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EFFECTS OF NEEM, STRAIGHT AND SOLUBLE OILS AS CUTTING FLUIDS ON TOOL WEARING DURING METALWORK PRACTICALS IN TECHNICAL COLLEGES IN KANO STATE, NIGERIA

Lkama, J. Drambi [1], Yusuf, Mohammed [2]
[1] PhD, Department of Technology Education, Modibbo Adama University of Technology, Yola
[2] Goni Bello Islamic Education Centre, P. O. Box 167, Mubi, Adamawa State, Nigeria

Abstract:

The study investigated the effects cutting fluids on tool wearing on high speed steel (HSS) using mild steel workpiece for teaching machining operation. Two specific objectives guided the study, two corresponding research questions were poised and two null hypotheses were formulated. The theoretical frame work for the study was hinged on experiential learning theory as propounded by Rogers (1969). The growing demand for biodegradable materials has opened an avenue for using vegetable oils such as neem seed oil, castor oil and water melon seed oil as an alternative to conventional cutting fluids. In this study, some aspects of the turning process on mild steel using HSS cutting tool at variety of spindle speed, feed rate and constant depth of cut were observed using neem seed oil, soluble oil and straight oil in comparison. The data collected from the study was analyzed using mean and analysis of variance (ANOVA). The decision rule was that, the smaller the mean value obtained the more effective the cutting fluid and the higher the mean value, the less effective the cutting fluid. The hypotheses were tested at α=0.05 significance level using analysis of variance (ANOVA). The findings of the study revealed that soluble oil is more effective in reducing tool wearing than neem oil and straight oil at variety of feed rates and spindle speeds during machining operation. Also there is no significant difference in the mean readings of tool wearing when using neem oil, soluble oil, and straight oil as cutting fluid. It was therefore recommended that machinists should be encouraged to use soluble oil which has greater advantage over neem and straight oils in machining operations.

Keywords: Effect; Cutting Tool; Tool Wearing; Technical Colleges.

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1. Introduction

Cutting fluid is a type of coolant and lubricant used to reduce friction during machining operation. It is very important in machining process. Cutting fluids have varieties depending on the work and the process involved. Cutting fluids are also used to take away excessive heat in machining operations which can cause damage to the microstructure of metals. Proper use of coolants can also help improve work piece quality and dimensional accuracy (Hemant & Mahendra 2014).

The use of cutting fluids in metal cutting has been noticed that, cutting speed could be increased up to 33% without reducing tool life by applying large amounts of water in the cutting zone, cutting fluids increase the tool life and improve the efficiency of the production systems providing both cooling and lubricating the work surface (Avila & Abrao, 2001).

The classifications of cutting fluids are essential to understand, since today a variety of cutting fluids are widely available in the world. According to chemical formulations, cutting fluids are classified into four categories: cutting oils, soluble oils (emulsified oils, emulsions), synthetic (chemical) fluids, and semi-synthetic (semi chemical) fluids. Cutting oils named as neat oil or straight cutting oil are formed oil derived from petroleum, animal or vegetable origin. Cutting oils are used without further dilution in metal cutting processes has good lubrication properties, poor cooling properties and increases fire risk. They may also create a mist or smoke harmful to the health of operator. The use of cutting oils is limited to low temperature and low speed cutting operations. Emulsified oils are suspension of oil droplets in water. This cutting fluid is made by blending oil with emulsifier agent(s) to improve the stability of the emulsion in water (Kuram, Ozcelik & Simsek, 2011). The general compositions of water based cutting fluids according to Kuram, Ozcelik & Simsek (2011) are as follows:
Base oil + Emulsifier + Other additives
Base oil = mineral oil and vegetable oil

Other additives = Neutralization agents, Corrosion and rust inhibitors, lubricating additives (anti wear and EP additives), Biocides and Fungicides, Foam inhibitors. According to the International Standard Organizatio ISO (1993), there are multiple types of wear and phenomena, which can cause tool-life criterion to be fulfilled. Most important of the wear types are flank wear and crater wear. Flank wear is present in all situations and it is the best known type of wear. It can be found on the major flank of the tool. Crater wear appears on the face of the tool as a crater. Crater wear is the most commonly found wear on the face of the tool.

The wear process itself changes under the influence of different conditions. However, three main factors contributing to the wear are known: adhesion, abrasion and diffusion. Adhesion occurs when the work material, that the tool is cutting, welds onto the tool. This happens because of the friction between the tool and work material, which generates heat. When these welds are broken, small pieces of the tool are lost. Abrasion is mechanical wear resulting from the cutting action, where the tool grinds itself on to the work material. Diffusion wear occurs on a narrow reaction zone between the tool and work material. In diffusion wear the atoms from the tool move to the work material. This usually accelerates the other two wear processes as the tool material is weakened (Boothroyd & Knight, 2006).

Cutting tools are frequently used in our every day’s life. The regularly used cutting tools can be in the form of knives, razor blades, lawnmowers or more industrial tools in wood or metal working. Despite their widespread applications in modern lives, not too many questions have been raised about the origin and history of these tools. In the context of metal cutting or in general machining, a cutting tool is an instrument by means of which the metal is being removed from the work piece body. In order to achieve successful cutting, cutting tools must be mechanically harder than the material to be machined. Although cutting tools in their general form have been used by human beings for centuries; their modern history began during the industrial revolution in the nineteenth century. However, in the absence of systematic tool production before the twentieth century, the majority of the tools were prepared by their end users at local machine shops. As a result, having a combined knowledge of physics, chemistry, heat treatment, and also blacksmithing was among the necessary requirement for being a successful machinist (Ali, Hossam & kinshawy, 2014).

The twentieth century, cutting tools were mostly produced using carbon tool steels. These types of steel comprise high carbon content and can be successfully hardened. One of the earliest report advances in cutting tool history was made in 1868 by Robert Forester Mushet, a British metallurgist, who discovered that hardness of steel and consequently tool life can be improved by adding tungsten which has the second highest melting point of all elements after carbon and the highest melting point of all non-alloyed metals. Mushet steel is considered to be the first tool steel which was later led to the discovery of high speed steels. The emerging need for cutting tool material capable of enduring higher cutting speeds and resulting high temperatures led to a significant development which was made by American mechanical engineer Frederick Winslow Taylor during late 19th and early 20th century (Ali, Hossam & kinshawy, 2014). They studied the cutting tools and their corresponding performances and proposed a novel tool life equation which is, in its augmented form, still one of the most widely used equations in metal cutting science and machining industry. Various studies discovered that more durable steel, which is able to maintain its hardness at high temperature, can be achieved if it is being heated close to its melting point. This type of hardened steel can be assumed to be the first generation of high speed steel (HSS) tools, the introduction of HSS tool increased the practicable cutting speed four times in comparison to the previously used carbon steels. In comparison to carbon steel tools, HSS tools owe their superiority to the alloying elements. The alloying elements make the steel harder and more heat resistant (Ali, Hossam & kinshawy, 2014).

The HSS tools, according to Hemant and Mahendra (2014) can be divided into almost thirty different grades; while, all of these grades can be categorized in three principal classifications: molybdenum based grades (M series), tungsten based grades (T series), and molybdenum-cobalt based grades. Among these grades, M and T series are the most commonly used HSS tools in industry. Performance of HSS tools can be further increased by application of coating. Different types of coating can be used to cover the surface of HSS tools; among them, titanium nitride is the most effective one that increase allowable cutting speed as well as tool life. Titanium nitride can be deposited on the HSS surface by means of physical vapour deposition (PVD) techniques (Ali, Hossam & kinshawy, 2014).

One of the most common groups of cutting tool materials is high-speed steel (HSS). Though high-speed steel was first introduced around 1900, it is still used in today’s shops. As with the carbon tool steels that preceded these materials, HSS contains a balance of varying alloying elements. Generally speaking, according to Kalam (2007) HSS can be divided into these two major groups:

Tungsten high-speed steels were the first HSS tools created that used tungsten as a primary alloying element. Molybdenum high-speed steels later contained molybdenum as an alloying element to reduce the amounts of costly tungsten.

Both of these groups of high-speed steel are still available today. HSS tools are either wrought or sintered. During sintering, a fine powder of HSS is pressed and heated to create the final solidified shape. Sintered HSS tools cost more, but they tend to be harder, tougher, and more wear resistant.

The phenomenon of great significance in metal cutting is tool wear. Many factors determine the type and rate at which wear occurs on the tool. The major critical variables that affect wear are tool temperature, type and hardness of tool material, grade and condition of work piece, abrasiveness of the micro constituents in the work piece material, tool geometry, feed, speed, and cutting fluid. The type of wear pattern that develops depends on the relative role of these variables. Tool wear can be classified as flank wear, Crater wear on the tool face, localized wear, such as the rounding of the cutting edge; chipping or thermal softening and plastic flow of the cutting edge; concentrated wear resulting in a deep groove at the edge of a turning tool, known as wear notch**.** In general, the wear on the flank or relief side of the tool is the most dependable guide for tool life**.** A wear land of 0.060 in (1.5 mm) on high speed steel tools and 0.015 in (0.4 mm) for carbon tools is usually used as the endpoint. The cutting speed is the variable which has the greatest influence on tool life *(Yahya, 2010).*

Cutting fluids are essential in most metal cutting operations. During metal cutting processes, heat and friction are created by the plastic deformation of metal occurring in the shear zone, when the chip slides along the chip-tool interface. This chip sliding action and frictional effect causes metal to adhere to the tools cutting edge, causing the tool to breakdown, resulting to inaccurate and poor surface finish of the work piece (Ksar & Oswald, 1990). Cutting tools may fail by brittle fracture, plastic deformation or gradual wear. Carbon steel tool having enough strength; toughness and hot hardness generally fail by gradual wear. With the progress of machining, the tools attain crater wear at the rake surface and flank wear at the clearance surfaces, the principal flank wear is the most important because it raises the cutting forces and the related problems. Flank wear is a major form of tool wear in metal cutting. When machining using tools under typical cutting conditions, the gradual wear of the flank face is the main process by which a cutting tool fails (Yahya, 2010).

The international standard organization (ISO) standard 3685 in regards to tool life testing, the life of most cutting tools fail by wearing, and is assessed by the actual machining time after which the average value of its principal flank wear reaches a limiting value of 0.3 mm. In tool life evaluation turning processes were paused in every 60 mm and the average flank wear was measured. If the tool was not expired (which means it does not reach to a value of 0.3 mm of average flank wear land) at the end of the first bar, second bar of the same structure was used for the rest of the process. This was necessary for the constant cutting speed as explained previously. Tool life estimation involves a number of tests to be carried out at various cutting conditions till the failure of the cutting tool. In general, as the tool life criterion, amount of flank wear is used. Flank wear is an important factor in determining the tool life. The cutting test was started with a new cutting tool, and the machining process was stopped at certain intervals of cutting length in

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order to measure the width of flank wear. Flank wear rate is calculated as the average wear divided by the effective tool life (Yahya, 2010).

The main drawback is that the strength of the cutting wedge decreases when the rake angle increases. When cutting with a positive rake, the normal force on the tool–chip interfaces causes bending of the tip of the cutting wedge. The presence of the bending significantly reduces the strength of the cutting edge, causing its chipping. Moreover, the tool–chip contact area reduces with the rake angle so the point of application of the normal force shifts closer to the cutting edge. On the contrary, when cutting with a tool having a negative rake angle, the mentioned normal force causes the compression of the tool material. Because tool materials have very high compressive strength, the strength of the cutting edge in this case is much higher, although the normal force is greater than that for tools with positive rake angles. Another essential drawback is that the region of the maximum contact temperature at the tool–chip interface shifts toward the cutting edge when the rake angle is increased, which lowers tool life (Davim, 2008).

Sanusi and Akindapo (2015) conducted a research aimed evaluating the performance of neem seed oil as a cutting fluid in orthogonal machining of aluminum-manganese alloy 3003, carbide cutting tool insert was used as a cutting tool under different machining parameters of spindle speed, feed rate and depth of cut with different types of cutting fluids (neem seed oil and soluble oil) as well as dry machining. The results were obtained in terms of the average surface roughness of the machined work piece and flank wear under different cutting parameters (spindle speed, feed rate and depth of cut). The results indicated that the neem seed oil cutting fluid reduced the surface roughness by 39% and 22% as compared to dry turning and soluble oil cutting respectively. It was established from the results that the neem seed oil cutting fluid reduced the flank wear by 72% and 56% as compared to dry turning and soluble oil cutting respectively. Based on the study, it can be concluded that neem seed oil cutting fluid facilitates a better surface finish and substantial reduction in tool wear when compared with dry and soluble oil machining.

Mithun and Potdar (2015) Studied the effect of Vegetable oil based cutting fluid on machining characteristics of AISI 316L Steel. In the study the properties of the non-ionic surfactants have been identified to formulate vegetable based cutting fluid (VBCF) of castor oil for the formation of emulsion as non –conventional lubricant. The mineral oil based cutting fluid emulsion is also used for turning operation as conventional lubricant. Experimentation has been carried out for different combinations. Cutting fluid, cutting velocity, feed rate and depth of cut are considered as machining parameters. Then machining with conventional and non-conventional lubricants in wet condition has been carried out upon SS 316 L work piece with carbide cutting inserts tool, to evaluate cutting forces and tool wear. The results show that non-conventional lubricant performs better than conventional cutting fluid. This study therefore, is strictly on tool wear when three different cutting fluids are used at different feed rates and spindle speeds.

1.1. Purpose of the Study

The main purpose of the study was to determine the effects of different cutting fluids on tool wearing during machining operations. Specifically, the study determined:

1) The effects of neem , straight and soluble oils on tool wear when used as cutting fluid at different feed rates during machining process.
2) The effects of neem, straight and soluble oils on tool wear at different spindle speeds during machining operations.

1.2. Research Questions

The following questions guided the study.

1) What is the effect of neem oil, straight oil and soluble oil on tool wear when used as cutting fluid at different feed rates during machining process?
2) What is the effect of neem oil, straight oil and soluble oil on tool wear at different spindle speeds durng machining operation?

1.3. Hypotheses

The following null hypotheses were tested at 0.05 level of significance.
HO_1: There is no significant difference in the mean readings of neem oil, soluble oil, and straight oil on tool wearing when used at different feed rates during machining operations.
HO_2: There is no significant difference in the mean readings of neem oil, soluble oil and straight oil on tool wearing when used at different spindle speeds during machining operations.

2. Materials and Methods

The materials used for this study include:

1) Lathe machine – Model: Harrison, Serial No. M300, 5.3 amps, 2.2kw, 380 volts, 50Hz.
2) Cutting tool –facing tool High speed steel (HSS) with 10° rake angle, 9° clearance angle, 1.5mm nose radius with 10mm tool overhang.
3) Micro-meter screw gauge
4) Mild steel work pieces with diameter 49.50mm
5) Vanier Caliper

The effect of neem seed oil, soluble oil, and straight oil on tool wearing of the HSS cutting tool at varying spindle speeds, depths of cut and feed rates on the turning of mild steel were carried out on a Harrison lathe machine.

The experiments were carried out with the following specific procedures using the neem seed oil soluble oil and straight oil as the cutting fluid.

1) Turning operations of mild steel at varying spindle speeds (58, 85, 125, 180, 260 and 540 rev/min) and at variety of feed rate (1.0, 0.8, 0.6, 0.4, 0.2 mm/rev) and constant depth of cut of 6mm

2) Turning operations of mild steel at varying feed rates (1.0, 0.8, 0.6, 0.4, 0.2 mm/rev) and variety of spindle speed (58, 85, 125, 180, 260 and 540 rev/min and constant depth of cut of 6mm.
3) Procedures 1, 2 and 3 were repeated using neem oil, soluble oil and straight oil as cutting fluid.

3. Results

The results of the study are presented in tabular and chart form based on the research questions that guide the study.

3.1. Research Question 1

What is the effect of using neem oil, soluble oil and straight oil on tool wearing when used at different feed rates during machining operation?

Table: 1 Tool Wearing at Different Feed Rates During Machining Operation with Neem Oil, Soluble Oil and Straight Oil as Cutting Fluids

Cutting Fluid	**Readings**	**Feed rate: 1.00 mm**	**Feed rate: 0.8mm**	**Feed rate: 0.6mm**	**Feed rate: 0.4mm**	**Feed rate: 0.2mm**	**Feed rate: 0.2mm**
Neem oil	1.	0.01	0.15	0.20	0.70	0.80	0.85
	2.	0.01	0.15	0.21	0.70	0.81	0.85
	3.	0.01	0.14	0.21	0.70	0.81	0.85
Average		0.01	0.15	0.21	0.70	0.81	0.85
Soluble oil	1.	0.01	0.01	0.01	0.21	0.25	0.28
	2.	0.01	0.01	0.01	0.21	0.25	0.29
	3.	0.01	0.01	0.01	0.21	0.23	0.28
Average		0.01	0.01	0.01	0.21	0.24	0.28
Straight oil	1.	0.01	0.16	0.22	0.72	0.82	0.86
	2.	0.01	0.17	0.23	0.72	0.81	0.87
	3.	0.01	0.16	0.22	0.72	0.82	0.86
Average		0.01	0.16	0.22	0.72	0.82	0.86

Length of cut: 9.00 mm
Spindle speed: 58rpm, 85rpm, 125rpm, 180rpm, 280rpm.

Table 1: Table indicates that the tool wear resistance during turning operation at different feed rate using different cutting fluids, from table two above it shows that soluble oil cutting fluids has low mean reading of 0.10mm followed by neem oil with 0.38mm and straight oil with 0.39mm. Therefore the result shows that soluble oil reduces tool wearing to great extent than neem oil and straight oil.

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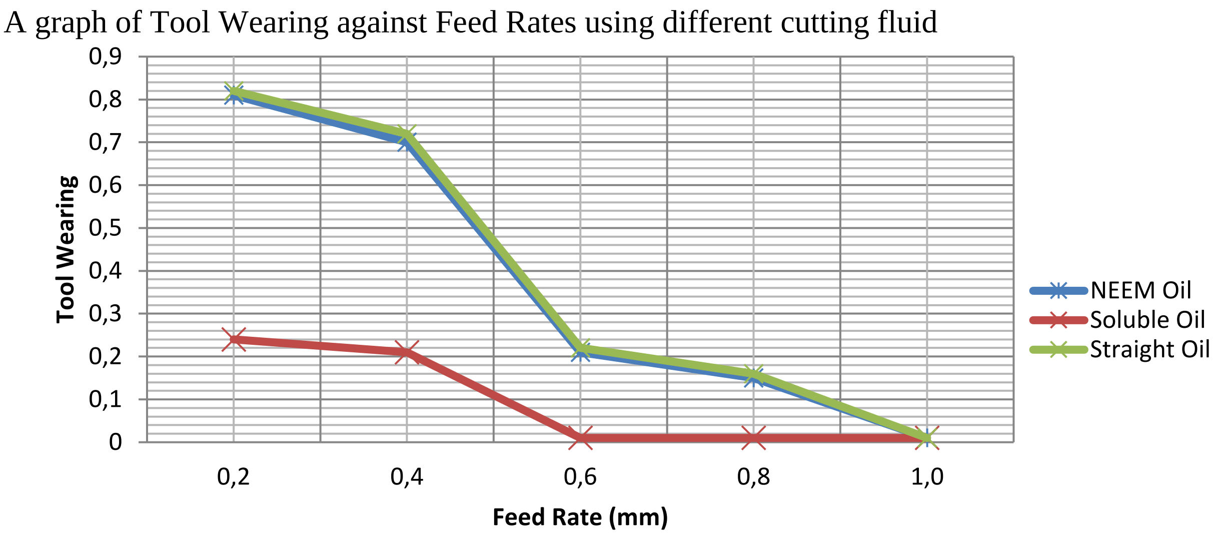

Figure 1: Variation of Tool Wearing with Different Cutting Fluids Neem Oil Soluble Oil and Straight Oil under Different Feed Rate.

Figure 1 also shows that at varying feed rate and spindle speed the characteristics of the cutting fluids indicates that tool wearing was less effective in soluble oil and high effective in neem oil and straight oil. Therefore it was found that from table and figure, tool wearing was less when soluble oil was used as cutting fluid. Therefore at variety of feed rate soluble oil was good in reducing tool wearing when used as cutting fluid than neem oil and soluble oil.

3.2. Research Question 2

What is the effect of neem oil, soluble oil and straight oil on tool wearing at different spindle speeds during machining operation?

Table 2: Tool Wear Resistance at Different Spindle Speeds During machining Operation with Neem Oil, Soluble Oil and Straight Oil as Cutting Fluids

Cutting Fluid	**Readings**	**Spindle speed: 58 rpm**	**Spindle speed: 85 rpm**	**Spindle speed: 125 rpm**	**Spindle speed: 180 rpm**	**Spindle speed: 280 rpm**	**Spindle speed: 540 rpm**
Neem oil	1.	0.01	0.15	0.20	0.70	0.80	0.85
	2.	0.01	0.15	0.21	0.70	0.81	0.85
	3.	0.01	0.14	0.21	0.70	0.81	0.85
Average		**0.01**	**0.15**	**0.21**	**0.70**	**0.81**	**0.85**
Soluble oil	1.	0.01	0.01	0.01	0.21	0.25	0.28
	2.	0.01	0.01	0.01	0.21	0.25	0.29
	3.	0.01	0.01	0.01	0.21	0.23	0.28
Average		**0.01**	**0.01**	**0.01**	**0.21**	**0.24**	**0.28**
Straight oil	1.	0.01	0.16	0.22	0.72	0.82	0.86
	2.	0.01	0.17	0.23	0.72	0.81	0.87
	3.	0.01	0.16	0.22	0.72	0.82	0.86
Average		**0.01**	**0.16**	**0.22**	**0.72**	**0.82**	**0.86**

Length of cut: 9.00 mm
Feed rate: 1.00 mm, 0.80mm, 0.60mm, 0.40mm, 0.20mm.

Table two above shows that soluble oil cutting fluids has low mean reading of 0.10mm followed by neem oil with 0.38mm and straight oil with 0.39mm. Therefore the result of the experiment shows that soluble oil reduces tool wearing to great extent than neem oil and straight oil under variety of spindle speed.

A Non-linear Graph of Tool Wearing against Feed Rates using Different Cutting Fluid

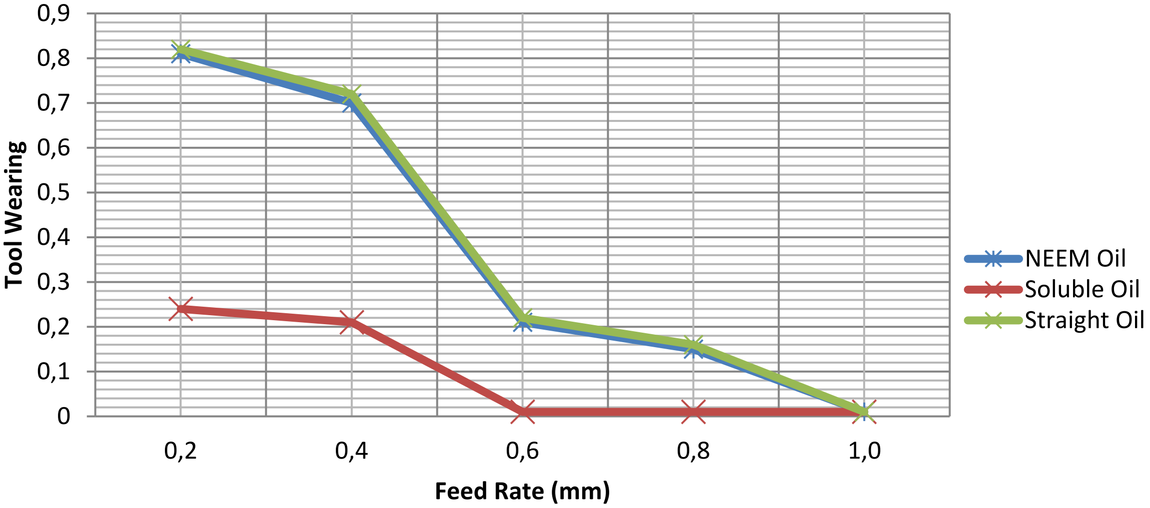

Figure 2: Variation of Tool Wearing with Different Cutting Fluids Neem Oil Soluble Oil and Straight Oil under Different Feed Rates.

Figure 2: shows that at varying feed rate and spindle speed the characteristics of the cutting fluids indicate that tool wearing was less effective in soluble oil and high effective in neem oil and straight oil. Therefore it was found that, soluble is more effective in tool wearing during machining operation.

3.3. Hypothesis 1:
there is no significant difference in the mean readings of neem oil, soluble oil, and straight oil on tool wearing when used as cutting during machining operations.

Table 3: Analysis of Variance of Different Cutting Fluids in Terms of Tool Wearing at Different Feed Rates

Source of variation	**SS**	**df**	**MS**	**F cal.**	**F crit.**	**Remark**
Between groups	0.27	2	0.14	1.50	3.89	Accepted
Within groups	1.08	12	0.09			
Total	1.35	14				

Table 3, above shows that there is no significant difference in the mean temperature reading of neem oil, soluble oil and straight oil on tool wearing when used as cutting fluids in turning operations of mild steel work piece using HSS cutting tool. This is of evident from the table since calculated f-value is 1.50 which less than 3.89 at 0.05 level of significant. Therefore the null hypothesis was accepted. This indicates that, there is no clear difference in the tool wearing resistance of the three fluids: neem oil, soluble oil and straight oil.

3.4. *Hypothesis 2*: there is no significant difference in the mean readings of neem oil, soluble oil, and straight oil on tool wearing when used as cutting fluids during turning operations at varied spindle speeds.

Table 4: Analysis of Variance of Different Cutting Fluids in Terms of Tool Wearing at Different Spindle Speeds

Source of variation	**SS**	**Df**	**MS**	**F cal.**	**F crit.**	**Remark**
Between groups	0.44	2	0.22	2.24	3.68	Accepted
Within groups	1.48	15	0.09			
Total	1.92	17				

Table 4 shows that there is no significant difference in the mean readings of neem oil, soluble oil and straight oil on tool wearing when were used as cutting fluids at different spindle speed during turning operation of mild steel work piece using HSS cutting tool. This is of evident from the table since calculated f-value is 2.24 which less than f-critical value of 3.68 at 0.05 level of significant. Therefore the null hypothesis is accepted. This shows that, there is no clear difference in tool wears resistance of neem oil, soluble oil and straight oil when used as cutting fluids at different spindle speeds.

3.5. Major Findings of the Study

The results of the study revealed the following findings:

1) Soluble oil is more effective in reducing tool wearing than neem oil and straight oil during machining operation.
2) Soluble oil is more effective in reducing tool wearing than neem oil and straight oil when machining at varying spindle speed.
3) There is no significant difference in the tool wearing resistance of neem oil, soluble oil and straight oil when machining mild steel work piece.
4) There is no clear difference in tool wear resistance of neem oil, soluble oil and straight oil when used as cutting fluids at different spindle speeds.

4. Discussions

The findings of this study are discussed in the other of research questions raised in the study. The findings related to research question one revealed that tool wear resistance of HSS cutting tool during turning operation of mild steel work piece at different feed rate using soluble oil as cutting fluids was more effective than those of neem oil and straight oil. Because of the fact that neem oil can be able to cool the mild steel work piece better than soluble oil and straight oil but unable to reduce wear on tool, this is perhaps due to the fact that neem oil has no water content in it so it could not take away heat on the cutting tool, hence tool wear. Soluble oil reduces tool wearing to a great extent. This is in line with findings of Mithun and potdar (2015) and Sanusi and Akindapo (2015) found that, neem oil facilitates a better surface finish than soluble oil while soluble oil reduces tool wear when compared with dry and neem oil during machining operation.

The second finding which said Soluble oil is more effective in reducing tool wearing than neem oil and straight oil when machining at varying spindle speed is in line with Mithun and Potdar (2015), Sanusi and Akindapo (2015) who indicated that tools resists wearing during machining of mild Steel work piece using HSS cutting tool at different spindle speed with neem oil, soluble oil and straight oil as cutting fluid. The result showed that soluble oil cutting fluids has low mean reading value. Therefore soluble oil reduces tool wearing to a great extent than neem oil and straight oil. Because of the fact that neem oil can be able to cool the mild steel work piece better than soluble oil and straight oil but unable to reduce wear on tool, this is perhaps due to the fact that neem oil has no water content in it so it could not take away heat on the cutting tool, hence resulting tool wear.

The analyzed data relating to null hypothesis one reveled that there was no significant difference in the mean readings of tool wearing when using neem oil, soluble oil, and straight oil as cutting fluid in reducing wear on high speed steel cutting tool during machining operation (turning) at variety of feed rate which is consistent with Sanusi and Akindapo's view, who asserted that neem seed oil cutting fluid reduced tool wear by 70% and 50% as compared to soluble oil.

5. Conclusions

Lower tool wear values were obtained with soluble oil and high tool wear was achieved at spindle speed of 540 rpm using Neem oil. Soluble oil possess the highest value in terms tool wear, followed by neem oil when machining mild steel at a spindle speed of 540 rpm, a feed rate of 0.2 mm/rev and length of cut of 9.00 mm.

Therefore an increase in the spindle speed decreased the surface roughness value. A decrease in spindle speed, feed rate and length of cut increased the surface roughness value. An increase in the spindle speed, increase in the feed rate and length of cut increased the flank wear value.

References

[1] Ali, H., Hossam A. & kinshawy. (2014). Cutting tool materials and tool wear Machining Research Laboratory (MRL), Faculty of Engineering and Approval Science, University of Ontan Institute of Technology (UOIT), Oshawa, ON LM 7K4, Canada.
[2] Avila, R. F. & Abrao, A. M. (2001).The effect of cutting fluid on the machining or hardened AISI 4340-steel; Journal of materials processing technology, 119:21-26.
[3] Boothroyd, G. & Knight, W.A (2006). Fundamentals of Machining and Machine Tools, Third Edition. Taylor & Francis Group U.S.A,
[4] Davim, J.P (2008). Machining Fundamental and Recent Advances. P 362 ISBN 978-1-84800-12-8
[5] Hemant, S., Mahendra, S. (2014). Influence of Cutting Fluids on Quality and Productivity of Products in Manufacturing Industries. International Journal of Engineering, Management & Sciences (IJEMS) 1 (11)
[6] International Standard Organization ISO (1993). Tool-life testing with single-point turning tools. ISO 3685.
[7] Kalam, Z. (2007). Carbon steel hand book, Electric Power Research Institute (EPRI), 3420 Hill view Avenue, Palo Acto, California 94303-0813 USA.
[8] Ksar, S. F. & Oswald, J.W (1990). Technology of Machine Tools (4th Edition). MxGraw Hill Inc. New York, USA.

ISSN: 2454-1907
DOI: 10.5281/zenodo.3271338

[9] Kuram, E., Ozcelik, B. & Simsek, B.T. (2011). Experimental investigation of vegetable based cutting fluids with extreme pressure during AISI 204L. Green Manufacturing Processes and Systems, Materials Forming, Machining and Tribology, Verlag Berlin Heidelberg 2013Tribol Int 44:1864-1871.

[10] Mithun, S. & Potdar, V.V. (2015). Study the effects of vegetable oil based cutting fluid on machining characteristics of AISI steel. Recent trend in Mechanical Engineering Solapur, Maharashtra, Inadia. IJIERT.

[11] Rogers, C.R. (1969). Freedom to Learn. Columbus, OH: Merrill.

[12] Sanusi, B. & Akindapo, A. (2015): Evaluating the performance of different types of cutting fluid in the machining of Aluminium-Manganese alloy in turning operation. Mechanical Engineering Department, Nigerian Defense Academy, Kaduna. Mechanical and Mechatronics Engineering Department Federal University Oye-Ekiti, Nigeria.

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*Corresponding author.

E-mail address: juliuslkama@ mautech.edu.ng/ mahmud2985@ yahoo.com