelik , E. Demirbas , E. Şik& I. N. Tansel (2011) Evaluation of NewVegetable-BasedCutting Fluids on Thrust Force and Surface Roughness in Drilling of AISI 304 Using Taguchi Method, Materials andManufacturing Processes, 26:9, 1136-1146,
9. Belluco, W.; De Chiffre, L. Performance evaluation of vegetable-
10. based oils in drilling austenitic stainless steel. Journal of Materials Processing Technology 2004, 148,171–176

International Journal of Applied and Structural Mechanics
ISSN: 2799-127X
Vol : 02 , No. 06 , Oct-Nov 2022
http://journal.hmjournals.com/index.php/IJASM
DOI: https://doi.org/10.55529/ijasm.26.1.7

11. Thepsonthi, T.; Hamdi, M.; Mitsui, K. Investigation into minimal-cutting-fluid application in high- speed milling of hardened steel using carbide mills. International Journal of Machine Tools & Manufacture 2009, 49, 156–162.
12. Wisley F. SalesI, Álisson R. MachadoII, John BonneyIII, Emmanuel O. EzugwuIV,
13. "Evaluation of cutting fluids using scratch tests and turning process, "J. of the Braz. Soc. of Mech. Sci.&Eng.Vol. XXIX, No. 4, October-December 2007
14. Irina NITA, Anisoara NEAGU, Sibel GEACAI, Anca DUMITRU and Anca STERPU: "Study of the behavior of some vegetable oils during the thermal treatment," Technology and Chemical Engineering Department, Ovidius University, bd. Mamaia 124, Constanta, 900527, Romania
15. Mohammed Hassan Jabal, Abdulmunem R. Abdulmunem& Hussain Saad Abd (2019) "Experimentalinvestigation of tribological characteristics and emissions with nonedible sunflower oil as a biolubricant",
16. Journal of the Air & Waste Management Association, 69:1, 109-118
17. SharminAkter, Md. Ahiduzzaman. "Effect of Storage Life of Rice Bran on the Quality of Oil. Journalof Food and Nutrition Sciences", Vol. 5, No. 1, 2017, pp. 11-15.
18. E Gowthami, DD Smith, L Edukondalu, Vimala Beera and V Srinivasa Rao. "Frictional properties ofrice bran". The Pharma Innovation Journal 2021; 10(12): 124-127
19. Shoush K. A., Ali W. Y., Abdel-Sattar S. and El-Lithy F. M. "INFLUENCE OF MAGNETIC FIELD ON THE FRICTION AND WEAR CAUSED BY THE SCRATCH OF OIL LUBRICATED HIGH DENSITY POLYETHYLENE". JOURNAL OF THE EGYPTIAN SOCIETY OF TRIBOLOGY.VOLUME 9, NO. 2, APRIL 2012, 1 – 14
20. Lemuel M. Diamante, Tianying Lan. "Absolute Viscosities of Vegetable Oils at Different Temperatures and Shear Rate Range of 64.5 to 4835 s^{-1}". Journal of Food Processing.
21. Volume 2014 | Article ID 234583
22. OmojolaAwogbemi, Emmanuel IdokoOnuh, Freddie L Inambao. "Comparative study of propertiesand fatty acid composition of some neat vegetable oils and waste cooking oils".International Journal of Low-Carbon Technologies, Volume 14, Issue 3
23. J.M. Roncero1, M. Álvarez-Ortí1, A. Pardo-Giménez2, R. Gómez1, A. Rabadán1, J.E. Pardo."
24. Almond virgin oil: parameters of regulated physicochemical quality and stability".RivistaItalianaDelleSostanze Grasse Vol XCIII.(Ottobre-dicembre 2016.):237-241.
25. Samatham Madhukar, A V Vishnu Vardhan Reddy , N Vamshidhar Reddy PatlollaSrujan Reddy." Experimental Investigation on Effect of Heat Treatment on Mechanical Properties of Steels and Titanium". International Journal of Engineering and Technology. Vol.7, No.3
26. C. C. Tsao, "An experiment study of hard coating and cutting fluid effect in milling aluminum alloy,"Int J Adv Manuf Technol 2007;32:885-89