Reduction Of Tool Wear By Optimizing Cutting Parameters By Using Multi Regression Analysis

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Abstract - Machining or cutting of materials is a major need in a manufacturing sector. The materials are machined or material removal is achieved by using different machines such as lathe machine, milling machine, drilling machine etc. For this purpose the materials are needed to be machined with higher accuracy, higher surface finish and minimum tool wear to minimize tooling costs. The main objective of this paper is to minimise tool wear by optimizing cutting parameters such as speed, feed and depth of cut. To validate minimized readings of tool wear, experimental readings were taken and compared with software readings using ANOVA and Response Surface method in Software called MINITAB.

Index Terms – *ANOVA, Response Surface Method, MINITAB, CNC Lathe.*

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I. INTRODUCTION

To begin with the experiment, an experiment has been performed which comprises different combination of spindle speed, feed and depth of cut. Fifty four set of reading has been taken which gave different readings for MRR and SR. Later these readings for controlling parameters has been fed as an input in Minitab software and the software gave an equation to optimise MRR which had same constant values and the variables were speed, feed and depth of cut. Later the readings of actual MRR were obtained from the experiment and equation have been compared and it was found that they were closely matching and fetching optimised values of speed, feed and depth of cut. Thus optimising MRR and surface roughness.

II. Literature Survey

Leskover and Grum (1986). The cutting liquids serve numerous valuable capacities including, cooling of the cutting apparatus at higher paces, greasing up at low speeds and high loads, expanding device life, enhancing the surface wrap up, the bending because of temperature ascend in the work piece, encouraging chip taking care of and transfer, giving a defensive

III. layer on the machined surface from oxidation and protecting the machine tool components from rust. But the application of conventional cutting fluids creates some environmental problems like environmental pollution, water pollution, and biological problems to operators, Byrne.and Scholta (1993). Further, the cutting fluids also incur a major portion of the total manufacturing cost , Klocke and Eisenblatter (1997). Machining with solid lubricants, Shaji and Radhakrishnan (2002), Reddy and Rao (2005) and MQL, Varadarajan et al, (2002), and cryogenic cooling by liquid nitrogen, Pauls and Chattopadhay (1995) are some of the alternative approaches in this direction. Minimum quantity lubrication refers to the use of cutting fluids of only a minute amount typically of a flow rate of 50 to 500 ml/hour, which is about three to four orders of magnitude lower than the amount commonly used in flood cooling condition, where, for example, up to 10 liters of fluid can be dispensed per minute. Varodarajan et al. (2002) used 2ml/hr oil in a flow high pressure air at 20 Mpa, while hard turning AISI4340 steel. This may call to be near dry turning. It was found that cutting under near dry had better performance than that in dry or wet cutting in terms of cutting forces, cutting temperature, surface roughness, tool life, cutting ratio and chiptool contact length. Lower cutting force, lower cutting temperatures, better surface finish, shorter chip-tool contact length, larger cutting ratio and longer tool life were observed in near dry cutting compared with those in dry or wet cutting. The feasibility of application of graphite as a solid lubricant in surface grinding was investigated by applying it in.

IV. A suitable paste form to the work piece surface of the wheel, Reddy and Rao (2005). In metal forming applications, Liang and Jahanmir (1995), it is shown that the boric acid provided very low friction between an aluminum work piece and a steel forming tool. Abhang and Hameedullah (2010), investigated the possibility of using 10% boric acid by weight mixed with base oil SAE-40 as a minimum quantity lubricant, to reduce the heat generated in the machining zone (chip-tool interface) in metal cutting process. Author (2010) have developed power prediction model using response surface methodology while machining EN-31 steel.

MRR in cm3/min * 10-3	MRR from Regression Equation considering only Depth of Cut
1.1	1.1178

1	1.1178
2.2	2.0823
1.52	1.6965
1.12	1.1178
2.34	2.0823
1.45	1.6965
1.41	1.6965
1.53	1.6965
1.15	1.1178
1.2	1.1178
1.54	1.6965
1.41	1.1178
1.3	1.1178
2.13	2.0823
2	2.0823
1.43	1.6965
1.22	1.1178
2.12	2.0823
1.3	1.1178
2.32	2.0823
1.52	1.6965
2.3	2.0823
1.5	1.6965
1.52	1.6965
2.3	2.0823
2.14	2.0823

V.

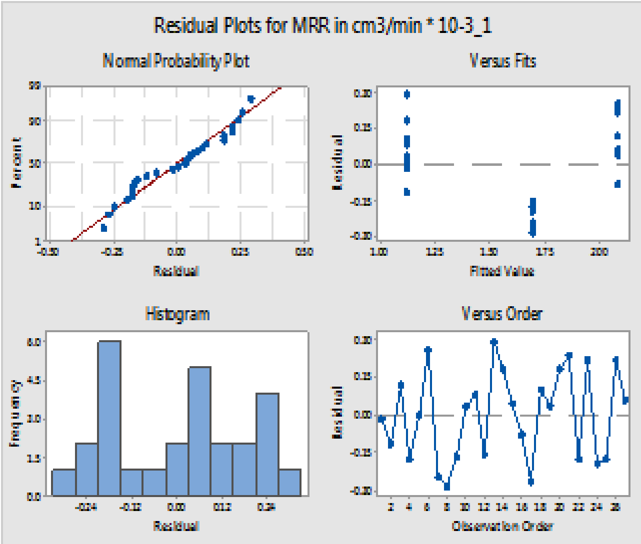
III.Methodology

For the above mentioned objective of minimising the tool wear, many approaches were considered and used by different researchers as mentioned in the literature survey. But none of them Used Multiregression analysis as an approach for minimising tool wear.This Provogued an idea of using ANOVA technique which is One of the tool of multiregression analysis to conduct an experiment and and minimise tool wear.54 set of readings were taken on CNC lathe machine for different combinations of speed ,feed and depth of cut and MRR an SR was calculated analytically where MRR and SR are the two significant factors responsible for tool wear.later these combinations of 54 readings were fed as an input to ANOVA technique of MINITAB where an equation was obtained as an output.This equation consists of some constant values and varivables such as speed ,feed and depth of cut on the RHS and MRR and SR as LHS.These equations give optimised values of MRR and SR to obtain minimised tool wear.these values match with the software readings thus proving validity of the experiment.

VI.Results

Regression Equation

MRR in cm3/min * 10-3 = 0.7320 + 0.1929 Depth of Cut in mm



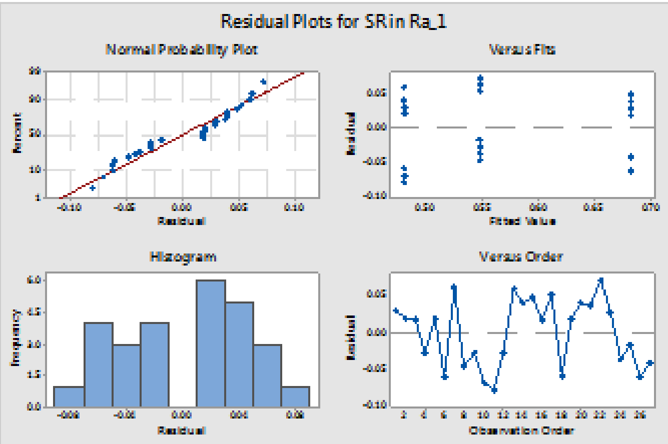
It can be observed from the residual versus fitted values are not so good and suggest the fact that the observations are from three different lots. Hence the predicted values from generalized Regression formula for MRR will give some differences from the actual observations as can be observed in the table.

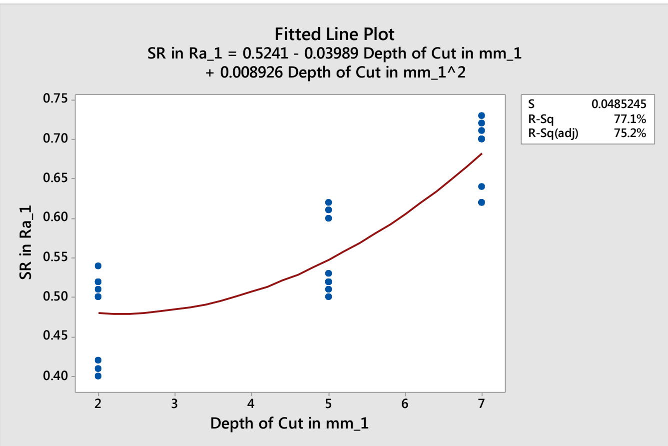
The regression equation is –

SR in Ra	SR from Polynomial regression equation
0.51	0.480024
0.5	0.480024
0.7	0.682244
0.52	0.5478
0.5	0.480024
0.62	0.682244
0.61	0.5478
0.5	0.5478
0.52	0.5478
0.41	0.480024
0.4	0.480024

0.52	0.5478
0.54	0.480024
0.52	0.480024
0.73	0.682244
0.7	0.682244
0.6	0.5478
0.42	0.480024
0.7	0.682244
0.52	0.480024
0.72	0.682244
0.62	0.5478
0.71	0.682244
0.51	0.5478
0.53	0.5478
0.62	0.682244
0.64	0.682244

SR in Ra_1 = 0.5241 - 0.03989 Depth of Cut in mm_1 + 0.008926 Depth of Cut in mm_1^2





Observation : It is a clear indication for both MRR Vs Depth of Cut as well as SR Vs Depth of Cut that the Polynomial Regression gives better prediction values as compared to linear Regression values as can be observed from the table above.

VI. Conclusion

Three iterations have been solved on MINITAB using ANOVA technique for finding optimum values for MRR and Surface Roughness.It has been observed that speed and feed play a negligible role in tool wear and major role is played by depth of cut.It can also be observed that for both MRR Vs Depth of Cut as well as SR Vs Depth of Cut that the Polynomial Regression gives better prediction values as compared to linear Regression values as can be observed from the table above.thus optimum values for depth of cut to achieve minimum tool wear is achieved.

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