[Swain*, 5(4): April, 2016] ISSN: 2277-9655
(I2OR), Publication Impact Factor: 3.785

IJESRT
INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY

OPTIMAZATION OF MACHINING PARAMETER OF ALUMINIUM OXIDE AND SILICON CARBIDE COMPOSITMETARIAL BY USING TAGUCHI METHOD

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ABSTRACT
Conventional materials like Steel, Brass, Aluminum etc will fail without any indication. Cracks initiation, propagation will takes place within a short span. Now a day to overcome this problem, conventional materials are replaced by Aluminum alloy materials. Aluminum alloy materials found to the best alternative with its unique capacity of designing the materials to give required properties. Aluminum matrix composites are wide ranging applications in automobile, aerospace and military industries because of their attractive properties such as high strength to weight ratio, high wear resistance, high temperature stability, etc Though most engineering components Aluminum matrix particulate composites are primarily manufactured in near net shape, machining of Metal matrix composites (MMCs) have joined the group of difficult-to-cut materials because of the inherent abrasiveness of ceramic reinforcements. The main objective of this paper is to study of Machining Parameter and Surface roughness of Aluminum oxide and Silicon Carbide (Al2O3&SiC) is investigated. Optimum machining condition for maximizing metal removal rate and minimizing the surface roughness is determined using taguchimethod .This paper attempts to establish a comprehensive mathematical model for correlating the interactive and higher-order influences of various machining parameters using Taguchi method with an L 27 fractional factorial design were selected for the present experiment to obtain the optimal settings of factors and study their effects on multiple performance characteristics. Analysis of variance (ANOVA) has been performed to verify the fit and adequacy of the developed mathematical models.

KEYWORDS: Aluminum Matrix Composite; Machining Parameter ;Surface roughness; silicon carbide particulates; machining speed; feed rate; Taguchi Method; Optimization.

INTRODUCTION
The cost of machining amounts to more than 20% of the value of manufactured products in industrialized countries. It is therefore imperative to investigate the machinability behavior of different materials by changing the machining parameters to obtain optimal results. The machinability of a material provides an indication of its adaptability to manufacturing by a machining process. Good machinability is defined as an optimal combination of factors such as low cutting force, good surface finish, low tool tip temperature, and low power consumption.

Process modeling and optimization are the two important issues in manufacturing products. The selection of optimal cutting parameters, like depth of cut, feed and speed, is a very important issue for every machining process. In workshop practice, cutting parameters are selected from machining databases or specialized handbooks, but the range given in these sources are actually starting values, and are not the optimal values. Optimization of machining parameters not only increases the utility for machining economics, but also the product quality to a great extent.

In today‘s manufacturing environment, many industries have attempted to introduce flexible manufacturing systems (FMS) as their strategy to adapt to the ever changing competitive market requirements. To ensure quality of machined products to reduce the machining costs and to increase the machining effectiveness, it is very important to select appropriate machining parameters when machine tools are selected for machining.

OPTIMIZATION

The design objective preceding most engineering design activities is simply to minimize the cost of production or to maximize the production efficiency. An optimization algorithm is a procedure which is executed iteratively by comparing various solutions till the optimum or satisfactory solution is found. Accepting the best solution after comparing a few design solutions is the indirect way of achieving optimization in many industrial design activities. There is no way of guaranteeing an optimal solution with this simplistic approach. Optimization algorithms on the contrary, begin with one or more design solutions supplied by the user and then iteratively check new design solutions, relative search spaces in order to achieve the true optimum solution.

In optimizing the economics of machining operations, the role of cutting conditions such as feed rate, cutting speed and depth of cut have long been recognized. F.W.Taylor (1907) showed that an optimum or economic cutting speed exists which would maximize material removal rate.

Gilbert (1950) studied the optimization of machining parameters in turning taking maximum production rate and minimum production cost as criteria. Armarego & Brown(1969) investigated unconstrained machine-parameter optimization using differential calculus. Brewer & Rueda (1963) carried out simplified optimum analysis for non-ferrous materials. For Cast Iron (CI) and steels, they employed the criterion minimum machining cost.

EXPERIMENTAL PROCEDURE

Accordingly the present study has been done through the following plan of experiment.

a) Checking and preparing the Centre Lathe ready for performing the machining operation.
b) Cutting Al_2O_3 and Sic performing initial turning operation in Lathe to get desired dimension of the work pieces.

c) Calculating weight of each specimen by the high precision digital balance meter before machining.
d) Performing straight turning operation on specimens in various cutting environments involving various combinations of process control parameters like: spindle speed, feed and depth of cut.
e) Calculating weight of each machined plate again by the digital balance meter.
f) Calculating the Fx,Fy,Fz by using lathe tool dynamometer.
g) Measuring surface roughness and surface profile with the help of a portable Surface roughness tester.

EQUIPMENTS USED

5.1 HIGH SPEED LATHE MACHINE

It consists of 8 spindle speeds ranging from 70 R.P.M, 116, 186, 269, 315, 525, 842, and 1250. Each speed consists of 4 different feeds.

Fig.1 High Speed Lathe Machine

5.2 CUTTING TOOL USED
Tool material-HSS

5.3 WORK PIECE USED
Aluminum oxide and silicon carbide composite material.

5.3 TOOL DYNAMOMETER
It is a device used to measure the force exerted by tool to the work piece. We are measuring three types of forces (Fx, Fy, Fz). Fx=Feed force Fy=Thrust force Fz=cutting force.

Fig.2 SHOWS TOOL DYNAMOMETER SET UP

5.4 ROUGHNESS MEASUREMENT
Roughness measurement has been done using a portable surface roughness tester,
shown in Figure 3.3. The surface roughness tester is a portable, self-contained instrument for the measurement of surface texture. The parameter evaluations are microprocessor based. The measurement results are displayed on an LCD screen and can be output to an optional printer or another computer for further evaluation.

The instrument is powered by non-rechargeable alkaline battery (9V). It is equipped with a diamond stylus having a tip radius 3.16µm. The measuring stroke always starts from the extreme outward position. At the end of the measurement the pickup returns to the position ready for the next measurement. The selection of cut-off length determines the traverse length. Usually as a default, the traverse length is five times the cut-off length though the magnification factor can be changed. Roughness measurements, in the transverse direction, on the work pieces have been repeated four times and average of four measurements of surface roughness parameter values has been recorded.

The measured profile has been digitized and processed through the dedicated advanced surface finish analysis software Taguchi for evaluation of the roughness parameters. Surface roughness measurement with the help of surface roughness tester has been shown in Figure.

ISSN: 2277-9655
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Fig.3 SHOWS SURFACE ROUGHNESS TESTER ***Fig.4 SHOWS MEASUREMENT OF SURFACE***

5.41 DIFFERENT SURFACES ACHIEVED IN VARIOUS SPEED ,FEED & DEPTH OF CUT ROUGHNESS

Fig.5 VARIOUS SURFACES MACHINED FOR Al_2O_3 AND SIC COMPOSITE MATERIAL

RESULTANT DISCUSSION

Minitab statistical software has been used for the analysis of the experimental work. The Minitab software studies the experimental data and then provides the calculated results of signal-to-noise ratio. The objective of the present work is to minimize surface roughness in turning process optimization. In this phase of experimentation a design of experimentation technique viz Taguchi's L9 orthogonal array has been used for studying the influence of 3 process parameters (cutting speed, feed and depth of cut) on 3 different responses (Thrust force (Fy),Feed force(Fx) and Cutting force (Fz)) during machining of mild steel. Experiments were performed at three different levels. Nine experiments were performed.

6.1 Parameters

In this experiment the speed, feed, and depth of cut are taken as input parameter and we calculate feed force(Fx), thrust force(Fy),cutting force(Fz) table 1 indicate the cutting parameter chosen for the experiment

Level	speed	Feed(mm/rev)	Depth of cut(mm)
high	186	0.771	0.75
medium	128	0.4285	0.5
low	70	0.086	0.25

Table 1: cutting parameter chosen for the experiment

Table 2 indicates the output parameter for Al_2O_3 and Sic

Exp. No	INPUT PARAMETERS			OUTPUT PARAMETERS FORCE			
	Speed	Feed	Depth of Cut	Cutting Force(Fz) in Kgf	Feed Force(Fx) in Kgf	Thrust Force(Fy) in Kgf	Resultant force in Kgf (Actual)
1	70	0.086	0.25	25.65	0.5	9.75	27.445
2	70	0.4285	0.5	15.75	1.75	35.35	38.739
3	70	0.771	0.75	5.65	12.35	65.85	67.235
4	128	0.086	0.5	26.56	0.85	9.2	28.121
5	128	0.4285	0.75	24.14	13.35	14.2	31.025
6	128	0.7771	0.25	24.56	10.66	14.15	30.282
7	186	0.086	0.75	8.72	5.89	46.65	47.822
8	186	0.4285	0.25	26.42	1.65	10.72	28.559
9	186	0.771	0.5	24.89	9.1	12.55	29.322

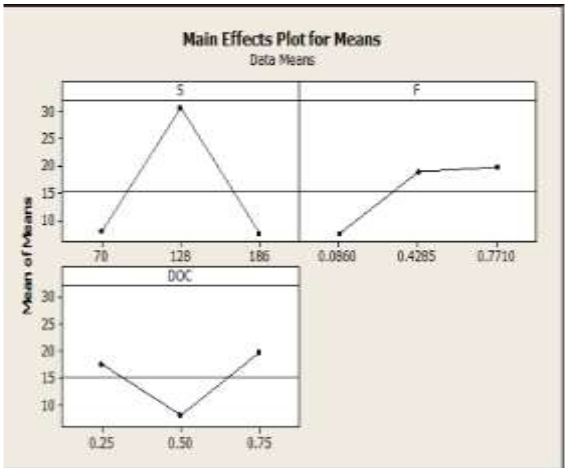

Fig.6 Main effect plot

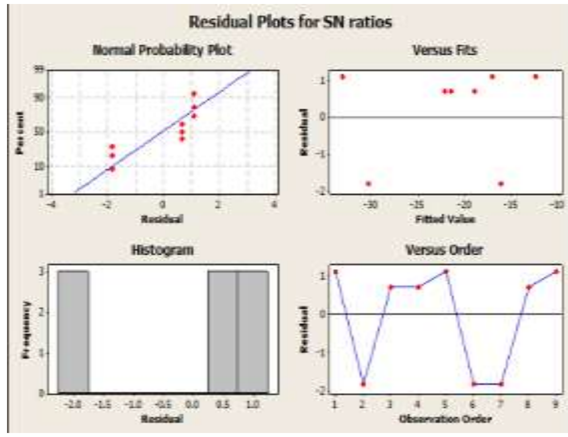

Fig.7 Residual Plot

From Fig.6 main effect plot, it has been observed that the minimum surface roughness can be achieved with the optimal parameter level of speed at 128 rpm, feed 0.771 mm, depth of cut 0.75mm, respectively.

From the residual plot it is observed that the factors are very closer to linear line that indicate the residual error is minimum

Term Constant	Coef SE	Coef	T	P
	-20.614	0.978	-21.079	0.002
S 70	4.2238	1.383	3.054	0.093
S 128	-7.6068	1.383	-5.5	0.032
F 0.0860	4.1533	1.383	3.003	0.095
F 0.4285	-2.0778	1.383	-1.502	0.272
DOC 0.25	0.1325	1.383	0.096	0.932
DOC 0.50	2.588	1.383	1.871	0.202
S=2.934	R-Sq=95.7%		R-Sq(adj)=82.7%	

Table 2 indicates Estimated Model Coefficient For SN Ratios

Level	Speed	Feed	DOC
1	-16.39	-16.46	-20.48
2	-28.22	-22.69	-18.03
3	-17.23	-22.69	-23.33
Delta	11.83	6.23	5.31
Rank	1	2	3

Table 3 .Iindicate Effects of Cutting Parameters on Surface roughness.

CONCLUSION

Following conclusion are drawn from the present experiment work.

- From above experiment we concluded that at 128rpm, feed 0.7710mm and depth of cut 0.75mm.We got optimal parameter.
- The optimum conditions obtained from Taguchi method for optimizing Surface roughness by turning of Aluminum oxide and silicon carbide under dry condition are cutting speed of 128 rpm, Feed rate of 0.7710 mm/rev and depth of cut of 0.75 mm.

FUTURE WORK

From above experiment we got the good surface roughness by turning operation . We are looking for more accuracy surface roughness, MRR, by using advance CNC machine and advance milling machine also.

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