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Parametric Analysis of Surface Roughness Value of Aluminium Using Different Work Tool Combination

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ABSTRACT: -

In this paper, the Taguchi method has been applied to optimize the machining performance in terms of surface roughness of the product, with aluminium work piece. Two different types of cutting tools were used of which were HSS and Carbide for experiment on a VMC machine. Taguchi's L-16 orthogonal array is used for the experimentation. The factors considered for experimentation are spindle speed, feed rate, depth of cut and tool type. Signal-to-noise (S/N) ratio and analysis of variance (ANOVA) were employed to analyse the effect of these milling parameters.

INTRODUCTION: -

The most work to easy material is one which allows the easy removal of material with good surface finish at low cost. Machine parameters like spindle speed, feed, depth of cut are the major parameters for turning and milling operations. In manufacturing, where machining operation economy plays a vital role in market competitiveness, optimising machining parameters has been a major concern. The machining parameters have been optimized by various researchers for turning, milling, drilling etc. The aim of optimization is to find the most efficient machining parameters to maximize material removal rate.

LITERATURE REVIEW: -

Sr. No	Title of Paper	Author	Contents
1	Using a generic algorithm, optimize machining settings for face milling operations in a vertical CNC milling machine.	1. Milon D. Selvam 2. Dr. A.K. Shaik Dawood 3. Dr. G. Karuppusami	In this paper author has concluded that, Taguchi's Orthogonal array provides a large amount of information in a small amount of experimentation.

2	Surface Roughness Optimization in End Milling using Taguchi method & ANOVA	1. Ashish Saxena 2. Sushant 3. Anubhav Khandelwal	In this paper Taguchi method of experimental design has been applied for optimizing roughness process parameters for CNC End Milling Al 7075 T6 Alloy with L9 orthogonal array
3	Experimental Investigation to optimize machining parameters of Al Alloy	1. Krishna Pal Singh Chauhan	In this paper author concludes that Taguchi orthogonal array, S/N ratio and ANOVA are used for optimization of cutting parameters. The results show that the order of priority, for performance characteristic's MRR are: speed, depth of cut, and feed in reducing order.
4	Research on Surface Roughness by Laser Cut	1. Miroslav Radovanovic 2. Predrag Dasic	In this paper the author has concluded that standard roughness Rz increases along with the sheet thickness, but decreases with increase of laser power.
5	Machining Characteristics on Surface Roughness of (ZRO2) Reinforced in (Al7075) MMC'S	1. Nithin Chakravarthy	In this Paper the author has concluded that the feed rate is the dominant parameter for surface roughness followed by the cutting speed, depth of cut shows minimal effect on surface roughness.

PROBLEM STATEMENT:

1] Parametric analysis of surface roughness value of aluminum using different work tool combination.

2] To get better surface quality

3] To Obtain Cost Effective Machining

Taguchi's Method:

Dr. Taguchi has created a "ORTHOGONAL ARRAY" technique. The marriage of Design of Experiments with optimization of control parameters to obtain results is achieved in the Taguchi Method. Dr. Taguchi's Signal-to-Noise ratios (S/N), which are log functions of desired output, serve as objective functions for optimization, aid in data interpretation, and prediction of optimum outcomes, and "Orthogonal Arrays" provide a set of well balanced (minimum) experiments.

SMALLER-THE-BETTER:

$$SN_s = -10\log_{10}(\sum y^2/n)$$

This is usually the chosen signal to noise ratio for all the characteristics which are not required. For which the ideal value is zero. Also, when an ideal value is finite and its maximum or minimum value is defined (for example, maximum purity is 100%, maximum Tc is 92K, and minimum time for

Experimental Method:

This experiment of end milling is carried out on VMC end milling machine equipped with maximum spindle speed 8000rpm, three axes. The work material used was aluminium in the form of 50mm X 25mm X 10mm block. The machining parameter with considerably affect the surface roughness are identified as spindle speed (rpm), Feed (m/min), depth of cut (mm). The experiment was conducted using High Speed Steel (HSS) and Carbide cutting tool. Surface roughness of each was test on surface roughness tester Mitutoyo 178-561-12A Surface Roughness tester

Fig. 1 VMC Machine

Fig. 2 Carbide Tool

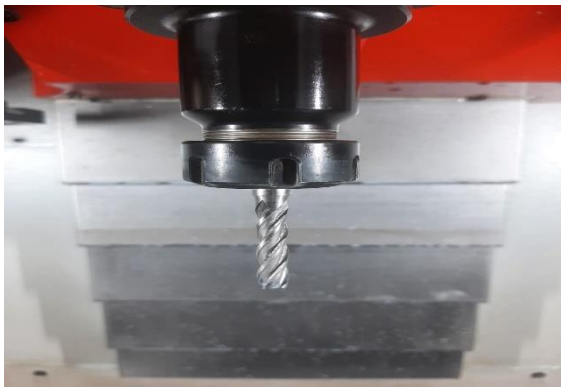


Fig. 3 HSS Tool

Fig. 4 Aluminium Material

Each experiment was conducted Four time to get authentic value and then mean value were calculated this value are shown in the table no. 1. According to the Taguchi method, the S/N ratio is the ratio of signal-to-noise where signal represents the desirable value and noise represents the undesirable value. As a result, the S/N ratio equals the mean to square deviation ratio. It is measured in decibels (dB). The following equation is used to calculate the S/N ratio for each experimental run (1)

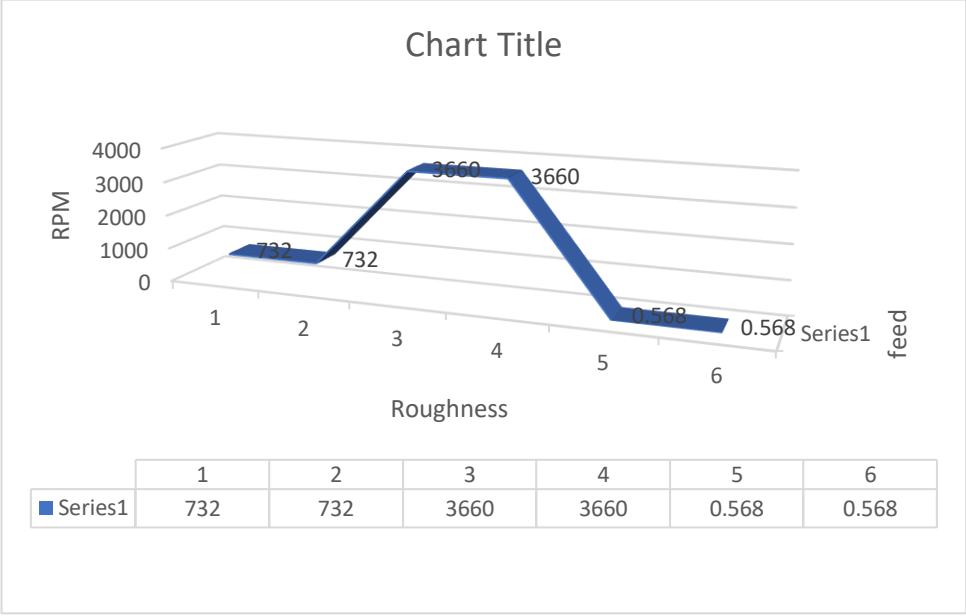
S/N=-10log [MSD]..... (1)

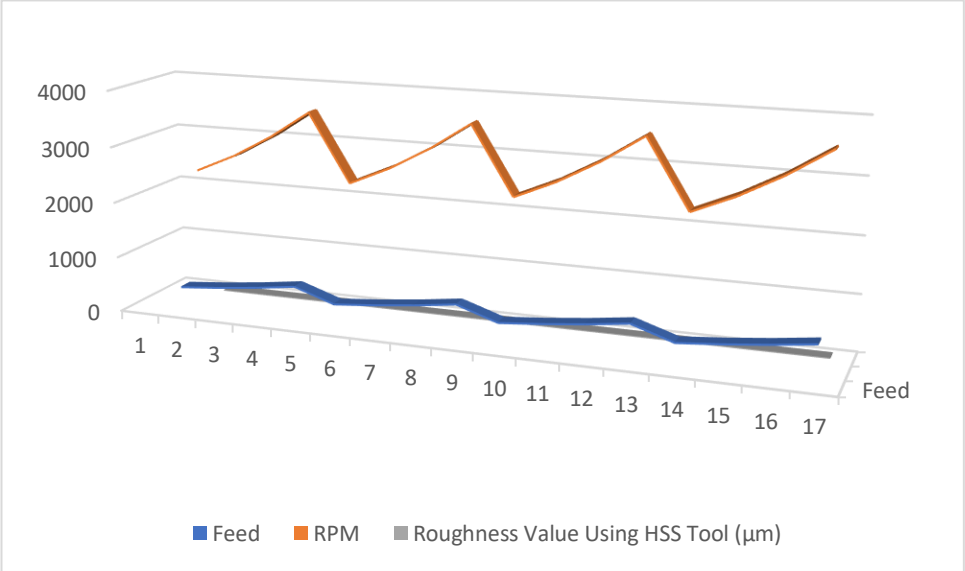
MSD stands for Mean Square Displacement.

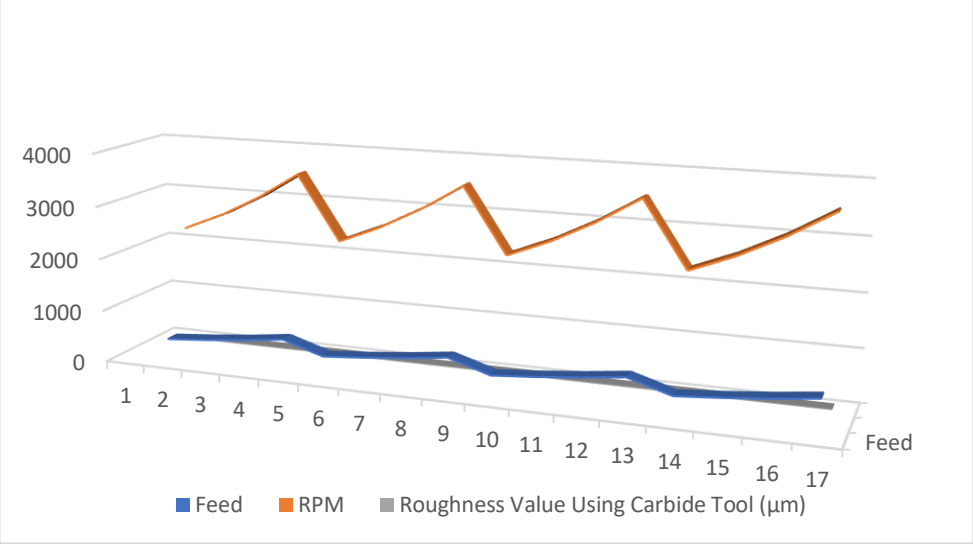
Sr. number	Depth Of Cut	Feed	RPM	Spindle Load	Roughness Value Using HSS Tool (µm)	Roughness Value Using Carbide Tool (µm)	S/N Ratio
1	0.6	493	2466	4	0.940	0.787	-36.138
2	0.6	557	2785	5	0.906	0.761	-36.666
3	0.6	636	3183	5	1.128	0.589	-37.246
4	0.6	732	3660	7	1.045	0.568	-37.853
5	0.8	493	2466	4	1.130	0.823	-34.889
6	0.8	557	2785	4	1.003	0.675	-35.417
7	0.8	636	3183	5	1.056	0.793	-35.997

8	0.8	732	3660	7	1.027	0.670	-36.603
9	1.0	493	2466	4	0.887	0.996	-33.919
10	1.0	557	2785	5	1.016	0.895	-34.448
11	1.0	636	3183	7	1.182	0.670	-35.028
12	1.0	732	3660	7	1.028	0.645	-35.634
13	1.2	493	2466	5	1.135	1.138	-33.128
14	1.2	557	2785	6	1.008	0.837	-33.656
15	1.2	636	3183	7	1.068	0.701	-34.236
16	1.2	732	3660	9	1.391	0.747	-34.807

Table no. 1 Signal to noise ratio for surface roughness







Conclusion:

1) Taguchi method has been applied for optimizing process parameters for VMC end milling with L-16 orthogonal array.
2) Optimum parameter for minimum surface roughness for HSS tool, spindle speed=2466 rpm, feed=493m/min, Depth of cut=1.0 mm Spindle load= 4.
3) Optimum parameter for minimum surface roughness for Carbide tool, spindle speed=3660 rpm, feed=732m/min, Depth of cut=0.6 mm Spindle load= 7.
4) From point 2&3 we can conclude that for HSS tool when spindle speed is minimum, we observe minimum surface Roughness and for carbide tool when spindle speed is maximum surface Roughness is minimum.

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