A REVIEW OF MINIMUM QUANTITY LUBRICATION (MQL) ON MACHINING PROCESSES

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ABSTRACT

Conventionally the flood lubrication system is used for cooling the tool and work interface to attain maximum surface finish, close dimensional tolerance and better tool life. This method has disadvantages that the chips get mixed with the coolant, more over coolant has minimum shelf life and hence has to be replaced frequently and flood lubrication has tendency to wet the workplace area making it dirty slippery and unsafe for working hence the conventional process needs to be replaced by new one which is minimum quantity lubrication. This article reviews various MQL methods used by various machining processes for different materials. MQL requires minimal quantity of lubricant and thus the overall cost decreases. It also highlights the future work directions for research in this area

Keyword: - *Cutting fluids, Minimum Quantity Lubrication, Vortex tube, mixing chamber Turning, near dry machining.*

1.INTRODUCTION

The enormous reduction in the quantity of lubricant compared to the circulated quantities of conventional metalworking fluid systems is the key feature of MQL. In contrast to conventional flood lubrication, minimum quantity lubrication uses only a few milliliters (ml) of lubrication per hour for the machining process. Minimum quantity lubrication today uses such precise metering that the lubricant is nearly completely used up. Typical dosage quantities range from 5 ml to 50 ml per process hour (tool cutting time).The extreme reduction in lubricant quantities results in nearly dry work pieces and chips. Losses due to evaporation and wastage, which may be considerable with emulsion lubrication (depending on the work piece being. processed), are inconsequential with MQL. This greatly reduces health hazards due to emissions of metalworking fluids on the skin and in the breathed-in air of employees at their workplaces. The cost-inflating factors of conventional flood lubrication are done away with when MQL is used. This results in:

1. No need to prepare and dispose of used metalworking fluids.
2. Decrease in the work required for cleaning the processed pieces. Easy recycling of the nearly dry chips due to less oil soiling
3. Reduction of metalworking fluid quantities in use.
4. To decrease in the work required for monitoring and metalworking fluid maintenance.

Lubricant is supplied by means of a minimum quantity lubrication system (MQL system). Application of a targeted supply of lubricant directly at the point of use lubricates the contact surfaces between tool, work piece and chip. The lubricant is either applied from outside as an aerosol using compressed air or it is “shot” at the

tool in the form of droplets. Another possibility is internal lubricant feed through the rotating machine tool spindle and the inner channels of the tool

2.REVIEW ON MQL

[1] The purpose of this article is to review the relevant literature in machining using minimum quantity lubrication particularly as it pertains to environmental, and health issues and outline future potential research in this technology. The results indicate that the process of mist particles generation and their physical characteristics are yet to be determined for a whole class of machining processes and machining conditions. The resulting impact of the findings as related to machine and work place design is yet to be determined. [2]In all machining processes, tool wear is a natural phenomenon and it leads to tool failure. The growing demands for high productivity of machining need use of high cutting velocity and feed rate. Such machining inherently produces high cutting temperature, which not only reduces tool life but also impairs the product quality. Metal cutting fluids changes the performance of machining operations because of their lubrication, cooling, and chip flushing functions but the use of cutting fluid has become more problematic in terms of both employee health and environmental pollution. The use of cutting fluid generally causes economy of tools and it becomes easier to keep tight tolerances and to maintain workpiece surface properties without Damages Due to these problems, some alternatives has been sought to minimize or even avoid the use of cutting fluid in machining operations. Some of these alternatives are dry machining and machining with MQL. [3]This paper presents the effects of minimum quantity lubrication The motto of this project work is focused on the effect of Minimum Quantity Lubrication (MQL) on the surface roughness produced during turning In coloy 800. Experiments were designed using Orthogonal array and nine experiments each under different conditions of lubrication viz. dry. Later Taguchi Methodology was used to optimize the cutting parameters to have lowest surface roughness among different combinations of speed, feed and depth of cut. The results were analyzed using Analysis of Variance (ANOVA). It was shown that feed played a major role in producing lower surface roughness followed by speed whereas depth of cut has least significance in producing lower surface roughness. Through the results it was observed that MQL1 showed lowest surface roughness compared to dry, MQL2 and flood condition. Regression Analysis was carried out for different cutting conditions using Minitab software and mathematical models were generated which established relation among cutting parameters and surface roughness. The models validation were checked using residuals normal probability plot, residual versus order run plot. Finally the accuracy of the developed models was checked using predicted versus actual surface roughness plot. [4]The review articles describes the preparations and properties of different types of water soluble cutting fluid additives derived from different materials .It is concerned with different synthetic additives classified according to their functional groups carboxylic acids esters, dibasic acids , ethers amides , substituted fatty acids and others or iron material .Testing methods or soluble cutting fluids are described on laboratory ways and practical test for factories.[5]Micro lubrication or also known as minimum quantity lubrication (MQL) serves as an alternative to flood cooling by reducing the volume of cutting fluid used in the machining process; but not without significant health concerns. Flood cooling is primarily used to cool and lubricate the cutting tool and work piece interface during machining process. The adverse health effects caused by the use of coolants and the potential economic advantages of greener machining methods are drawing manufacturer's attention to adapt and develop new methods of using lubricants. The objective of this paper is to review the state of the art literature in machining using MQL, highlight the benefits, but also stress the adverse health effects of using minimum quantity lubrication. Finally we highlight areas of relevant future research.[6]Similar to other lubricating techniques the performance of this method is also governed by process parameters, work material, tool material and the lubricant used Out of all the available machining processes, turning remains to be the most widely used machining process because of wide variety of operations available. This varied operations can be used to increase productivity and reduce the manufacturing cost. [7][8] While turning at higher values of cutting parameters in order to increase productivity, the surface finish gets adversely affected and it also has a negative impact on tool life. Research has been focused on improving the conventional turning, to enhance tool life and reduce tool failure. Here tool failure is considered whenever the tool is incapable of doing any further machining. [9]The total amount of heat generated is summation of the heat generated because of the plastic deformation of the chips, friction between tool and chips and friction between tool and work-piece. Out of all these heat generated the chips carry the major amount of the heat generated (about 80%) and the remaining is shared between work-piece and tool.[10]MQL does not generate a significant amount of mist compare to Fluid cooling. These technologies in place however, machining is safe for both operators and the environment. The

use of MQL also decreases the production cost by reducing the coolant cost. [11]Chip thickness ratio- MQL by cutting oil shows more effectiveness than machining in a dry environment. The MQL jet, with both its lubricating and cooling effect, minimized the shrinkage of shear zone and plasticization and reduced Cutting temp-With the increase in cutting speed and feed rate , tool-chip interface temperature has been increased as usual, even under MQL due to increase in energy input.[12]The results show us that amongst all the MQL conditions, medium order coolant flow rate and higher pressure has better grinding performance due to boundary lubricated environment that develops around the wheelwork interface. A higher order coolant concentration (4%) provides better grinding performance as shown lower grinding forces, lower surface roughness, and relatively better surface texture. High coolant concentration with high pressure and medium coolant flow rate produced good surface texture without any burn marks, smear marks or debris covered area.[13]It can thus be concluded that the use of cutting fluid at minute amounts can potentially protect the tool while holding the cutting forces relatively unchanged in comparison to completely dry cutting.[14].In Vortex Tube Refrigeration System air is being used in place of refrigerant is of having zero ozone depletion, zero global warming potential, non-pollutant, non-toxic, inflammable, cheaper and eco-friendly to the Environment and overcomes the major problems such as global warming and ozone depletion Cooling conditions met by the Vortex Refrigeration System is healthier than the comfort conditions met by the VCRS system. Vortex Tube Refrigeration 2System is of having no moving parts, so its durability is more. Installing and maintaining is easier than the current air conditioning system. Cooling system works well in the vehicles with less cabin space as the C.O.P of the vortex tube is less [15] Experiment results showed that, cutting performance of MQL machining is better than that of dry and conventional machining with flood cutting fluid supply, because MQL provides the benefits mainly by reducing the cutting forces which improves the chip-tool interaction and maintains sharpness of the cutting edges and lower machining temperatures. Surface finishes improved mainly due to reduction of wear and damage at the tool tip by the application of MQL.

4.CONCLUSIONS

After careful study of literature, it is found that though various methods of MQL have been applied and various cutting fluids have been used .Major researchers have focussed their work on proposal of MQL for different materials but special study has been observed for steel . Moreover no specific study was found as to study effect of variation in cutting parameters on surface finish, machining time and dimension on tolerance achieved on application of MQL system. Hence the study is proposed to study the effect of variation in cutting parameters on the output parameters of dimensional accuracy or tolerance,surface finish and machining time for work piece material . So also for specific Surface finish optimization technique using Taguchi method has been adopted to find the optimal parameters for the same

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