OPTIMISATION OF TURNING OPERATION FOR ALUMINIUM 7075 USING TAGUCHI METHOD

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***Abstract*— This paper investigate the process parameter affecting the material removal rate, machine timing and surface roughness produced while turning operation on Aluminium 7075. Design of experiments was conducted for the investigation of influence on turning parameter by using Taguchi design. The aim of this project is to find out the optimal combination process parameter based on S/N ratio obtained from Taguchi**

***Keywords*— Taguchi, material removal rate, Al7075**

I. INTRODUCTION

Productivity play significant role in today's manufacturing market. The producing industries area unit incessantly challenged for achieving higher productivity among lesser time. Turning method is in an exceedingly one among in every of the foremost elementary and most applied material removal operations in a real producing atmosphere. The process of turning is influenced by many factors such as Cutting speed, Feed rate and Depth of cut. The challenge that the engineers face is to find out the optimal parameters for the preferred output and to maximize the output by using the available resources. Higher material removal rate is desired by the industry to cope up with mass production without sacrificing product quality in short time. Higher material removal rate is achieved through increasing the process parameters like Cutting speed, Feed and Depth of cut. Aluminium Alloy 7075 area unit the foremost wide used non-ferrous materials in engineering applications due to their enticing properties like high strength to weight quantitative relation, good ductility, excellent corrosion, availability and low cost.

Naga and Devaki Devi [1] explains Associate in Nursing best setting of turning parameters (Cutting speed, Feed Associate in Nursing Depth of Cut) which ends in an best price of Surface Roughness and most Metal Removal rate where as machining aluminium bar with HSS tool. A mathematical technique has been wont to generate model with Response Surface Methodology. Warhade et. all [2] investigated the result of cutting parameters specifically, cutting speed, depth of cut and feed rate on minimize needed machining time and increasing metal removal rate throughout machining of Al Alloy 6063 mistreatment VBM0.2 tool. Experiments were conducted supported the established Taguchi's technique L9 orthogonal array and minitab-16 applied math computer code is employed to come up with the array. Dave et. all [3] during the study, the improvement of 2 response parameters (Surface roughness and Material Removal Rate) by 3 machining parameters (cutting speed, feed rate and depth of cut) is investigated in high speed turning of linear unit materials mistreatment TiN Coated cutting tools in dry conditions. Taguchi's L'18 orthogonal array and analysis of variance (ANOVA) square measure used for individual improvement. Kamal et. all [4] This paper are investigation of the machining characteristic of C34000 (medium brass alloy) material in CNC turning method mistreatment GC1035 coated inorganic compound tool. During the analysis paper centered on the analysis of optimum cutting conditions to urge the most material removal rate in CNC turning of various grades of medium brass alloy material by Taguchi technique. It's been found that ANOVA shown that the depth of cut has vital role to play in manufacturing higher MRR. Taguchi technique was developed by Dr. Genichi Taguchi. This technique involves 3 stages: system style, parameter style, and tolerance style. The Taguchi technique could be a statistical procedure wont to improve the merchandise quality. It is unremarkably utilized in rising industrial product quality because of the tried success.

The aim of our project is to study the effect of change of process parameter over surface roughness, material removal rate and machining timing in Al 7075 during turning operation and also to find optimal process parameter using Taguchi method

II. EXPERIMENTAL METHOD

A. Work Piece Material and cutting tool insert

The work is conducted in Aluminium 7075. The cutting tool used is HSS which have high hardness and resistance when compared to common carbon and steel. The experiments were conducted in CNC lathe XL. The chemical composition and properties of Al 7075 are shown in Table 1. and Table 2.

TABLE I
CHEMICAL COMPOSITION OF AA7075

Elements	Composition %
Aluminium	89.58
Silicon	0.4
Copper	0.098
Manganese	1.41
Magnesium	0.055
Chromium	2.33
Zinc	5.95

TABLE III
PROPERTIES OF AA7075

Property	Value
Tensile Strength	572 Mpa
Density	2.81 kg/m3
Elongation	11 %
Machinability	70 %

B. Cutting parameters

The cutting parameter is selected based on the work experience. The three levels of cutting speed, feed and depth of cut used in these processes which are shown in Table 3.

TABLE IIIII
PROCESS PARAMETER

S. No	Process Parameter	Levels		
		1	2	3
1	Speed (m/min)	1500	2000	2500
2	Feed (mm/rev)	0.10	0.15	0.20
3	Depth of Cut (mm)	0.3	0.6	0.9

Taguchi method is incorporated to indentify the optimum process parameter. The L9 orthogonal array is designed by Taguchi with experimental results. Minitab software is used to predict the optimum process based on Taguchi method.

III. RESULT AND DISCUSSION

DOE techniques help to determine the effect of individual factor that affect the output result in any design. Taguchi method consists of plan of experimenting the objective in a controlled manner to obtain the behaviour of the given process. L9 orthogonal array is employed to analyze the results obtained from 9 experiments by varying three parameters such as speed, feed and depth of cut. Based on the three process parameter the material removal rate, machine timing and surface roughness is calculated and shown in table 4.

A. Analysis of signal –to Noise Ratio

Minitab applied mathematics software system has been used for the analysis of the experimental work. The Minitab software provides the calculated results of S/N. the target of this work is to reduce machining time and maximize the MRR in turning method improvement. The impact of various method parameters on material removal rate and machining time are calculated and planned because the method parameters changes from one level to a different. The common value of S/N ratios has been calculated to seek out out the results of various parameters and likewise as their levels. Larger-the-better performance characteristic is selected to obtain material removal rate. Smaller-the better performance characteristic is selected to obtain machining time. From the response Table 5 and Fig.1 it's clear that cutting speed is that the most influencing issue followed by feed rate and depth of cut for MRR.

TABLE IVV
EXPERIMENTAL DESIGN AND RESULTS

Speed	Feed	DOC	MRR	MT	Roughness
m/min	mm/rev	mm	mm3/sec	sec	micro meter
1500	0.1	0.3	58.875	93.6	1.42
1500	0.15	0.6	176.625	34.67	1.35
1500	0.2	0.9	353.25	15.6	2.1
2000	0.1	0.3	78.5	39	1.55
2000	0.15	0.6	235.5	15.6	1.85
2000	0.2	0.9	471	35.1	1.73
2500	0.1	0.3	98.125	18.72	1.14
2500	0.15	0.6	294.375	20.8	0.76
2500	0.2	0.9	588.75	15.6	1.96

The optimum for MRR is cutting speed of 2500 m/min, feed rate of 0.20mm/rev and depth of cut of 0.9mm. From the response Table 6 and Fig.2it's clear that cutting speed is the most influencing factor followed by feed rate and depth of cut for machining time. The optimum for machining time is cutting speed of 2500m/min, feed rate of 0.20mm/rev and depth of cut of 0.9mm

TABLE V
RESPONSE TABLE FOR MRR

Level	Speed	Depth of cut	Feed
1	43.77	37.71	37.71
2	46.27	47.25	47.25
3	48.20	53.27	53.27
Delta	4.44	15.56	15.56
Rank	3	1.5	1.5

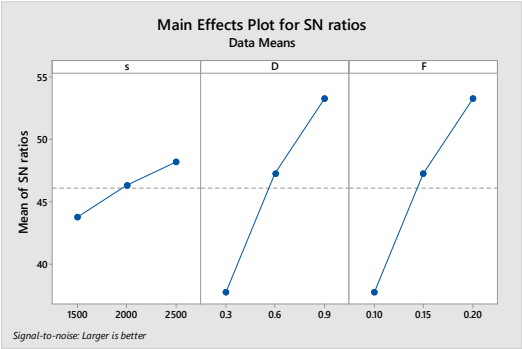

Fig - 1: Main Effect Plot for MRR

TABLE VI
RESPONSE TABLE FOR MACHINING TIME

Level	Speed	Depth of cut	Feed
1	-31.36	-32.23	-32.23
2	-28.86	-27.01	-27.01
3	-25.22	-26.21	-26.21
Delta	6.14	6.02	6.02
Rank	1	2.5	2.5

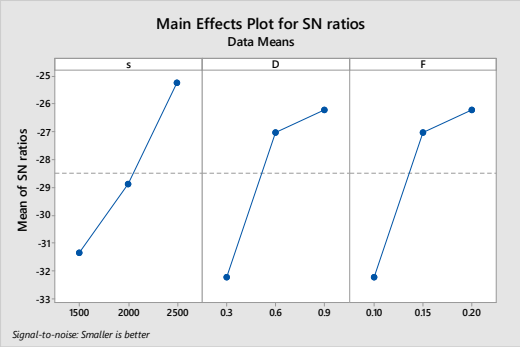

Figure - 2: Main Effect Plot for Machining Time

IV. CONCLUSIONS

The optimum conditions obtained from Taguchi method for optimizing Material Removal Rate during turning of Aluminium Alloy 7075 under dry condition are cutting speed of 2500 m/min, Feed rate of 0.20 mm/rev and depth of cut of 0.9mm. From response table for S/N ratio of MRR it is clear that cutting speed is the most significant factor influencing MRR followed by Feed rate and Depth of Cut is the least significant factor.

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