APPLICATION OF DIFFERENT FORMULATIONS OF PLANING AND SHAPING OPERATIONS

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Abstract

The purpose of this research is to find the roughness of a steel slab by using planing and shaping machine. For that first we find the hardness of the steel slab by using the Rockwell hardness machine and after we take the different formulations of the coolant by taking the solutions like additive, antifoaming agent, paraffin oil. These formulation solutions should be 10 solutions of planing and 10 solutions should be in shaping. We have to take the chemical solutions of 20 and make the 10 of solution in planing machine and 10 of solutions in shaping machine. The paraffin oil will be constant and the additive, antifoaming agents will be changes. After that we will find the 20 different formulations in planing and shaping operations.

Introduction

Coolant is a type of cutting fluid that is used in metalworking and other machining operations to reduce heat and friction between the cutting tool and the workpiece. In planing and shaping operations, coolant is essential to ensure that the workpiece is cut cleanly and that the tool remains sharp. The choice of coolant formulation can have a significant impact on the performance of planing and shaping machines. Water-based coolants are the most commonly used coolant formulations in planing and shaping operations. They are composed of water, oil, and other additives that improve their lubricating and cooling properties. Water-based coolants are effective in reducing friction and heat, which results in better surface finish and longer tool life. They are also environmentally friendly and cost-effective. Oil-based coolants are less commonly used in planing and shaping operations compared to water-based coolants. They are composed of mineral oils, synthetic oils, or a blend of both. Oil-based coolants have better lubricating properties than water-based coolants, which results in better surface finish and longer tool life. However, they are more expensive and can be more difficult to clean up. Synthetic coolants are composed of synthetic oils and other additives. They are designed to provide better lubrication and cooling properties than water-based and oil-based coolants. Synthetic coolants are ideal for high-speed machining operations and for machining difficult-to-cut materials. They are also more expensive than water-based and oil-based coolants. the choice of coolant formulation can have a significant impact on the performance of planing and shaping machines. Water-based coolants are the most commonly used coolant formulations due to their effectiveness and cost-effectiveness. Oil-based coolants are less commonly used but offer better lubricating properties than water-based coolants. Synthetic coolants are ideal for high-speed machining operations and difficult-to-cut materials but are more expensive than water-based and oil-based coolants.

Literature survey

Gary Wong Ang Kui· Sumaiya Islam· Moola Mohan Reddy· Neamul Khandoker· Vincent Lee Chieng Chen "Recent progress and evolution of coolant usages in conventional machining methods, " The International Journal of Advanced Manufacturing Technology (2022) 119:3–40.

This paper reviews recent progress and applications of usage of cutting fluids in conventional machining processes. In addition to reviewing the various conventional and advanced cooling techniques during machining, the paper also discusses the use of minimum quantity lubrication (MQL) in several types on metals such as steel, aluminum, alloy, and titanium alloys. Due to the toxicity of conventional cutting fluid resulting in ecological problems, the demand for environmentally friendly cut-ting fluid is rising. Therefore, natural vegetable oil is chosen as potential replacement as an environmentally friendly cutting fluid which fulfills the important aspects of biodegradability and sustainability. Application of vegetable oil-based cutting fluids under MQL techniques are also discussed. Moreover, the potential of palm oil as biodegradable and environmentally friendly natural vegetable oil-based metal-working fluids in MQL are reviewed.

Khor ZhengYang, A. Pramanik , A.K. Basak , Y. Dong , Chander Prakash , S. Shankar , Saurav Dixit , Kaushal Kuma r , Nikolai Ivanovich Vatin "Application of coolants during tool-based machining," Ain Sham Engineering Journal Volume 14, Issue 1, February 2023, 101830.

Machining processes such as drilling, turning, milling and grinding transform bulk workpieces into the desired form, size and shape. The machining operations deform workpiece materials plastically where large thermal stress is experienced by cutting tools and workpieces. Other than that, the chip formation during the machining process inevitably affects its performance and thus the quality of newly generated surfaces. Therefore, coolants of different forms such as solid, liquid or gases are used to decrease the friction and heat generated in the contact zones between cutting tools and workpieces during machining operations. Several methods used to deliver the coolants such as flooding, misting and spraying depend on the requirement of the machining process. The main roles of coolants in machining processes are to decrease the machining temperature, to induce lubrication for the reduction in friction, to facilitate chip evacuation from machining zone and to deter a corrosion process. Therefore, coolants increase the efficiency of the machining process, provide better surface quality, and extend the life of cutting tools. Coolants generally contribute to a large portion of total machining costs (Shaw & Cookson, 2005). By choosing the right type of coolants, the effectiveness of the machining process and the produced workpiece quality may improve, thereby leading to low total machining costs.

Achebe CH, Ohiafi BO, Chukwuneke JL, Obika EN, "Optimization of Coolant Composition on Tool Wear during Turning Operation of Mild Steel,"Journal of Scientific and Engineering Research, 2016, 3(6):61-69.

The cutting temperature is a key factor which directly affects tool wear, work piece surface integrity and machining precision according to the relative motion between the tool and work piece. The amount of heat generated varies according to the type of material being machined. The cutting parameters especially cutting speed, feed rate and depth of cut influence the chip-tool interface temperature. Temperature in the cutting zone depends on contact length between tool and chip, cutting forces and friction between tool and work piece material. A considerable amount of heat generated during machining is transferred into the cutting tool and work piece. The remaining heat is removed with the chips; the highest temperature is generated in the flow zone. Therefore, contact length between the tool and the chip affects cutting conditions and performance of the tool and tool life.

T.S. Ogedengbe , A. P. Okediji , A. A. Yussouf O. A. Aderoba , O. A. Abiola , I. O. Alabi and O. I. Alonge., "The Effects of Heat Generation on Cutting Tool and Machined Workpiece," International Conference on Engineering for Sustainable World, T.S. Ogedengbe et al 2019.

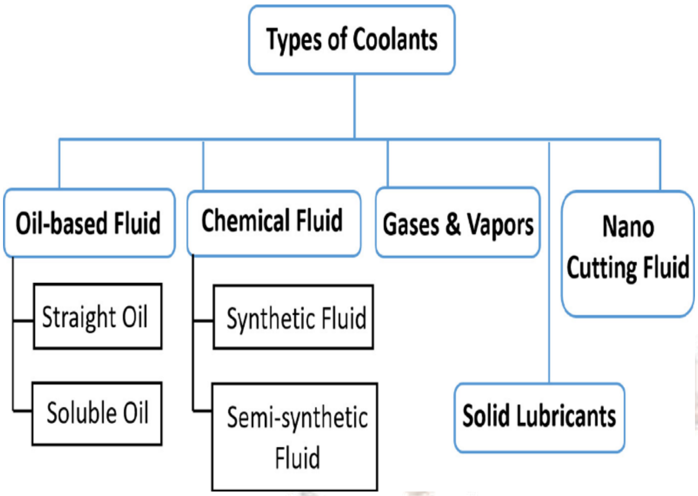
Metal cutting processes usually cause heat generation at the cutting zone (around the workpiece-tool intersection). The heat generated during these processes may cause different effects on both the workpiece and tool, this in turn may affect the finished product and the general performance of the machined piece. In this study, a review was done on various types of machining conditions available, effects of heat generated on the workpiece and tool, and the approaches adopted to reduce this heat at cutting zones. This study also focuses on the simulation of percentage ratio of heat removal. To handle the simulation, various approaches of heat removal methods were used to get the percentage ratio using the ansys version 19.1 software. It was discovered that heat generation causes two major types of wear on the tool, crater and flank wear, resulting in the reduction of cutting tool life as well as dimensional inaccuracy, surface damage and severe corrosion cases on the workpiece. Various heat reduction methods and coolant application types were as well studied and their merits and demerits were discussed.

Mousumi Kar, ... Rakesh K. Tekade., "Current Developments in Excipient Science," Comprehensive Biotechnology (Second Edition), 2011.

Antifoaming agents are added to prevent or counter the foam generation in the formulation. Generally, these agents have surface active properties and are insoluble in the foaming medium. These are less viscous, easily spreadable on the foamy surface, and possess affinity to the air–liquid surface where it destabilizes the foam lamellas, which rupture the air bubbles and break down the surface foam. Entrained air bubbles are agglomerated, and the larger bubbles rise to the surface of the bulk liquid more quickly.

Commonly used antifoaming agents are certain alcohols (cetostearyl alcohol), insoluble oils (castor oil), stearates, polydimethylsiloxanes and other silicones derivatives, ether and glycols (Karakashev and Grozdanova, 2012).

Coolants



MATERIALS REQUIRED

- Steel Slab
- Surface profilometer
- Paraffin oil (P1)
- Additives
- Antifoaming Agent
- Planing and Shaping Machines
- Rockwell hardness machine

Methodology

Hardness of the Steel Slab:

Rockwell Hardness Machine

HARDNESS

Sl.No	Material	Major Load	Indentator	Scale	Rockwell Hardness no(RHC)
1	Mild Steel	150kg	Diamond	c	85
2	Mild Steel	150kg	Diamond	c	92
3	Mild Steel	150kg	Diamond	c	95

Calculation :

Total = 85+92+95

= 272

Average = 272/3 = 90.6 N/mm^2

85

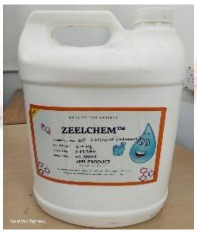
92

95

Different formulations of Coolant:

Additive

Paraffin oil



Antifoaming agent – Silicone Defoamer

Coolant Mixing Process

Shaping Operation

Shaping Operation Using Different Formulation of Coolant on Steel slab:

Shaping Machine

Shaping Process of Steel Slab

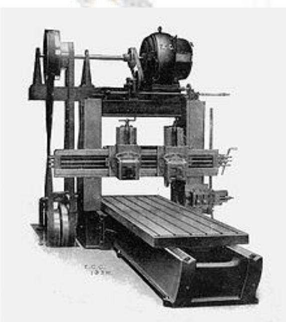
Shaping Operation Table:

Paraffin Oil	Additive	Antifoaming Agent	Roughness Average (Ra)	Ten Point Height of Irregularities (Rz)	Roughness (Rq)	Kurtosis (Rkv)
70 ml	10ml	20ml	5.892	35.860	7.462	2.892
70 ml	25ml	5ml	10.740	39.200	10.232	1.932
70ml	20ml	10ml	6.790	25.702	7.120	3.726
70ml	5ml	25ml	7.428	30.980	8.712	2.712
70ml	15ml	10ml	5.217	34.103	7.643	2.336
70ml	10ml	15ml	3.456	27.642	6.732	3.301

Values of Shaping Operation

Planing Operation

Planing Operation Using Different Formulation of Coolant on Steel slab:



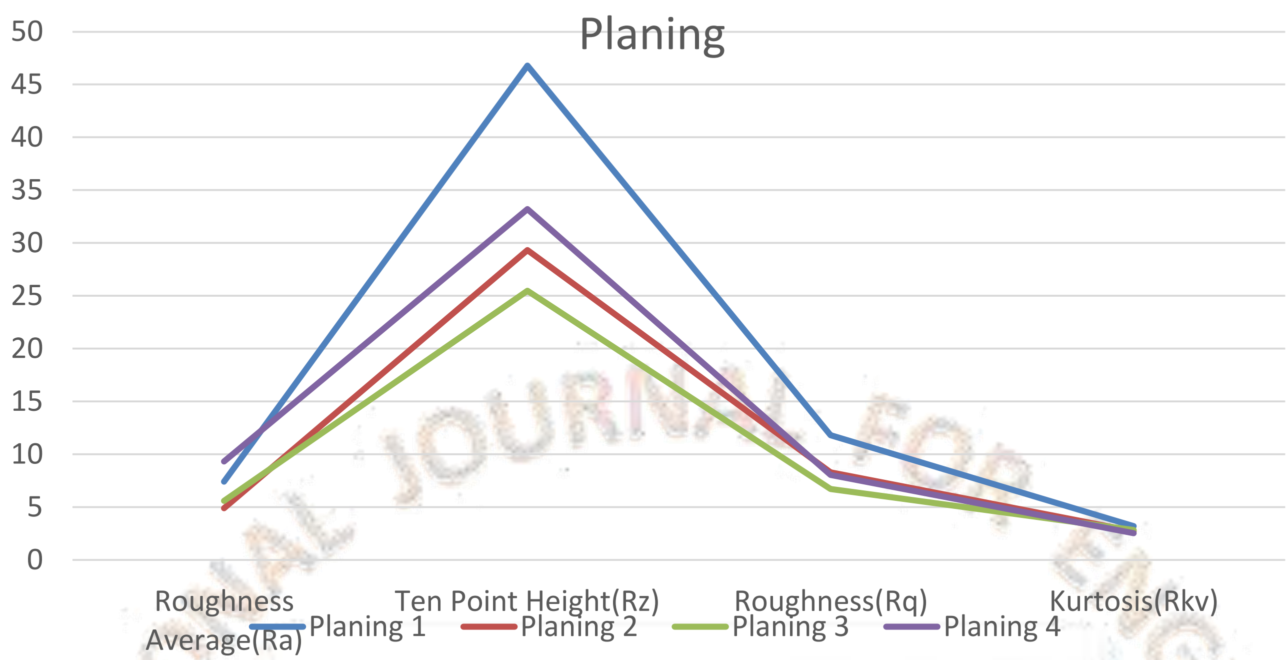
Planing Machine

Planing Process of Steel Slab

Paraffin Oil (p1)	Additive	Silicone Defoamer
60ml	30ml	10ml
60ml	25ml	15ml
60ml	35ml	5ml
60ml	15ml	25ml

Coolant Formulation for Planing

Planing Operation Line Graph:



Conclusion

Overall, the best coolant formulation depends on the specific application, materials being cut, cutting conditions, and operator preferences. It is essential to consider the advantages and disadvantages of each coolant formulation before making a decision. Additionally, proper coolant management and maintenance are crucial to ensure the effectiveness and longevity of the coolant and the equipment. Regular monitoring and testing of coolant quality, concentration, and pH levels can help identify potential issues and prevent machine damage and worker exposure to hazardous conditions.

References

1. Gary Wong Ang Kui· Sumaiya Islam· Moola Mohan Reddy· Neamul Khandoker· Vincent Lee Chieng Chen "Recent progress and evolution of coolant usages in conventional machining methods, " The International Journal of Advanced Manufacturing Technology (2022) 119:3–40.

2. Khor ZhengYang, A. Pramanik , A.K. Basak , Y. Dong , Chander Prakash , S. Shankar , Saurav Dixit , Kaushal Kumar , Ni kolai Ivanovich Vatin "Application of coolants during tool-based machining," Ain Sham Engineering Journal Volume 14, Issue 1, February 2023, 101830.

3. Achebe CH, Ohiafi BO, Chukwuneke JL, Obika EN, "Optimization of Coolant Composition on Tool Wear during Turning Operation of Mild Steel,"Journal of Scientific and Engineering Research, 2016, 3(6):61-69.

4. T.S. Ogedengbe , A. P. Okediji , A. A. Yussouf O. A. Aderoba , O. A. Abiola , I. O. Alabi and O. I. Alonge., "The Effects of Heat Generation on Cutting Tool and Machined Workpiece," International Conference on Engineering for Sustainable World, T.S. Ogedengbe et al 2019.

5. Mousumi Kar, ... Rakesh K. Tekade., "Current Developments in Excipient Science," Comprehensive Biotechnology (Second Edition), 2011.

6. E. Takeuchi & J. K. Brimacombe , "The formation of oscillation marks in the continuous casting of steel slabs", Metallurgical Transactions B, 1984.