Journal of Engineering, Project, and Production Management
2024, 14(1), 0004

Comparative Economic Analysis and Investigation of Micro Lubrication Over Conventional Cooling in Manufacturing

Dipali K Bhise[1], Bhushan T Patil[2], Vasim A Shaikh[3], and Sujata P. Deshmukh[4]

[1]Research Scholar, Department of Mechanical Engineering, Fr. CRCE, Bandra (W), Mumbai 400 050, India, E-mail: dkbhise@gmail.com (corresponding author).

[2]Professor & Head, Department of Mechanical Engineering, Fr. CRCE, Bandra (W), Mumbai 400 050, India, E-mail: bhushan.patil@fragnel.edu.in

[3]Assistant Professor, Department of Mechanical Engineering, Fr. CRCE, Bandra (W), Mumbai 400050, India E-mail: vasim.shaikh@fragnel.edu.in

[4]Associate Professor, Department of Computer Engineering, Fr. CRCE, Bandra (W), Mumbai 400050, India, E-mail: sujata.deshmukh@fragnel.edu.in

Selected paper from 2022 International Conference on Embracing Industry 4.0 Technologies for Sustainable Growth Engineering Management
Received June 28, 2022; revised November 26, 2022; accepted February 28, 2023
Available online May 29, 2023

Abstract: Cutting fluid is a major concern in conventional cooling methods because of its high cost, effects on operator health, and environmental consequences. Microlubrication (MQL) is a better cooling method than traditional cooling. MQL can be used for machines with a high metal removal rate, such as those used in metal turning, milling, drilling, and boring. MQL has a lower lubrication consumption, a higher cooling rate, and a cleaner production than do conventional flooded lubrication. This study performed a cost-benefit analysis to compare MQL with conventional flood cooling methods. For both traditional flood cooling at 35 L/min and MQL cooling at 50 mL/h, face and slot milling techniques with constant machining settings were used. The quantity of components that must be produced to recoup the fixed and variable costs of MQL and conventional cooling were calculated by performing a breakeven point (BEP) analysis. The MQL methodology used 20% fewer components to recoup all expenses compared with conventional cooling. The findings indicated that MQL is more economical than traditional cooling. Moreover, the BEP for both cooling systems exhibited variances, and the BEP can be reached sooner for MQL than flood cooling lubricant.

Keywords: Microlubrication, cost analysis, bio-degradability, breakeven point.

DOI 10.32738/JEPPM-2024-0004

---

1. Introduction

Metal cutting techniques have been used for a long time. Coolant; machining operating conditions; and tool shape, material, and wear all play crucial roles in metal cutting operations. Heat is generated in the metal cutting zone during machining. This heat considerably affects tool life, reducing tool hardness, causing structural changes in the tool, and increasing tool wear. Thus, metalworking fluid is utilized to regulate temperature and provide lubrication. The use of cutting fluids can reduce power usage. Metalworking fluid is also used to remove chips and protect machine equipment and workpieces from corrosion. Thus, metalworking fluid can enhance productivity because it optimizes machining and tool performance (Byers, 2006).

Metalworking fluid has diverse applications. The most common method is flooding. Continuous flow is used at the tool and workpiece in this procedure. A recirculating system, filters, nozzles, pipes, and an oil recovery mechanism are required for flood cooling. Because cutting fluids are reused for a month and even for years occasionally, filtration and a recirculating system are required. Cutting fluid contacts with metal chips and debris. Impurities, chips, and dirt should be removed from the cutting fluid through filtration to enhance its performance (Byers, 2006, Irani et al. 2005). However, direct contact with cutting fluids can affect machine operators' health (Byers, 2006). Operators can develop eye, skin, and respiratory illnesses and experience discomfort in the nose and throat. In addition, throughout the machining process, the clean-cutting fluid becomes polluted. However, the disposal of this fluid can adversely affect the environment. Moreover, disposal can lead to substantial costs. Thus, reducing environmental contamination in the industrial sector is critical.

Moreover, the demand for an alternative to traditional cooling methods is increasing. During the manufacturing process, industrial waste should be reduced or eliminated.

In recent years, new alternatives have been developed to overcome the drawbacks of traditional cooling. Minimal quantity lubrication, dry machining, cryogenic cooling, gaseous cooling, nanofluids, and solid lubrication are some of the different cooling technologies (Fig. 1) (Byers, 2006, Sharma et al. 2009).

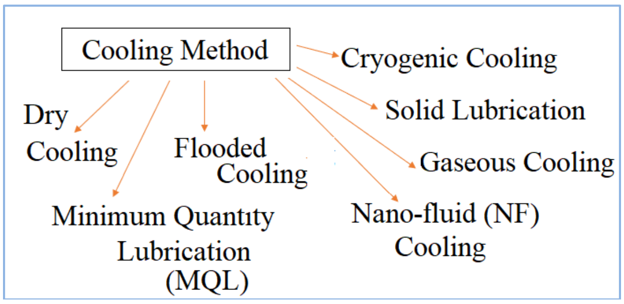

Fig. 1. Different cooling methods in metal cutting

Dry machining eliminates the need for cutting fluid, increasing the temperature in the metal cutting zone with a decrease in the heat extracted (Sharma et al., 2009). Hence, proper cutting tool material should be employed. The dry metal cutting tool should have a higher temperature and a higher thermal fatigue limit and should be resistant to pressure, more robust, and chemically stable (Stanford et al., 2002). However, dry machining is impossible under specific metal cutting conditions because of increased heat generation in the metal cutting zone, which results in increased friction between the tool and workpiece material (Siniawski et al., 2009, Weinert et al., 2004). Microlubrication (MQL) is a spray that consists of compressed air and a tiny oil droplet. Compressed air is used to atomize cutting fluid into tiny droplets. The amount of oil consumed every hour varies between 5 and 150 mL. For sustainable manufacturing, biodegradable fluid can be used in MQL. MQL might outperform other lubrication technologies. In addition, tool wear, expense, and coolant usage can be reduced. Because less industrial waste is produced in MQL, pollution is decreased (Dudzinski et al., 2004). Gaseous and cryogenic cooling are two options for traditional cooling. Liquid nitrogen (at 196°C) or carbon dioxide (at −78°C) are used in cryogenic cooling. They absorb heat and dissipate it. Liquid nitrogen and carbon dioxide act as lubricants by generating a gas layer between the tool and chip contact. This cooling method, however, necessitates the use of specialized equipment to maintain the stability of the coolant temperature. This, in turn, increases the price of the cutting fluid procedure (Irani et. al 2005). At normal temperature, the cutting fluid is in a gaseous phase in gaseous cooling. Air is among the most common cutting fluids; it has a limited cooling capacity that can be improved by cooling. Helium, nitrogen, and argon are other gaseous cutting fluids that prevent the oxidation of the tool and workpiece. The expense of gaseous fluids, such as cryogenic cooling, is expensive. Thus, they are not commonly used (Shokrani et al., 2012, Najiha et al., 2016). MQL appears to be a preferable option to conventional cooling because it eliminates the problem of fluid disposal. Furthermore, for sustainable production, biodegradable lubricants are being used, reducing operator health problems (Benedicto et al., 2017). Many studies have examined various cooling and lubricating techniques used during various machining operations and determined their potential for sustainable machining (Singh et al., 2020).

Here, we performed a literature review to determine relevant aspects for the economic analysis of MQL versus traditional cooling. Few studies have performed an economic analysis of MQL versus conventional cooling in milling operations. Ju et al. (2005) performed a cost analysis for a machining center and a transfer line for MQL and traditional cooling drilling, boring, and face filling operations.

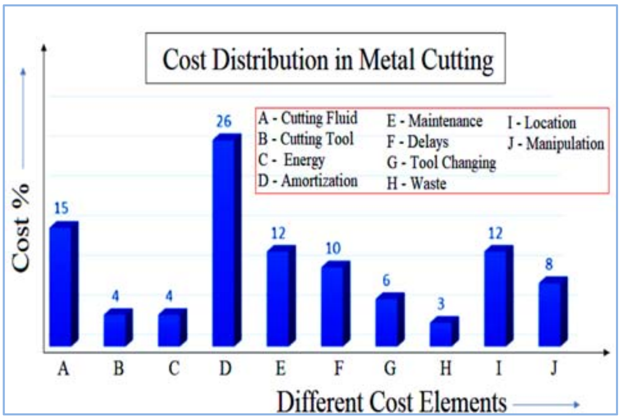

Fig. 2. Cost distribution in metal cutting

Cutting fluid, ventilation, chip handling, and machining costs were factored into overhead costs. For a fair comparison, a transfer line and three machining centers were used. The cost of flooded coolant was significantly higher than that of the MQL. The cost of flooded coolant was 22% higher than that of MQL (Ju et al., 2005). Amrita et al. compared the costs of two systems that used low- and high-pressure compressed air with nanocutting fluid at 5 mL/min and 1 mL/min, respectively. Low-pressure air is employed in the system, with a separate setup for cutting fluid and air. System B is based on the atomization principle. Experimentation was perfomed in a controlled environment. The economic study considered dry, flooded, and MQL cutting conditions. The costs of cutting fluid disposal and purchase, nanopowder purchase and surface treatment, water, cleaning, power consumption by the pump and compressor, and tools were considered in the cost analysis. MQL costs were lower in system A with nano as well as traditional cooling (Amrita et al., 2015).

An industry survey was conducted to understand the features of MQL and conventional cooling. The industry survey contained questions on the machining operation, the amount of oil used, the tank capacity, the amount of coolant input, the amount of coolant discharged, the amount of coolant needed, the amount of time needed for coolant filtration, the method for disposing the coolant and the cost associated with it, the postmachining cleaning time, the type of work piece, the tool used, the number of components prepared per shift, and the amount of tool change time. This study estimated the breakeven point and the quantity of components that must be produced to recover fixed and variable costs. This study hypothesized that MQL is better at cooling.

2. Methodology

An industry survey indicated that face and slot milling with the same line are the most common milling operations. In terms of a coolant, 90% of the industry utilizes cutting oil (grade-30) for traditional cooling. Thus, we performed an economic analysis of face and slot milling operations. Cutting oil with grade-30 cutting fluid was also chosen. Castor oil is used for MQL; this oil exerts less adverse effects on the environment and no negative effects on the operator's health. According to a practical survey, coolant is changed after 15 days; thus, the total cutting fluid cost was calculated using the 15-day cycle time. Pump and tank costs are fixed in traditional cooling systems. The prices of the MQL compressor and MQL unit were included in the fixed cost. Fixed and additional costs for cutting fluid for both cooling systems are listed in Table 1. MQL had higher total fixed costs than did conventional cooling.

Table 1. Fixed costs for cutting fluid

Sr. No	Cooling Type	Fixed Cost (Rs)	Other Cost (Rs)	Total (Rs)
1.	Conventional cooling	Pump =8500 Tank = 10,000	Preventive Maintenance = 600	19,100
2.	MQL	Compressor=9000 MQL unit= 40,000 FRL unit= 1000	Oil Changing in compressor & FRL unit= 550	50,550

Other expenses must be considered when estimating the cost of cutting fluid. Moreover, the pump or compressor's electrical costs, cutting fluid costs, cleaning costs, and idle costs must all be considered.

In the economic analysis, we considered the component's cutting time because cutting fluid usage is proportional to cutting time. The workpiece was used to calculate cutting time (Fig. 3). A block size of aluminum 6061 (300 × 100 × 50) mm was used for machining. On the top surface of the workpiece, a face milling operation was performed (300 × 100 mm). For the face milling process, the cutter diameter, feed per tooth, and number of passes were 25 mm, 0.1 mm, and 4, respectively. The 50-mm approach length and overall travel were considered. For traditional cooling, a cutting velocity of 50 m/min was used. MQL is primarily used for lubrication instead of cooling, and it provides a thin coating between the tool chip interface, which reduces tool wear and produces lower surface roughness than the traditional cooling method (Elmunafi et al., 2015). Because tool wear decreases with an increase in velocity, we chose 80 m/min as the velocity for MQL for its face milling process.

Total cutting time for the workpiece for conventional cooling and MQL were 22.139 min and 13.481 min, respectively. Different losses occur due to heat dissipation, splashing, and other factors in traditional cooling. The amount of cutting fluid left in the tank after 15 days decreases to 27 L from 50 L. Thus, the actual cutting fluid consumption was 200 mL/h (i.e., 160 mL water and 40-mL cutting oil-30).

3. Results and Discussion

A. Total cutting fluid cost for conventional cooling as per cutting time

According to an industry survey, in conventional cooling, a water and cutting oil ratio of 80:20 is used. Therefore, for 50-L cutting fluid, 40 L of water and 10 L of cutting oil were used.

Total Cutting Fluid Cost for Conventional Cooling = Cutting Oil-30 Price for 14.76 mL+ Water Price. (1)
=1.476 + 1
= Rs 2.476 /-

Where,

Cutting time for Conventional cooling = 22.139 min
Cutting fluid consumption for cutting time 22.139 min = 59.04 mL (Water): 14.76 mL (Cutting oil)
Water Price = Rs. 1/L
Cutting oil-30 Price = Rs. 100/L
Cutting oil-30 Price for 14.76 mL = Rs. 1.476/-

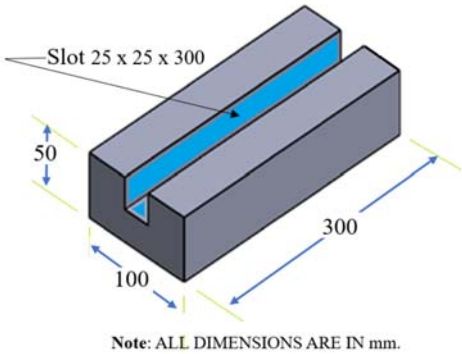

Fig. 3. Workpiece geometry

B. Total cutting fluid cost for MQL as per cutting time:

Biodegradable castor oil is used for MQL. In this lubrication, 50 mL/h to 150 mL/h cutting oil is used.

Total Cutting Fluid Cost for MQL = Castor oil Price for 11.24 mL. (2)

= Rs.1.124 /-

Where,

Cutting time for MQL = 13.481 min

Cutting fluid consumption for cutting time 13.481 min = 11.24 mL

Castor oil Price = Rs. 100/L

C. Variable cost calculation for conventional cooling

Electricity Cost for Pump: In traditional cooling, the pump is used for cutting fluid for recirculation. Thus, 35 L/min discharge of coolant 600-watt pump was used. As presented in Fig. 4, the electricity cost for pump/component, cutting fluid cost/component, cleaning cost/component, and idle cost/component were 31%, 49%, 2%, and 18%, respectively.

Variable Cost for Conventional Cooling = Electricity cost for pump/component + cutting fluid cost/component + cleaning cost/component + idle cost/component (3)

=I + II + III + IV + V

= 1.55 + 2.476 + 0.105 + 0.922

= Rs. 5.053/component

Where,

I. Electricity cost/component = (Electricity cost by pump in 15 days)/(No. of component in 15 days)

= 1512/976 = Rs. 1.55/-

As,

No. of component in 15 days = (60 min × 24/cutting time) × 15

= (60 × 24/22.139) × 15

= 976 units.

Electricity cost by pump in 15 days = Industry electricity price × Unit consumed by pump in 15 days

= 7 × 216

= Rs.1512 /-

II. Cutting Fluid Cost/Component = Rs 2.476 /-

III. Cleaning Cost/Component = Cleaning Cost for 2 hours/No. of component in 15 days

= 102.25/976

Note: For the tank cleaning, 2 hours are required during 15 days.

= Rs. 0.105 /-

As, = Rs.409 /day

Labor cost Note: On July 1, 2021: 12286/pm for semi skilled = 409 /day

= (409/8)

Labor cost per hour = Rs.51.125/-

Hence,

Cleaning Cost for 2 h = Labor cost per hour × 2

= (409/8) × 2

= Rs.102.25/-

IV. Idle Cost/component = Idle cost of machine/No. of component in 15 days

= 900/976

= Rs. 0.922 /-

As, Note: In 15 days, 2 hours are idle time for the CNC machine.

No. of component in 15 days = 976 units.

Idle cost of machine = Machining price for CNC × 2

= 450 × 2

= Rs.900/-

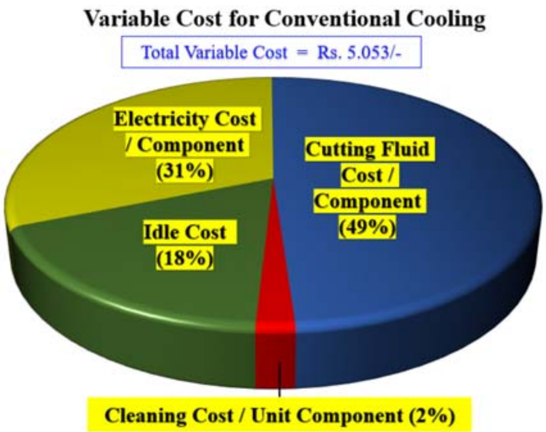

Fig. 4. Variable cost distribution for conventional cooling

D. Variable cost calculation for MQL:

Electricity cost for compressors: MQL is a mixture of small oil droplets and compressed air. For 30-L tank capacity, 1.5 HP compressor was used. As shown in Fig. 5 electricity cost for compressor/component, cutting fluid cost/ component were 60% and 40% respectively.

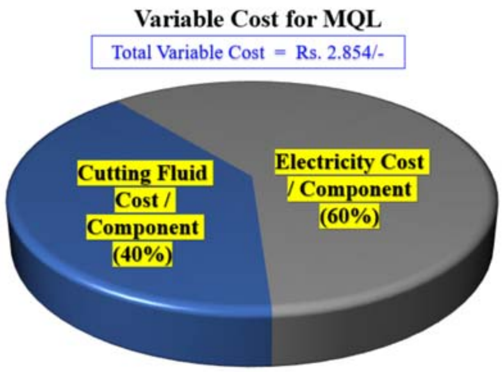

Fig 5. Variable cost distribution for MQL

Variable cost for MQL = Electricity cost for Compressor/component + Cutting Fluid Cost/component + Cleaning Cost + Idle Cost (4)

= I + II + III + IV

= 1.73 + 1.124 + 0 + 0

= Rs 2.854/-

Where,

I. Electricity cost for compressor/ componer = Electricity cost by compressor in 15 days/ No. of component in 15 days

= 2772/1602

= Rs.1.73/-

As,

No. of component in 15 days = (60 min × 24/cutting time) × 15

= (60 × 24/13.481) × 15

= 1602 units

Electricity cost by Compressor in 15 days = (Industry Electricity price) × (Unit Consumed By Compressor in 15 days)

= (7) × (1.1 × 360)

= Rs. 2772/-

II. Cutting Fluid Cost/component = Rs. 1.124/-

III & IV. Cleaning Cost Idle Cost = MQL is nearly cleaner production, there are no cleaning and idle cost.

The findings indicated that MQL costs more in fixed expenses and less in variable costs compared with conventional cooling.

In machining, the purpose of any metalworking fluid is to deliver optimal performance at the lowest possible cost. Thus, all cost aspects must be evaluated when comparing MQL with conventional cooling. At the beginning of an economic study, fixed costs are compared because they help in reducing fluid expenses.

Pump and tank costs are considered in conventional cooling. The costs of the MQL, compressor, and FRL units are all considered in the case of MQL. As shown in Fig. 6, the cost of MQL was 62% more than the cost of conventional cooling. The pump/electricity, compressor's cutting fluid, cleaning, and idle charges are all variable costs.

Fig. 6. indicates that MQL has a variable cost per component that is 41% lower than conventional cooling. The cost of cutting fluid per component for MQL was 39% cheaper than for conventional cooling. Similar results were noted by Ju et al. and Amrita et al. However, MQL is hypothesized to be superior than conventional cooling even if the component changes.

A breakeven analysis is conducted to determine the minimum production volume for MQL and conventional cooling, which will aid in determining the number of components that must be manufactured to recover the fixed and variable costs of MQL and conventional cooling.

To recover all the aforementioned costs while manufacturing, 20% fewer components should be used for MQL (16052 Unit) than those used in traditional cooling (20168 Unit). When comparing MQL with conventional cooling techniques in terms of days required to reach the breakeven volume, MQL requires 51% less days. The number of years required to reach BEP in MQL was 0.41 and 0.85 year. Thus, MQL is more cost-effective than conventional cooling for the current machining process.

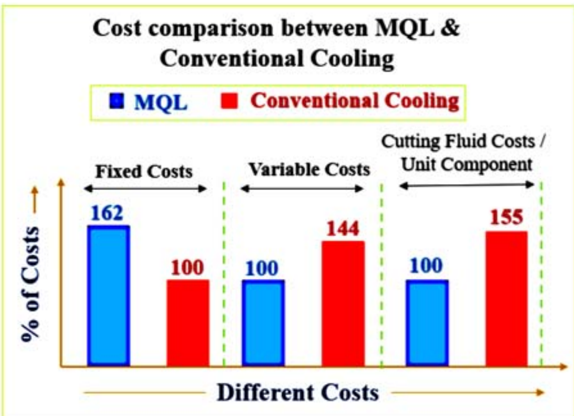

Fig. 6. Cost comparison of MQL versus conventional cooling

4. Conclusion

This study compared the economics of MQL and traditional cooling. In addition, we performed a component-by-component cost analysis of face milling and slot milling operations. The findings of this study are as follows (Amrita et al., 2015):

- Cutting fluid costs were Rs. 1.124 and Rs. 2.476 in MQL and traditional cooling, respectively, which is 55% cheaper than traditional cooling.

- The fixed costs of MQL and traditional cooling were Rs. 50,550 and Rs. 19,100, respectively, which is 62% more expensive than traditional cooling. The variable costs per component were Rs. 2.854 and Rs. 5.053, which is 44% cheaper.

- In MQL, 20% fewer units were required to accomplish BEP units than in traditional cooling. In addition, as presented in Fig. 7, MQL required 51% fewer days to reach the breakeven point.

- The findings of the component-by-component cost comparison in MQL and conventional cooling indicated that MQL is less expensive.

This study mainly focused on milling processes and castor oil. The results will not be the same if this study is applied to different machining operations such as lathe, drilling, and grinding.

Future studies should investigate various materials, such as super alloys, which are widely used in the automotive and aerospace industries. Furthermore, a hybrid cooling approach should be developed to improve machining performance. Studies should analyze surface morphology under various machining conditions. A mathematical model for predicting MQL performance under various machining conditions should be developed. Furthermore, studies should examine the various characteristics of different vegetable oils to improve MQL performance and focus on MQL parameter optimization for various machining circumstances.

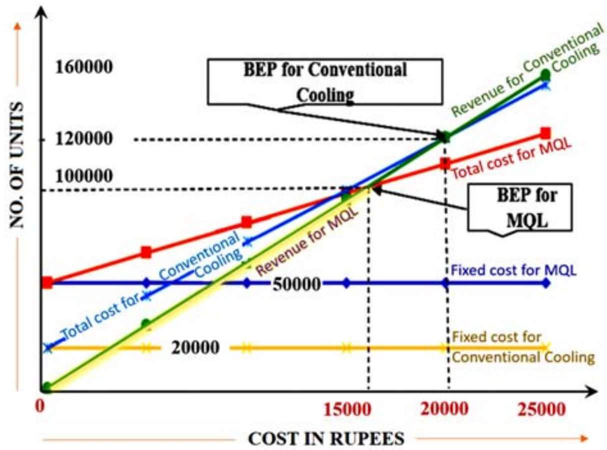

Fig. 7. Component wise BEP for MQL and conventional cooling

Acknowledgments

I dedicate my research to my guide Dr. Bhushan T. Patil and Dr. Vasim A. Shaikh and, with assistance from Prof. D.S.S. Sudhakar for the specifics of the contents. I am grateful that the Fr. Conceicao Rodrigues College of Engineering in Bandra's Research Center has made equipment and space available for conducting research. Finally, I thank my colleague Professor M.V.B. Rao for the documentation.

Author Contributions

Dipali K Bhise contributes to conceptualization, methodology, validation, analysis, investigation, data collection, draft preparation, manuscript editing. Dr. Bhushan T. Patil and Dr. Vasim A. Shaikh to contributes conceptualization, methodology, investigation, data collection, draft visualization, supervision. Dr.Sujata P. Deshmukh contributes to investigation, data collection, draft preparation, manuscript editing.

Funding

This research received no specific financial support from any funding agency.

Institutional Review Board Statement

Not applicable.

References

Byers, J. P (2016). *Metalworking fluids*. Boca Raton Florida: CRC Press.

Irani, R. A., Bauer, R. J., and Warkentin, A. (2005). A review of cutting fluid application in the grinding process. *International Journal of Machine Tools and Manufacture*, *45*(15), 1696-1705.

Sharma, V. S., Dogra, M., and Suri, N. M. (2009). Cooling techniques for improved productivity in turning. *International Journal of Machine Tools and Manufacture*, 49(6), 435-453.

Stanford, M., and Lister, P. M. (2002). The future role of metalworking fluids in metal cutting operations. *Industrial Lubrication and Tribology*, *54*(1), 11-19.

Siniawski, M., and Bowman, C. (2009). Metal working fluids: finding green in the manufacturing process. *Industrial Lubrication and tribology*.

Weinert, K., Inasaki, I., Sutherland, J. W., and Wakabayashi, T. (2004). Dry machining and minimum quantity lubrication. *CIRP annals*, *53*(2), 511-537.

Dudzinski, D., Devillez, A., Moufki, A., Larrouquere, D., Zerrouki, V., and Vigneau, J. (2004). A review of developments towards dry and high speed machining of Inconel 718 alloy. *International journal of machine tools and manufacture*, *44*(4), 439-456.

Shokrani, A., Dhokia, V., and Newman, S. T. (2012). Environmentally conscious machining of difficult-to-machine materials with regard to cutting fluids. *International Journal of machine Tools and manufacture*, *57*, 83-101.

Najiha, M. S., Rahman, M. M., and Yusoff, A. R. (2016). Environmental impacts and hazards associated with metal working fluids and recent advances in the sustainable systems: A review. *Renewable and Sustainable Energy Reviews*, *60*, 1008-1031.

Elmunafi, M. H. S., Kurniawan, D., & Noordin, M. Y. (2015). Use of castor oil as cutting fluid in machining of hardened stainless steel with minimum quantity of lubricant. *Procedia Cirp*, *26*, 408-411.

Ju, C., Keranen, L. P., Haapala, K. R., Michalek, D. J., and Sutherland, J. W. (2005, January). Issues associated with MQL implementation: effect on peripheral milling process performance and impact on machining economics. *Proceedings of the ASME International Mechanical Engineering Congress and Exposition*. 42231, 3-12.

Benedicto, E., Carou, D., & Rubio, E. M. (2017). Technical, economic and environmental review of the lubrication/cooling systems used in machining processes. *Procedia engineering*, *184*, 99-116.

Tan X., Liu D. and C. Li. (2008). A decision-making framework model of cutting tool selection for green manufacturing and its application. *Journal of Advanced Manufacturing Systems*, 7(2), 257–260.

Amrita M., Srikant R. R., and Raju A. V. S. R. (2015). Performance Evaluation and Economic Analysis of Minimum Quantity Lubrication with Pressurized / Non-Pressurized Air and Nanofluid Mixture. *Int. J. Mech. Aerospace, Ind. Mechatron. Manuf. Eng*. 9(6), 929–934.

Shokrani, A., Dhokia, V., and Newman, S. T. (2012). Environmentally conscious machining of difficult-to-machine materials with regard to cutting fluids. *International Journal of machine Tools and manufacture*, *57*, 83-101.

Deshpande, S., and Deshpande, Y. (2019). A review on cooling systems used in machining processes. *Materials Today: Proceedings*, *18*, 5019-5031.

Vishnu, A. V., Kumar, P. J., and Ramana, M. V. (2018). Comparison among dry, flooded and MQL conditions in machining of EN 353 steel alloys-an experimental investigation. *Materials Today: Proceedings*, *5*(11), 24954-24962.

Kaynak, Y., Gharibi, A., Yılmaz, U., Köklü, U., and Aslantaş, K. (2018). A comparison of flood cooling, minimum quantity lubrication and high pressure coolant on machining and surface integrity of titanium Ti-5553 alloy. *Journal of Manufacturing Processes*, *34*, 503-512.

Derflinger, V., Brändle, H., and Zimmermann, H. (1999). New hard/lubricant coating for dry machining. *Surface and coatings technology*, *113*(3), 286-292.

Rafai, N. H., and Islam, M. N. (2010). Comparison of dry and flood turning in terms of quality of turned parts. In *Lecture notes in engineering and computer science: proceedings of the world congress on engineering* (2044-2049).

Singh, G., Aggarwal, V., and Singh, S. (2020). Critical review on ecological, economical and technological aspects of minimum quantity lubrication towards sustainable machining. *Journal of Cleaner Production*, *271*, 122185.

Dipali Kisan Bhise is presently a Research Scholar and pursuing PhD (Mechanical Engineering) from Fr. Conceicao Rodrigues College of Engineering, Mumbai. Her areas of study are Computational Fluid Dynamics, MQL, CAD/ CAM, Machine science Technology.

Bhushan T. Patil is Research Guide for Ph.D and Master’s students in Mechanical Engineering. He is currently the Mechanical Engineering Department Head and Professor at Fr. University of Mumbai's Conceicao Rodrigues College of Engineering is located in Bandra. His research focuses on advanced machining technologies, cloud computing, digital manufacturing, and industry 4.0 trends.

Vasim A. Shaikh is Assistant Professor in Mechanical Engineering at Fr. Conceicao Rodrigues College of Engineering, Bandra with over 14 years of experience in research and development (R&D), sustainable manufacturing processes, and technology innovation. He is an expertise in mist and materials characterization, testing, and analysis. He also has a deep understanding of manufacturing engineering.

Sujata Deshmukh is presently Head of Department & Professor in Computer Engineering at Fr. Conceicao Rodrigues College of Engineering, Bandra. Her areas of Interest are Data Mining, Machine Learning and Block-Chain. She has published numerous research papers in national and International platforms to her credit. She is core member of Research & Development and been formerly as Faculty advisor for Rotaract Club at Fr. Conceicao Rodrigues College of Engineering. She assists in providing better software solutions for Mechanical systems and Designs and other Interdisciplinary branches of Engineering.