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Use of MQL Technique to on Different Specimen during Turning Operation and Calculation of Grey Relational Co-efficient

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Abstract: Machining is one of the most important process that is carried out in industries to develop product. The goal of every industry to lower the cost of machining by improving quality and productivity. The machining process mainly depends on the lubricant and heat. If these are in control than tool wear also in control than tool wear also in control. For lower the heat generation, cooling method applied like flood cooling. But flood cooling which is traditional cooling is not successful at every place as well as it hazardous for people working there and for environment also. Flood cooling is very effective at lower cutting speed but not at higher speed because of more heat generation and coolant cannot reach every area of work piece. [1] In tead of flood cooling an alternative comes out that is 'Minimum Quantity Lubrication'. There are several studies completed and still going on regarding the usage of MQL by manufactures. MQL is the process in which minute amount of high quality lubricant apply to the cutting tool or work piece where flood cooling floods the machining zone in attempt to cool things down but MQL coats the matching zone with a thin film of lubricant and prevents heat buildup as the friction reduces. Majority of the heat from friction transmitted to the chip and exit as chips are removed. There is no disposal problem and it includes mixture of high pressure air and oil. These mixes in the chamber and supply directly to machine zone by nozzle.[2] The usage of MQL technique at machining steel also has a positive effect on performance characteristics such as surface quality and tool wear.[3] It is observed that ,if well pulverized the usage of water added MQL provides a very good lubrication and that is usage of MQL with synthetic ester without water addition harms the cutting tool and has negative effect on the surface roughness of the work piece[4] Besides this, the effect on cooling methods used at manufacturing and the cutting parameters on the performance characteristics constitute the subject of various studies.[5]
Keywords; MQL, turning, cutting fluid, specimen

I. INTRODUCTION

It has been reffered as Minimum Quantity Lubrication. It is alternative of flood cooling. MQL uses lubricant not coolant and in minimum quantity. Coolant which used in flood cooling used to cool thing down but MQL interface with small droplets or a thin layer of lubricant and prevent heat build up. The good lubricity of MQL means heat is transmitted to chip and exit that heat as chip removes. This transfer of heat and lubrication keep the tool and work piece cooler and reduces tool wear. It uses small amount of lubricant which vapourize due to heat and leaves the floor, machine, equipment and tool dry and clean. It is common for machinists to experience the twice the tool life after adopting MQL as well as parts do not require any cleaning before oil are used as lubricant in the MQL which are completely safe for skin contact as well as for environment. MQL includes the high pressure air(6 bar) mix with lubricant in the chamber and supply where machining take place with the help of nozzle and there is no disposal problem as it uses less amount of lubricant which vapourizes due to heat. Product is of high quality and economical as uses less lubricant. The best product includes good surface finish, desired shape and size all thios we can obtained by heat dissipitation from machining zone.[6]

A. Advantages of MQL

1) It uses less amount of lubricant, so almost a dry process which remain safe working environment.
2) Directly applied where machining occurs(between work piece and tool) instead all over.
3) High pressurized gas flushes away chip from machining zone, so disposal of chip is easy.
4) Cutting fluid for lubrication and high pressurized gas helps in heat dipitation.

5) It gives better tool life and surface finish.

B. Types of MQL

1) *Mixing inside the Nozzle:* In this type the lubricant mixes with air inside the nozzle and applied to the machining zone. Mixing chamber present inside the nozzle.

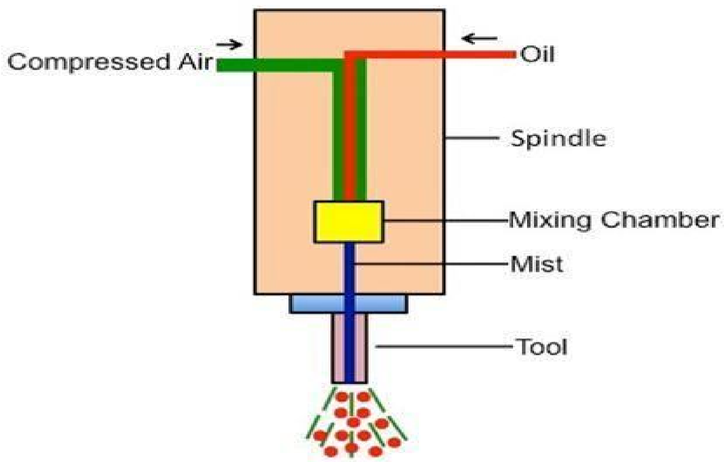

Figure1.1: MQL mixing inside the nozzle

2) *Mixing outside the Nozzle:* In this mixing chamber is outside the nozzle. Lubricant and air mixes in chamber and supply to the nozzle with the help of oil control valve and than splits on the machining zone.[7]

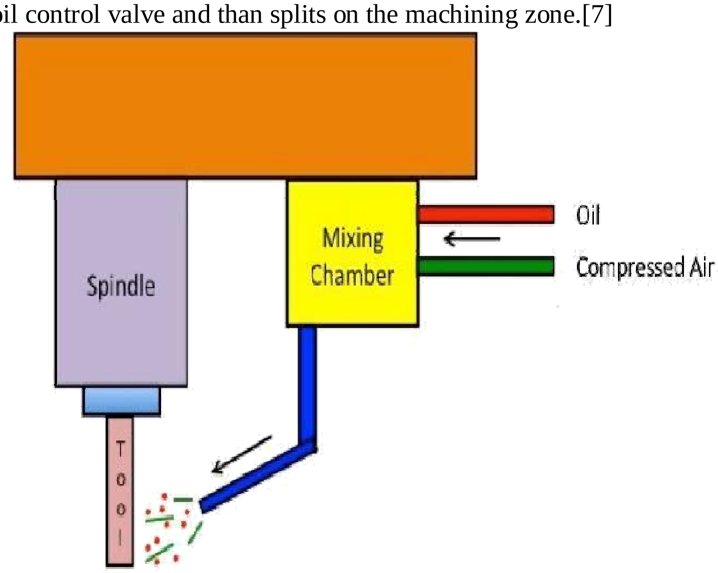

Figure1.2: MQL mixing outside the nozzle

C. Application of Minimum quantity lubrication

This technique has been employed successfully in various metal cutting, turning and shaping process. The advantages it offers suggest that it range of applications will expand, however the variable of influence to be considered and their effects on the results of the process is still in studies.[8] Minimum quantity lubrication fulfils the desire of almost all the machining process where the cooling and lubrication is must. The machining process in which MQL has wide application are turning, grinding, drilling and milling.[9]

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D. Terminology and Methodology

The turning experiment done using a heavy duty lathe machine. The experiment was done on a cylindrical job of a stainless steel(17-4PH).The work piece on which the entire experiment was carried out with 42mm in diameter and 400mm in length. The turning experiment was carried out on conventional cooling conditions and minimum quantity lubrication (MQL) system conditions.

Figure 2.1: Experimental set-up for conventional cooling

Figure 2.2: Experimental setup for MQL lubrication syatem

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E. Workpiece and Tool material selection

The 17-4PH is used as different aerospace application, chemical processing equipment. This also used as refining for oil, petroleum and equipment for food processing. The chemical composition of the steel are shown in Table 3.1 and in Table 3.2.

Table 3.1: Chemical composition of 17-4PH stainless steel.

Elements	C	Mn	P	S	Si	Cr	Ni	Cu	Nb & Ta
Wt%	0.07	1	0.04	0.03	1	17	4	3-5	0.15-0.45

Table 3.2: Physical properties of 17-4 PH stainless steel

Physical Properties	Values
Density	7810kg/m^3
Poisson's Ratio	0.29
Elastic Modulus	196GPa
Ultimate Tensile Strength(UTS)	1103MPa
Yield Strength	1000MPa
Specific Heat	460J/kg-K
Thermal conductivity	18.3W/m-K
Rockwell Hardness	35

The machining was carried out using uncoaed cemented carbide tool inserts.

II. EXPERIMENTATION AND RESULT

After machining, the output responses were measured and tabulated as shown in tables

Table 4.1: output responses for turning under flood cooling environment

Run No	Vc (m/min)	F (mm/rev)	t (mm)	Fz (N)	Fy (N)	Fx (N)	Ra (µm)	Rt (µm)	Rz (µm)	€	µ
1	47	0.08	0.5	220	134	105	2.266	14.66	11.33	2.4071	0.22534
2	47	0.14	1	442	190	243	1.866	15	9	2.2777	0.21116
3	47	0.2	1.5	651	215	392	1.933	13.66	10.666	1.8066	0.151722

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4	61	0.08	1	338	170	223	1.933	19.66	10	2.21127	0.19187
5	61	0.14	1.5	540	222	375	2.266	18	12.666	2.36651	0.22097
6	61	0.2	0.5	290	180	120	3.4	12.66	11.33	1.65648	0.129468
7	103	0.08	1.5	354	220	335	1.866	13.33	9	2.56244	0.24138
8	103	0.14	0.5	207	187	100	1.666	13.66	9	1.4642	0.09781
9	103	0.2	1	524	212	261	1.866	12	9.666	2.1327	0.19429

Table 4.2: output responses for turning under MQL

Run No	Vc (m/min	F (mm/rev)	t (mm)	Fz (N)	Fy (N)	Fx (N)	Ra (µm)	Rt (µm)	Rz (µm)	€	µ
1	47	0.08	0.5	210	130	100	3.666	29.66	12	1.993011	0.176913
2	47	0.14	1	421	186	258	1.6	11	9.666	2.529211	0.23803
3	47	0.2	1.5	674	237	400	1.733	10.66	9.33	2.18449	0.20044
4	61	0.08	1	307	160	225	1.533	12	7.33	3.3907	0.31323
5	61	0.14	8	520	214	379	1.8	10.66	9	2.11507	0.19216
6	61	0.2	0.5	280	170	116	3.466	28.66	16	2.0602	0.185419
7	103	0.08	1.5	334	200	325	1.2	11	6.33	2.30361	0.214067
8	103	0.14	0.5	220	165	105	1.266	7.66	6	1.61218	0.122514
9	103	0.2	1	512	220	273	1.933	11.33	9.333	1.03012	0.00761

III. RESULT AND CONCLUSION

From the analysis of graphs, it is clear that MQL cutting environment is producing better result by minimizing cutting forces, surface roughness and chip reduction coefficient..

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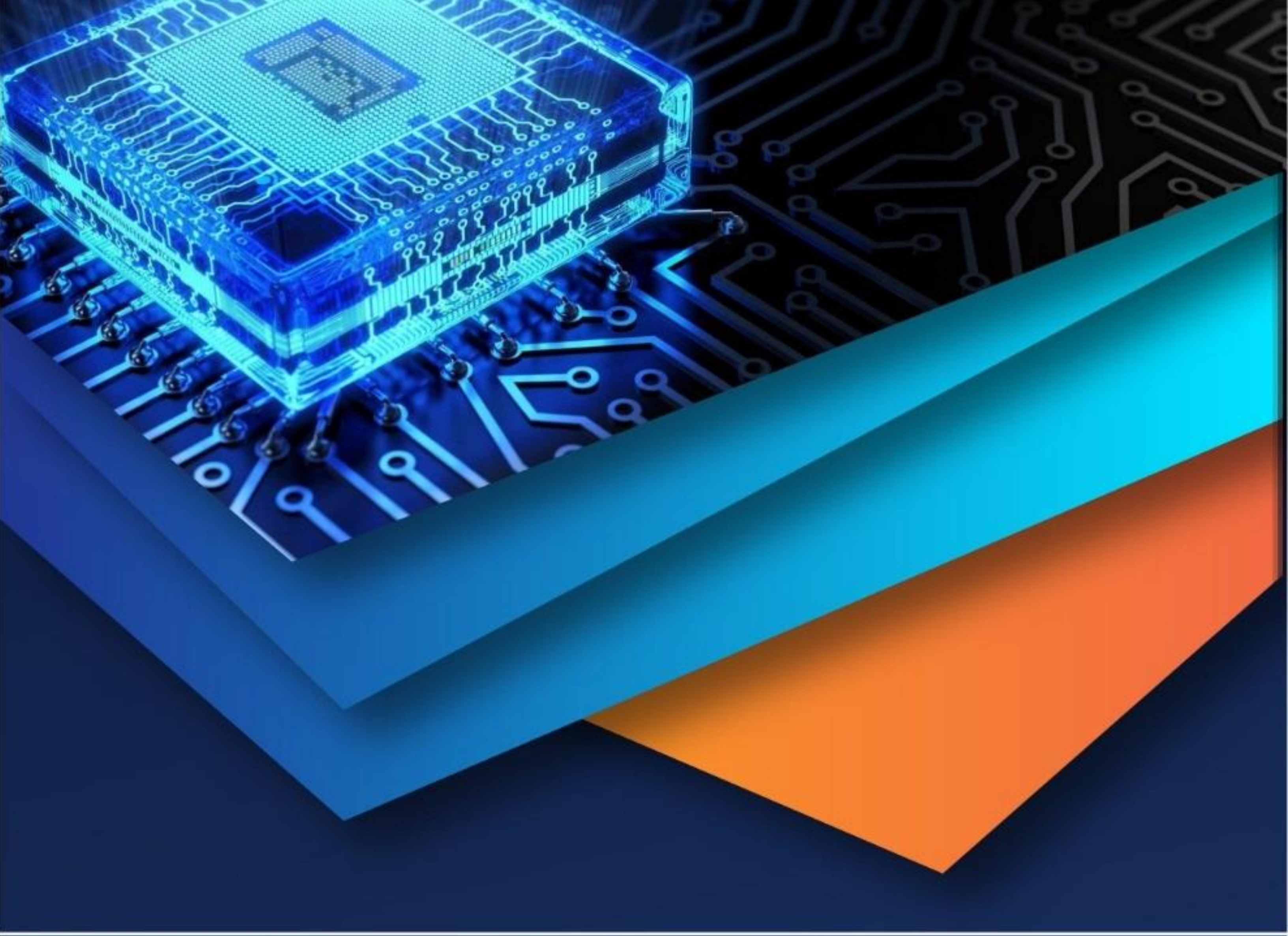

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