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# Parameter Optimization of Turning Process (Cast Iron) Using Taguchi Method

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***Abstract* -This paper focuses on the optimisation of turning parameters using Taguchi technique to obtain minimum cycle time & surface finish. A number of turning experiments were conducted using the L9 orthogonal array on a CNC machine. The experiments were performed on cast iron by using coated carbide insert. Minitab is employed to determined most significant control factor affecting cycle time & surface finish. The cutting speed ,Feed ,Depth of cut were selected as control factors . After the nine experimental trials, It is found that cutting speed is the most significant factor on the Cycle time. Result of the Validation test shows that Taguchi method was notably successful**

***Keyword*- Optimization, Turning process parameters ,Taguchi method, orthogonal array, MINITAB-17.**

## INTRODUCTION

There is a need for optimizing the process parameter both from technological and economic point of view. optimization of process parameter helps to finding out the correct adjustment of parameter which improve the quality and quantity of the product .This must be done in timely manner to avoid production delay and effectively

Design of experiments and procedure-

Design of experiments and procedure as follows:

Techniques of experimentation- There are different types of experimentation. The most widely used strategies for experimental analysis.

**1.** By guess approach-

In this approach an artificial combination of factors are selected and then tested end its effect on output response is observed. If guessing doesn't produce a desired result the research take another guess for correct combination of factor level. Thus may continue for long period of time without any proper prediction of the combination. It guess is found to be correct at correct at the initial level then it is well and good but still it may not be the best combination

**2.** Pilot experiment-

Pilot experiment is same as guess approach but the difference is that whatever combination is predicted is tested on the actual machine and result are observed if the result are satisfied then the combination may be valid. Mostly pilot experiment depends upon the type of machine capacity and other important factors.

to avoid defect. Therefore in the situation, it is important for the engineering or technician to use past experience to select parameters which willlikely yield a surface finish below that of a specified level and perhaps make some parameter adjustment as a time allows or quality control require.

Engineers and technicians establishing such and operation would ideally consider other implications of setup parameters such as production schedules, processing time and noise factors. A more methodical, or experimental approach to setting parameters should be used to ensure that the operation meets the desired level of quality with given noise condition and without sacrificing production time. As we are dealing with the cycle time and surface finish, low speed affect the cycle time and higher depth of cut damage the surface.

In order to optimize such an operation with such restrictions, a more efficient experiment method is needed An excellent solution to this issue is an approach known as Taguchi Parameter Design.

Taguchi based design of experiment-

Among the various method available, Taguchi method is one of the most powerful and best method in short simple but smart method for analysis. It is widely used in many fields. In application and development of new process and product in quality control.

The salient feature of method are:

(a) A simple, smart and efficient method optimise process to improve the performance and productivity or reducer cost.
(b) It gives best parameters for the optimal condition with least number of analytical invention.
(c) Therefore Taguchi method has great potential in area of low cost experiments.

Thus it become an attractive and widely accepted tool to engineering and scientist.

Taguchi defines there quality characteristics in terms of signal to noise ratio (S/N ) which can be formulated for different categories which are as follows

A) Small and Nominal are best characteristics:-
As we are dealing with cycle time and surface finish the data sequence must be smaller the better. Which are processed as per equation as
S/N= -10log (y/s2y) …… (1)

- Taguchi methodology-

It consist of following step:

1. Identification of objective function to be optimize
2. Identification of signal to noise factor
3. Selection of control factor and level
4. Selection of orthogonal array
5. Conduct matrix experiment
6. Analysis of the data and prediction of optimum level
7. Validation of experiment for cycle time and surface finish.

**1.** Identification of objective function to be optimize-

"Low or less production due to non-optimize parameter."

**2.** Identification of signal to noise factor-

The environment in which experiment are performed is the main external source of variation of performance of turning process. Some examples of the environment noise factor are "Temperature, vibration and human error" in operating the process.

**3.** Selection of control factor and level-

The process parameter affection the characterises of turning part are cutting speed, feed, depth of cut. Which largely affect the turning process.

- Selection of cutting speed-

Most of researches have reported improvement in surface finish and cycle time with an increase in cutting speed. Also increasing level of cutting speed which allows the better understanding of wear patterns.

- Selection of cutting feed-

S/N= -10log (1/n)(∑y2) …… (2)

B) Larger is best characteristics :-
This type of data sequence is used for the MRR i.e. Material removal rate. Which can be processed by equation (3)

S/N= -10 log (1/n)(∑(1/y2)) ……(3)

Where Y =value of response variable n is no of observation in experiments.

An increase in feed rate increase the amount of cracks, pits on machined surface due to the reinforcement pull-out and fracture, which then deteriorates surface quality and introduces higher thermal stresses on the machined surface. Also effect on the change in tool geometry.

- Selection of depth of cut-

It is known that depth of cut influence the chip load by change in chip cross –sectional area and hence the cutting forces, which in turn could influence the stability of the machining process and machined surface characteristics. The surface roughness deteriorates with an increase in depth of cut, which is attributed to the formation of unstable BUE at lower feed and higher depth of cut.

Consider the literature review and the available machine setting following process parameters were selected for the present work.
1. Cutting speed
2. Feed
3. Depth of cut
And the three levels are low, intermediate and high.

**4.** Selection of orthogonal array-

In Taguchi method-based design of experiments, to select an appropriate orthogonal array for experimentation, The total DOF need to be computed. The DOF is defined as number of comparisons between machining parameters that need to be made to determine, which level is better and especially how much better it is. For ex. In three level and three machining parameters according to Taguchi method L9 array most feasible array for experiment.

Fig.1; photograph of experimental setup


Fig.2; photograph of measuring surface finish

**5.** Conduct matrix experiment-

| No. of Trail | Control Parameters | | | Observed Value | |
|---|---|---|---|---|---|
| | Speed (rpm) | Feed (mm/rev) | Depth of cut (mm) | Cycle Time (sec) | Surface finish (µm) |
| 1 | 200 | 0.10 | 1.5 | 2.25 | 6.46 |
| 2 | 200 | 0.17 | 1.0 | 2.22 | 4.47 |
| 3 | 200 | 0.25 | 0.5 | 2.18 | 4.37 |
| 4 | 220 | 0.10 | 1.0 | 2.15 | 4.05 |
| 5 | 220 | 0.17 | 0.5 | 2.10 | 4.31 |
| 6 | 220 | 0.25 | 1.5 | 2.12 | 4.57 |
| 7 | 240 | 0.10 | 0.5 | 2.02 | 3.47 |
| 8 | 240 | 0.17 | 1.5 | 2.05 | 3.95 |
| 9 | 240 | 0.25 | 1.0 | 2.04 | 3.85 |

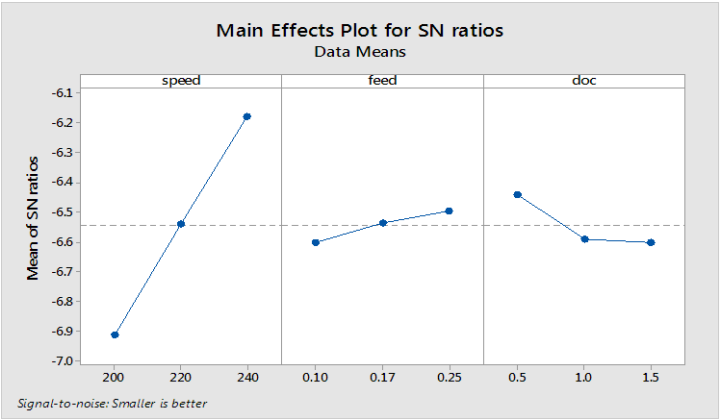


Table No. 1

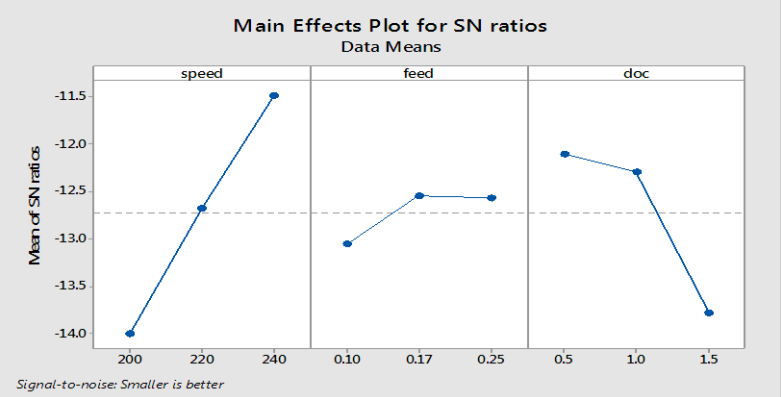
**6.**

**7.** Analysis of the data and prediction of optimum level-

**8.**




Graph for cycle time (a)




Graph for surface finish (b)

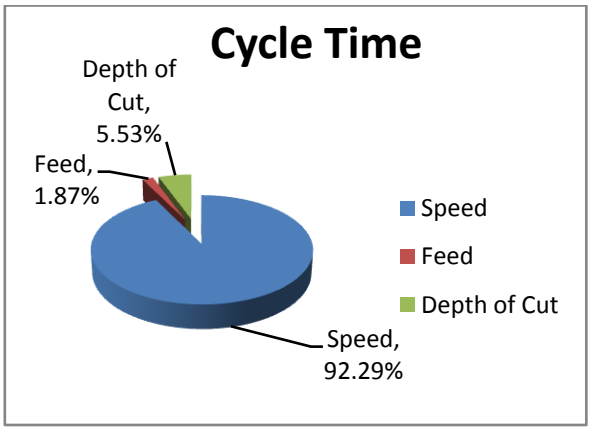
**9.** Validationof experiment for cycle time and surface finish-

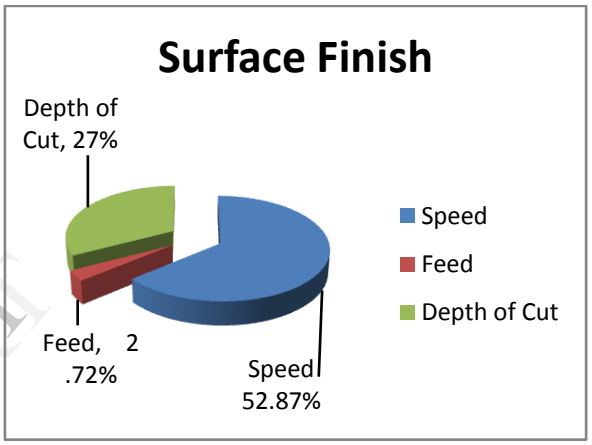
The experiment are conducted according to table no.1 from graph and S/N ratio. It is seen that optimization values are speed (240), feed (0.17) and depth of cut (0.5) and above result are cross verified by conducting the same experiment and it found the same result.

CONCLUSION-

This paper has discussed the Taguchi method for finding out the specific ranges and combination of turning parameters like cutting speed (240), feed (0.17) and depth of cut (0.5) to achieve optimal values of response variable like cycle time (2.02) and surface finish (3.47). Also we can conclude that cutting speed have major influence on cycle time as well as surface finish but as depth of cut increases cycle time and surface finish increases.

Percentage of contribution for cycle time & surface finish as shown in pie charts




Pie charts

Taguchi method is powerful tool, which can offer simultaneous improvements in quality and cost.

## REFERENCES-:

1. ( Yogendra Tyagi, Vedansh Chaturvedi, Jyoti Vimal, ) '' Parametric Optimization of drilling machining process using Taguchi design and ANOVA Approch.'' International Journal of emerging technology and advance engineering ( ISSN 2250-2459, Volume 2, issue 7th juley 2012.
2.S. Dolinsek, J. Kopac, "Mechanism and types of tool wear particularities in advanced cutting materials", Journal of Achievements in Materials and Manufacturing Engineering, November 2006, Volume 19 Issue 1.
3.Hari Singh, "Optimizing Tool Life of Carbide Inserts for Turned Parts using Taguchi's Design of Experiments Approach", Proceedings of the International Multi Conference of Engineers and Computer Scientists 2008 Volll, 19-21 March, 2008.
4.BalaMuruganGopalsamy, BiswanathMondal and SukamalGhosh, "Taguchi method and ANOVA: approach for process parameters optimization of hard machining while machining hardened steel".Journal of Scientific and Industrial Research,Vol.^8,August 2009,pp.686-695.
5.Kassab S.Y.andKhoshnaw Y.K., "The Effect of Cutting Tool Vibration on Surface Roughness of Work piece in Dry Turning Operation", Engineering and Technology, 2007, Volume 25, Number 7, pp. 879-889.
6. ( Ji -Min Wang, Hong- Jie Yan, Shi-Xuan Li,Guang Chen gui,2011) '' Optimization of parameter of a aluminum melting furnace using the Taguchi approach ''
7.(Arun Kumar Parida, Tapas Kumar Moharana,2012) "Optimization of machining parameters in turning using Design of Experiments (DOE) and Analysis of Variance (ANOVA)". Int. J. Adc. Res. Sci. Technol. Volume 1 , Issue 1, Oct-2012, pp 30-34

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