

International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: www.ijirset.com

Vol. 7, Issue 12, December 2018

Optimization of Milling Process Parameters Using Taguchi Parameter Design Approach

P.Vijendran¹, K. Sasank Kumar², T. Venkata Divakara³

M.Tech Scholar, Dept. of MEC, MITS (UGC Autonomous), Madanapalle, AP, India^{1,2,3}.

ABSTRACT: Manufacturing industries try to make high great products at decrease price to remain competitive within the market. The merchandise can be made the use of numerous production methods, including machining, etc. Milling is many of the most common machining processes used to make planar surfaces with faster material elimination and good floor first-rate. The vital objective of the technology of steel reducing is the solution of realistic issues associated with the green and particular removal of metal from work piece. It has been diagnosed that the dependable quantitative predictions of the numerous technological overall performance measures, preferably in the form of equations, are critical to broaden optimization techniques for deciding on slicing situations in procedure making plans. In this thesis experiments conducted to improve the floor end pleasant of aluminium alloy 6061 work piece by way of the use of carbide device, insert cutter, HSS and by using Taguchi's approach including L9 orthogonal array. A series of experiments can be accomplished by means of various the milling parameters spindle speed, feed price and depth of reduce. The spindle speeds are 900rpm, 1100rpm and 1200rpm. The feed charges are 120mm/min, 210mm/min and 250 mm/min. Depth of cut is zero 0.5mm and 1.0mm and 1.5mm. Taguchi 294 P.Vijendranmethod is used to observe the impact of process parameters and establish correlation some of the reducing speed, feed and depth of reduce with recognize to the primary machinability component, surface end. Validations of the modelled equations are proved to be well within the settlement with the experimental statistics.

KEYWORDS: Machining, milling, Taguchi approach, aluminium alloy6061, spindle speed.

I. INTRODUCTION

Milling system is one of the critical machining operations. In this operation the paintings piece is feed in opposition to a rotating cylindrical tool. The rotating device includes more than one slicing edges (multipoint slicing device). Normally axis of rotation of feed given to the work piece Milling operation is prominent from other machining operations on the premise of orientation between the device axis and the feed route; however, in other operations like drilling, milling, and so forth. The tool is fed inside the path parallel to axis of rotation. The reducing tool utilized in milling operation is known as milling cutter, which consists of more than one edge known as teeth. The system device that plays the milling operations by means of producing required relative motion between paintings piece and tool is referred to as milling machine. It provides the desired relative motion below much managed situations. These situations might be mentioned later in this unit as milling velocity; feed fee and intensity of reduce. Normally, the milling operation creates aircraft surfaces. Other geometries also can be created by way of milling system. Milling operation is considered an interrupted slicing operation enamel of milling cutter enter and go out the paintings all through every revolution. This interrupted cutting movement topics the tooth to a cycle of effect force and thermal surprise on each rotation. The tool fabric and cutter geometry ought to be designed to bear the above said situations. Depending upon the positioning of the device and paintings piece the milling operation may be categorized into different sorts.

International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: www.ijirset.com

Vol. 7, Issue 12, December 2018



Fig 1: Vertical Milling Machine

II. LITERATURE REVIEW

ANIL CHOUBEY optimized “Optimization of gadget parameters of CNC Milling device for moderate metal using Taguchi layout and Single to Noise ratio Analysis” [1]. Balinder Singh minimized “Optimization of Input Process Parameters in CNC Milling Machine of EN24 Steel” [2]. N. Gopkrishna and M. Shiva Chander determined the surface roughness in the paper “Determining the Influence of Cutting Fluid on Surface Roughness during Machining of EN24 and EN8 steel by using CNC Milling Machine”. [3]. G., Krishna studied and investigated “Selection of Optimum Process Parameters in High Speed CNC End-Milling of Composite Materials Using Meta Heuristic Techniques –a Comparative Study Pare”. [4]. B. Satish Kumar and N. Gopikrishna made an investigation in “optimization of turning process parameters, on EN 9 carbon steel using grey relational analysis”. [5]. G. Petropoulos, Ntziantzias, C. Anghel, made observations in “A predictive model of slicing forces in milling the usage of Taguchi & response floor strategies” [6]. C. Tsao, in his paper, “Grey–Taguchi technique to optimize the milling parameters of aluminum alloy”, studied parameters. [7].

III. METHODOLOGY

Taguchi Method

Taguchi Method is evolved via Dr. Genichi Taguchi, a Japanese first-class management representative. The method explores the idea of quadratic exceptional loss function and uses a statistical degree of overall performance referred to as Signal to Noise (S/N) ratio. The S/N ratio takes both the imply and the variability into account. The S/N ratio is the ratio of the imply (Signal) to the usual deviation (Noise). The ratio depends at the high-quality characteristics of the product/technique to be optimized. The general S/N ratios normally used are as follows: - Nominal is Best (NB), Lower the Better (LB) and Higher the Better (HB). In this assignment the experiments are designed with the assist of taguchi L9 orthogonal array. The software program used for DOE (Design of test) is Minitab18. The mission incorporates many procedures that are described one after the other within the methodology respectively.

International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: www.ijirset.com

Vol. 7, Issue 12, December 2018

Input parameters and their levels

Table 1: Process parameters.

PROCESS PARAMETERS	LEVEL 1	LEVEL 2	LEVEL 3
Cutting speed (rpm)	900	1100	1200
Feed rate (mm/rev)	120	210	250
Depth of cut (mm)	0.5	1.0	1.5

IV. EXPERIMENTAL INVESTIGATION

THE EXPERIMENTS ARE DONE ON THE CNC MILLING MACHINE WITH THE FOLLOWING PARAMETERS:

CUTTING TOOL MATERIAL –CEMENTED CARBIDE TOOL, HSS AND INSERT CUTTER

WORK PIECE MATERIAL – ALUMINIUM 6061

FEED – 120MM/MIN, 210MM/MIN, 250MM/MIN

CUTTING SPEED – 900RPM, 1100RPM, 1200RPM,

DEPTH OF CUT – 0.5MM, 1.0MM, 1.5MM

V. EXPERIMENTAL PHOTOS



Fig 2: CNC milling machining

International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: www.ijirset.com

Vol. 7, Issue 12, December 2018



Fig 3. Milling insert cutter



Fig 4. Carbide tool

The above two figures represent the information that the tools that are used for the experimentation which are inserted in a CNC collet, responsible for the milling operation in a CNC machine.

International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: www.ijirset.com

Vol. 7, Issue 12, December 2018



Fig 5. HSS tool

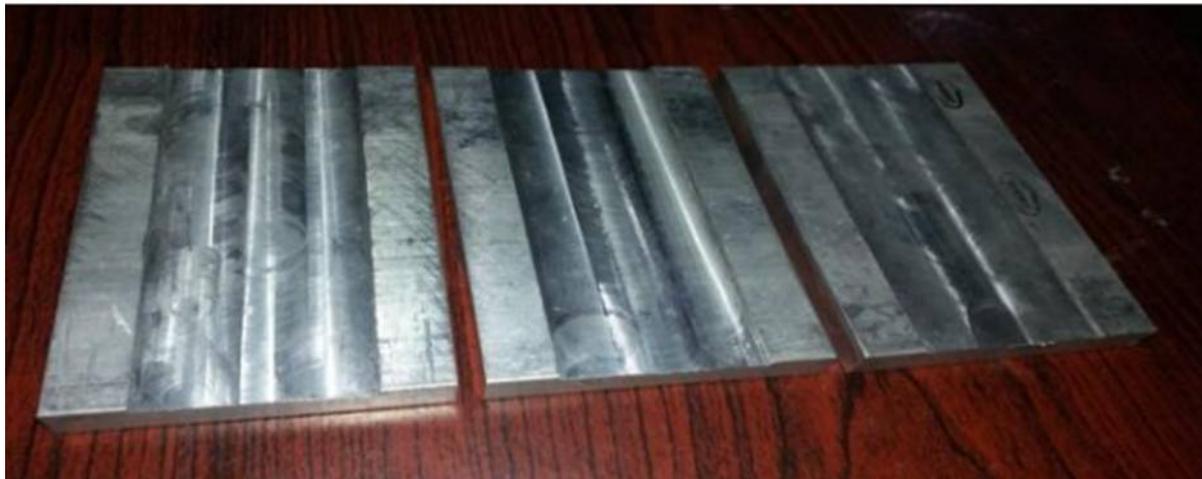


Fig 6. Work piece

VI. DESIGN OF EXPERIMENTS (DOE)

For selected input parameters experiments are designed using Taguchi L9 orthogonal standard array. For this purpose software Minitab 17 is used

Taguchi Design

Taguchi Orthogonal Array Design

L9 (3^3)

Factors: 3

Runs: 9

Columns of L9 (3^4) Array 1 2 3

International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: www.ijirset.com

Vol. 7, Issue 12, December 2018

JOB NO	SPINDLE SPEED(RPM)	FEED RATE(mm/min)	DEPTH OF CUT(mm)
1	900	120	0.5
2	900	210	1.0
3	900	250	1.5
4	1100	120	0.5
5	1100	210	1.0
6	1100	250	1.5
7	1200	120	0.5
8	1200	210	1.0
9	1200	250	1.5

Table 2: Experiment Process Parameters

VII. EXPERIMENTATION

After design of experiment, 9 experiments are carried out in CNC vertical Face milling. After each experiment surface roughness is calculated. A quality characteristic for surface roughness is “larger is the better”.

JOB NO	SPINDLE SPEED (rpm)	FEED RATE (mm/min)	DEPTH OF CUT(mm)	SURFACE FINISH(Ra)
1	900	120	0.5	0.514
2	900	210	1.0	0.623
3	900	250	1.5	0.691
4	1100	120	0.5	0.912
5	1100	210	1.0	1.114
6	1100	250	1.5	1.253
7	1200	120	0.5	1.632
8	1200	210	1.0	1.412
9	1200	250	1.5	1.351

Table 3: Surface Finish for cemented carbide tool

JOB NO	SPINDLE SPEED (rpm)	FEED RATE (mm/min)	DEPTH OF CUT(mm)	SURFACE FINISH(Ra)
1	900	120	0.5	0.415
2	900	210	1.0	0.594
3	900	250	1.5	0.612
4	1100	120	0.5	0.834
5	1100	210	1.0	1.015
6	1100	250	1.5	1.123
7	1200	120	0.5	1.215
8	1200	210	1.0	1.129
9	1200	250	1.5	1.127

Table 4: Surface Finish for insert cutter

International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: www.ijirset.com

Vol. 7, Issue 12, December 2018

JOB NO	SPINDLE SPEED (rpm)	FEED RATE (mm/min)	DEPTH OF CUT(mm)	SURFACE FINISH(Ra)
1	900	120	0.5	0.346
2	900	210	1.0	0.456
3	900	250	1.5	0.594
4	1100	120	0.5	0.731
5	1100	210	1.0	0.912
6	1100	250	1.5	1.005
7	1200	120	0.5	1.116
8	1200	210	1.0	1.015
9	1200	250	1.5	1.112

Table 5: Surface Finish for high speed steel

$$\text{VOLUME REMOVED /C.T} = L*W*T/C.T = E*T*FM$$

WHERE,

W= WIDTH OF CUT (MM),

T= DEPTH OF CUT (MM)

FM=FEED RATE (MM/MIN)

MRR(cm ³ /min)
1
2
3
1.33
2.67
3.33
1.67
3.3
5

Table 6: Evaluated Material removal rate

International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: www.ijirset.com

Vol. 7, Issue 12, December 2018

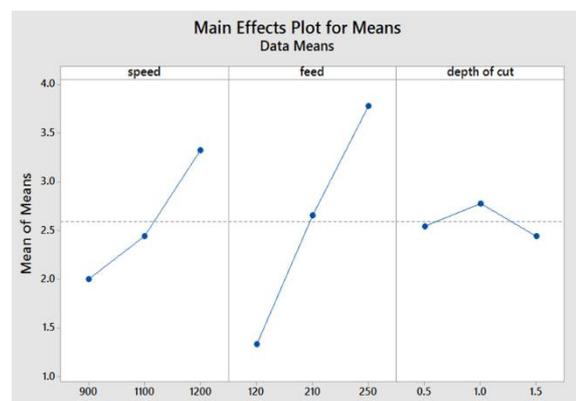
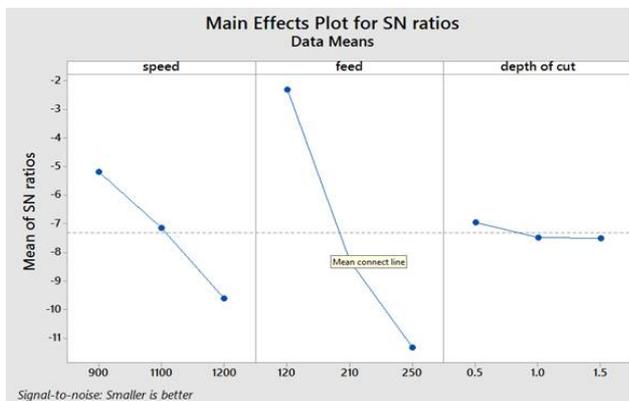
VIII. RESULTS & DISCUSSION

↓	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13
	speed	feed	depth of cut	SURFACE FINISH	MRR	SNRA1	MEAN1	SNRA2	MEAN2	SNRA3	MEAN3	SNRA4	MEAN4
1	900	120	0.5	0.514	1.00	5.78074	0.514	0.0000	1.00	0.0000	1.00	0.0000	1.00
2	900	210	1.0	0.623	2.00	4.11024	0.623	-6.0206	2.00	-6.0206	2.00	-6.0206	2.00
3	900	250	1.5	0.691	3.00	3.21044	0.691	-9.5424	3.00	-9.5424	3.00	-9.5424	3.00
4	1100	120	1.0	0.912	1.33	0.80010	0.912	-2.4770	1.33	-2.4770	1.33	-2.4770	1.33
5	1100	210	1.5	1.114	2.67	-0.93770	1.114	-8.5302	2.67	-8.5302	2.67	-8.5302	2.67
6	1100	250	0.5	1.253	3.33	-1.95902	1.253	-10.4489	3.33	-10.4489	3.33	-10.4489	3.33
7	1200	120	1.5	1.632	1.67	-4.25440	1.632	-4.4543	1.67	-4.4543	1.67	-4.4543	1.67
8	1200	210	0.5	1.412	3.30	-2.99669	1.412	-10.3703	3.30	-10.3703	3.30	-10.3703	3.30
9	1200	250	1.0	1.351	5.00	-2.61311	1.351	-13.9794	5.00	-13.9794	5.00	-13.9794	5.00
10													

TABLE 7: RESULTS TABLE OF SURFACE FINISH FOR CARBIDE

Taguchi Analysis: SURFACE FINISH versus speed, feed, depth of Response Table for Signal to Noise Ratios
Smaller is better Response Table for Means

LEVEL	SPEED	FEED	DEPTH OF CUT	LEVEL	SPEED	FEED	DEPTH OF CUT
1	4.36714	0.77548	0.27501	1	0.6093	1.0193	1.0597
2	-0.69887	0.05861	0.76575	2	1.0930	1.0497	0.9620
3	-3.28807	-0.45390	-0.66056	3	1.4650	1.0983	1.1457
DELTA	7.65521	1.22938	1.42630	DELTA	0.8557	0.0790	0.1837
RANK	1	3	2	RANK	1	3	2



To get better surface finish, the optimal parameters are spindle speed –1200rpm, feed Rate – 250mm/min and depth of cut – 1.5mm.

International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: www.ijirset.com

Vol. 7, Issue 12, December 2018

IX. CONCLUSION

In this thesis an attempt to utilize Taguchi optimization approach to optimize slicing parameters during excessive pace milling of aluminum alloy using cemented carbide reducing device. The slicing parameters are cutting velocity, feed charge and intensity of reduce for milling of labor piece aluminum alloy6061. In this paintings, the most efficient parameters of reducing pace are 900 rpm, 1100rIXpm and 1200rpm, feed charge are 120mm/min, 210mm/min and 250mm/min and intensity of cut are 0.5mm, 1.0mm and 1.5 mm. Experimental paintings is carried out by way of thinking about the above parameters. Cutting forces, surface end and slicing temperatures are established experimentally. Milling experiments could be performed to enhance the surface finish pleasant of aluminum alloy paintings piece through the usage of carbide ,insert cutter, HSS and with the aid of the usage of Taguchi's method which include L9 orthogonal array. By observing the experimental effects via taguchi, the following conclusions was made: After completing the project it can be observed that optimal value of surface finish is obtained at third level of Spindle Speed and it was 1200rpm, third level of Feed Rate and it was 250mm/min and third level of Depth of Cut and it was 1.5mm. After completing the project it can be observed that optimal value of material removal is obtained at third level of Spindle Speed and it was 1200rpm, second level of Feed Rate and it was 210mm/min and second level of Depth of Cut and it was 1.0mm.

REFERENCES

1. M. Thakur and B. Singh, "Simulink Modal of Triple-Junction Solar Cell and MPPT Based on Incremental Conductance Algorithm for PV System," vol. 5, no. 9, pp. 92-95, 2015.
2. V. K. P. K, C. A. Asha, and M. K. Sreenivasan, "design , simulation and hardware implementation of efficient solar power converter with high mpp tracking accuracy for dc microgrid applications," pp. 380-387, 2014.
3. K. Supreeth, K. S. Sundar, and D. Balamurugan, "Performance Evaluation & Simulation of Solar Power System," vol. 2, no. 7, 2014.
4. J. Park, H. Kim, Y. Cho, and C. Shin, "Simple Modeling and Simulation of Photovoltaic Panels Using Matlab / Simulink Modeling of Photovoltaic Module," vol. 73, no. Fgcn, pp. 147-155, 2014.
5. Shukla, M. Khare, and K. N. Shukla, "Modeling and Simulation of Solar PV Module on MATLAB / Simulink," pp. 18516-18527, 2015.
6. E. G. S, P. S. Dhivya, and T. Sivaprakasam, "Solar Powered High Efficient Dual Buck Converter for Battery Charging," pp. 448-452, 2013.
7. J. Patel and G. Sharma, "modeling and simulation of solar photovoltaic module using matlab / simulink," pp. 225-228, 2013.
8. S. S. Mohammed-, "Modeling and Simulation of Photovoltaic module using MATLAB / Simulink," vol. 2, no. 5, 2011.
9. Nalbant, M., Gökkaya, H., Sur, G. "Application of Taguchi method in the optimization of cutting parameters for surface roughness in turning." Materials & Design. 28(4), pp. 1379-1385. 2007. DOI: 10.1016/j.matdes.2006.01.008.
10. Verma, N. K., Sikarwar, A. S. "Optimizing Turning Process by Taguchi Method under Various Machining Parameters." International Research Journal of Engineering and Technology. 2(6), pp. 307-312. 2015.
11. Hascahk, A., Çaydas, U. "Optimization of turning parameters for surfaceroughness and tool life based on the Taguchi method." International Journal of Advanced Manufacturing Technology. 38(9), pp. 896-903. 2008. DOI: 10.1007/s00170-007-1147-0
12. Kivak, T. "Optimization of surface roughness and flank wear using the Taguchi method in milling of Hadfield steel with PVD and CVD coated inserts." Measurement. 50, pp. 19-28. 2014. DOI: 10.1016/j.measurement.2013.12.017
13. Zhang, J. Z., Chen, J. C., Kirby, E. D. "Surface roughness optimization in an end-milling operation using the Taguchi design method." Journal of Materials Processing Technology. 184(1-3), pp. 233-239. 2007.
14. Gologlu, C., Sakarya, N. "The effects of cutter path strategies on surfaceroughness of pocket milling of 1.2738 steel based on Taguchi method." Journal of Materials Processing Technology. 206(1-3), pp. 7-15. 2008. DOI: 10.1016/j.jmatprotec.2006.11.029.