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Economizing of Material Shredding Allowance of Mild Steel Specimen by Employing Taguchi Method

[1]Mr.Deepanshu Prasad, [2]Akshay Agrawal
[1,2]Mech Dept. CSVTU, Chhattisgarh, India.
[1]*prasaddeepanshu1994@gmail.com*

Abstract -The Taguchi method provides an optimal solution of an optimization problem, which can be executed in the actual metal shredding process. Quality and productivity play a vital role in every manufacturing market. Through a customer's perception, quality is primal because the grade of quality determines the satisfaction of the customers. Apart from quality, productivity is another point of concern which is directly linked to the profit margin of an industry and also to its growth. Every manufacturing giant aims at producing the larger number of units within a short tenure. Productivity can be enhanced by having a profound savvy of all the optimization methods for machining, various traditional optimization techniques like fuzzy logic, genetic algorithm, Taguchi technique, scatter search technique, geometric programming, artificial neural networks etc. have been successfully applied in the past for optimizing the various cutting process variables. In this research, we would economize the turning parameters by the Taguchi method. Here we are choosing material removal rate as output characteristic and spindle velocity, feed and depth of cut as input control parameters. And practicing three stages of individual input governing parameters. For the introductory work, we are choosing the Conventional Center lathe machine. After obtaining the optimum parameter, we have built the ANOVA table which depicts the percentage contribution of the input parameter to amend the material removal rate.

***Keywords* — optimization, performance, the steep increase in preliminary research, ANOVA, depth of cut, workability.**

I. INTRODUCTION

To produce more and more in today's era is a big challenge because more and more production decreases the value of the item and meets market requirements in a fair price. The lathe machine is a very useful machine that works to make machine components. Lathe machine is also known by name mother of machine tools. Lathe machine is also known by name mother of all machine tools. Material Removal Rate is a very noticeable output characteristic that by controlling we can achieve good production. The rate of substance removal per minute is called the Material Removal Rate and its unit is mm / minute. Our task is to enhance the material shredding rate and for this task, we will employ the Taguchi method. This method helps us to find optimum constraints.

II. LITERATURE SURVEY

The Taguchi method of experimental design is one of the conventional strategies for yielding high quality product at economic cost. Taguchi technique and response surface methodology is the trending optimization methods that are being employed prolifically industrial applications for optimal selection of methods in the area of machining. In the recent optimization, technique Taguchi methods are latest design method broadly used in industries for making the product or conducting process regardless of inevitable factors such as environmental variables. It is also important to understand the characteristic features and selection ethics prior to application and the general conditions including constraints under which each designing techniques are applicable before optimization techniques are carried out.

It is an efficient and productive method of designing experiments and a quick way of identifying the parameters which influences the procedure. It is a revised method in design and analysis compared to traditional design and is popularly used in making quality improvements via developing Orthogonal Array (OA) and simplifying the Analysis of Variance (ANOVA). This approach was used to determine the feasible combination of design parameters which decreases vagaries in product outputs. Taguchi has developed a methodology for the application of factorial designed experiments. His contributions have also made the practitioner's work manageable through advocating the use of several experimental designs and affording a clear understanding of the complexion of variation and the economic outcomes of quality engineering in the world of manufacturing.

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The Taguchi method is broadly used to determine an optimum perspective of manufacturing process conditions. It is a pivotal statistical tools of (TQM) for planning high-quality systems at a provident cost. The chief impetus of the Taguchi method is the practice of design parameter, which is an engineering method for the product or process design. The objective of parameter design is to economize the settings of the procedure parameter for improving the performance characteristics and to distinguish the product. In addition, it is anticipated that the optimal process parameter data is calculated from the parameter design are insensitive to the modification of the environment.

Conditions and noise determinants. Therefore, the parameter design is a guideline for Taguchi method to achieve desirable quality without raising the cost (Taguchi et al 1989). Generally, standard dimensions, developed by Fisher (1925), is complex and not easy to use. Especially, a larger quantity of experiments has to be carried out when the quantity of process parameters increases. In contradiction, the Taguchi method uses a special design of orthogonal arrays to analyze the entire parameter range with a small fraction of experiments only.

III. OBJECTIVE

For larger the better properties, Taguchi method has been applied for a parameter design to inserts the following steps (NIAN ETAL, 1999)

1. Select the proper output quality mark to be optimized.
2. Select the control factors and their levels, identify their Viable interactions.
3. Select noise factors and their levels.
4. Select sufficient inner and outer arrays. Control factors assigned to an inner array and noise factors to the outer array.
5. Carry out the experiment.
6. Execute statistical analysis based on S/ N ratio.
7. Predict optimal output performance level based on optimal control factor level combination, and conduct a confirmation experiment to verify the result equipment

IV. TAGUCHI METHOD

The Taguchi technique is a very beneficial method for managing the quality. The Taguchi method provides an easy, effective and systematic approach to designing the design and optimization of cost enforcement in an experimental way. The foremost purpose of the Taguchi method is to reduce the variation in the process through a strong design of the experiment. Its broad form was presented by Dr Genichi Taguchi of Japan. A method was designed to design experiments by Dr Genichi Taguchi in which the performance of the process is stamped. In the Taguchi method, the use of orthogonal arrays by Dr Taguchi is used to organize the parameters and their different levels influencing the result in experimental work. By practicing it we can save resources and time.

Experimental and cutting parameters: Experiment set up is shown in figure.1. For the experimental work, we are using mild steel as an element of the work division and using High-Speed Steel as a substitute for cutting tools. We have done the whole experimental work on Conventional Type Center lathe machine. We are using three cutting parameters which have spindle speed, feed and depth of cut and with this, three stages of each parameter have been practiced. The cutting parameters with their stages are displayed in table 1 with their stages and chemical composition of an workpiece are displayed in table 2.

Serial no	Parameters	Level-1	Level-2	Level-3
1	Spindle speed(rpm)	400	600	800
2	Feed	0.05	0.1	0.15
3	Depth of cut(mm)	0.5	1.0	1.5

Table 1: CUTTING PARAMETERS

Component	C	Si	MN	S	P
MILD STEEL	0.16-0.25	Max 0.4	0.7-0.9	MAX 0.04	MAX 0.04

TABLE 2: CHEMICAL CONSTITUENT OF MILD STEEL

Figure-1 EXECUTION OF EXPERIMENT

To determine the material removal rate, we have used a formula that is written below

Material removal rate = $\frac{\frac{\pi}{4}(D^2-d^2)\times 1}{N}$ (mm /minute)

Where,

D = Diameter of workpiece before machining.

d = Diameter of workpiece before machining.

l = Length of workpiece.

N = Time taken for turning of l length of workpiece.

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From equation 1 it is clear that we are using the volume reduction system. We have chosen the L9 orthogonal array for the experiment.

***Procedure of Turning**:* The process of eliminating metal from the surface of the workpiece in the form of chips by turning the work cut into a particular axis by cutting it on a particular axis is called turning. After turning, the work segment can be found in cylindrical, conical forms according to our specification. If we have a parallel cut of the rotating axis of the work segment by cutting tools, then in this process we get cylindrical surface and this process is known simple turning. And if we cut the angle at the angle of the working axis by the cutting tool, then we get the conical surface and this method is called taper turning. Our three cutting parameters are spindle speed, feed and depth of cut which influence the material removal rate. The number of revolutions placed in a minute by a spindle of the headstock of the lathe machine is called spindle speed and it is denoted by RPM. The interval covered by a tool in one revolution of a spindle is called feed and its unit is mm/revolution. The amount of tool that is inserted into the work segment to remove the material is called the depth of cut. For the compound of cutting parameters in the experiment, we are taking the L9 orthogonal array, which is shown in table 3. For the operation, we have selected Mild Steel Bar of 50 mm diameter and 102 mm length, which we will later make 48 mm diameter and 100 mm length by machining. So that it comes in the finished shape and the black surface and the rolling defect get out and after this, we will start the operation according to the L9 orthogonal array. The material removal rate received after use on each orthogonal array is shown in Table 3.

Serial no	Spindle speed (A)	Feed (B)	Depth of cut (C)	Material removed rate
1	1	1	1	742.4
2	1	2	2	2918
3	1	3	3	6521.6
4	2	1	2	4394.5
5	2	2	3	12739.88
6	3	1	1	6603
7	1	3	3	8661.1
8	2	1	1	5829.1
9	3	2	2	17169.1

TABLE 3- CALCULATIONS

V. RESULT ANALYSIS

Optimum Parameter: From Fig.2, it is obvious that optimum parameter is that indicates spindle speed of 800 rpm, the feed of 0.15 mm/rev., and 1.5 mm depth of cut will generate the best results. Figure 2 shows the optimization of the material removal rate and Fig. 3 shows the optimization of the median of a signal to noise ratios of material removal rate. That is the same thing as the Figure- 2.

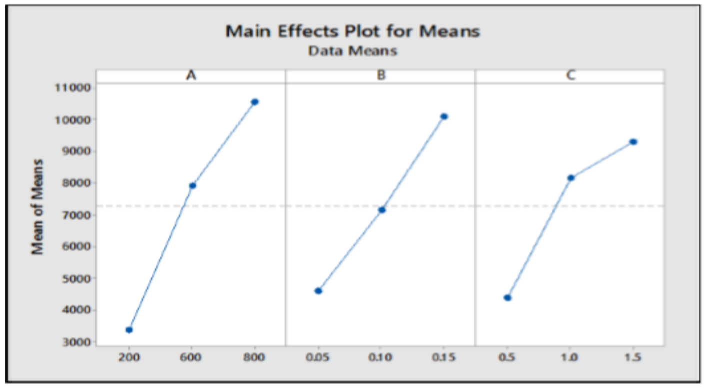

FIGURE 2- Variation of Mean of Material Removal Rate

Analysis of Variance (ANOVA): ANOVA table shows us the percentage offering to all the parameters. ANOVA table is shown in the table No. 3. It is clear from ANOVA table that spindle speed is the most primal parameter for high material removal rate, which contributes 38.79%. After that feed is on the second number which gives 22.4%. And finally, the least considerable parameter is a depth of cut, which is 19.88%.

FIGURE3- VARIATION OF MEAN OF S/N RATIOS OF MATERIAL REMOVAL RATE

Stage	DS	SEQ- SS	Percentage	ADJ- MS	F-rate
A	2	78642178	38.78	39321088	2.02
B	2	45420764	22.40	22710385	1.16
C	2	39688526	19.58	19844265	1.02
Error	2	38992165	19.23	19496086	
Total	8	124887876	100		

Table No. 3: ANALYSIS OF VARIANCE

VI. CONCLUSION

In the process of determining optimal parameters by the Taguchi method, we received the combination of levels, will get more Material Removal rate. The most important

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parameter spindle speed gives 38.79% and then the feed gives 22.40%, the depth of cut is the lowest significant parameter with 19.58%. The percentage of error is 19.23, which implies that there is a necessity to control the noise factor. A systematic method of cutting conditions has shown an interesting potential in both product and process quality improvement of metal cutting operation. The generic setup for process parameter optimization in metal cutting operation intends to provide a single, unified, and systematic approach to determine optimal conditions in various kinds of metal cutting process optimization issues, It consolidates the use of one or more than one of the modeling and optimization techniques, making the setup a unified and efficient means. Moreover, it facilitates the user with flexibility to adopt appropriate techniques based on their potential.

REFERENCES

[1] Sujit Kumar Jha. "Parametric Optimization of Turning Process using Taguchi Method and ANOVA". International Journal of Advances in Engineering & Technology, Volume 9, Issue 3, 2016, pp. 289-301.

[2] 1 D. S. Holmes, A. E. Mergen, Signal to noise ratio – What is the right size, www.qualitymag.com/.../Manuscript%20Holmes%20&%20 Mergen.pdf, USA, 1996, 1–6 M. Mete, X. Xu, Chun-Yang F., Gal Shafirstein, "Head and Neck Cancer Detection in Histopathological Slide, International Workshop on Data Mining in Bioinformatics", Sixth IEEE International Conference of Data Mining (ICDM 2006), December 18-22, 2006, Hong Kong.

[3] C Zhou, R A. Wysk, An integrated system for selecting optimum cutting speeds and tool replacement times, Int. J. Mach. Tools Manuf. 32 (1992) 5, 695–707.

[4] Grzesik W. and Brol S., Hybrid approach to surface roughness evaluation in multistage machining processes, Journal of Materials Processing Technology, 134, 265– 272 (2003).

[5] Hinduja S., Petty D.J., Tester M. and Barrow G., Calculation of optimum cutting conditions for turning operations, Proc. Inst. Mech. Eng., 31, 81–92 (1985).

[6] Sundaram R.M., An application of goal programming technique in metal cutting, Int. J. Prod. Res., 6, 76-81 (2003).

[7] Taylor F.W., The art of cutting metals, Trans. ASME, 28, 31–35 (1907).

[8] Chen M.C. and Tsai D.M., A simulated annealing approach for optimization of multi-pass turning operations, International Journal of Production Research, 34(10), 2803–2825 (1996).

[9] Taguchi G., parameter design: A panel discussion, In V. N. Nair, (Ed.). Technometrics, 34, 127–161 (1973).

[10] Hashmi K., El Baradie M.A. and Ryan M., Fuzzy logic based intelligent selection of machining parameter, Computers and Industrial Engineering, 35(3–4), 571–574 (1998).

 DOI : 10.18231/2454-9150.2018.0079