# Process Improvisation In Cylindrical Grinding Process

Saurav .I. Dhake[1], Pranay Joshi[2], Manish.A. Deore[3], Shrihari.R Upasani[4]

[1] *Saurav .I. Dhake ,Lect., Mech. Engineering, GGSP, Maharashtra, India*
[2] *Pranay Joshi,Lect., Mech. Engineering, GGSP, Maharashtra, India*
[3] *Manish.A.Deore, Lect., Mech. Engineering, GGSP, Maharashtra, India*
[4] *Shrihari.R.Upasani, Principal, GGSP, Maharashtra, India*

## ABSTRACT

*The manufacturing process of surface grinding has been established in the mass production of slim, rotationally symmetrical components. Due to the complex set-up, which results from the large sensitivity of this grinding process to a multiplicity of geometrical, kinematical and dynamical influence parameters, surface grinding is rarely applied within limited-lot production. The substantial characteristics of this grinding process are the simultaneous guidance and machining of the work piece on its periphery. Surface grinding is an essential process for final machining of components requiring smooth surfaces and precise tolerances. As compared with other machining processes, grinding is costly operation that should be utilized under optimal conditions. Although widely used in industry, grinding remains perhaps the least understood of all machining processes. The proposed work takes the following input processes parameters namely Work speed, feed rate and depth of cut. The main objective of this work is to predict the grinding behavior and achieve optimal operating processes parameters. a software package may be utilized which integrates these various models to simulate what happens during surface grinding processes. predictions from this simulation will be further analyzed by calibration with actual data. It involves several variables such as depth of cut, work speed, feed rate, chemical composition of work piece, etc. The main objective in any machining process is to maximize the Metal Removal Rate (MRR) and to minimize the surface roughness (Ra). In order to optimize these values Taguchi method, ANOVA and regression analysis is used.*

**Keyword :** *Surface Grinding,Optimazation Process,Taguchi Method,ANOVA,feed,speed,depth of cut,surface roughness.*

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## 1. INTRODUCTION

Grinding is a material removal and surface generation process used to shape and finish components made of metals and other materials. The precision and surface finish obtained through grinding can be up to ten times better than with either turning or milling. Grinding employs an abrasive product, usually a rotating wheel brought into controlled contact with a work surface. The grinding wheel is composed of abrasive grains held together in a binder. These abrasive grains act as cutting tools, removing tiny chips of material from the work. As these abrasive grains wear and become dull, the added resistance leads to fracture of the grains or weakening of their bond. The dull pieces break away, revealing sharp new grains that continue cutting. The requirements for efficient grinding include:

Process parameters: work speed, depth of cut, feed rate, dressing condition, etc., (iv) machine parameters: static and dynamic Characteristics, spindle system, and table system, etc. The proposed work takes the following input processes parameters namely Work speed, feed rate and depth of cut.

Alloy 304 is commonly used to rigid flanges; this application requires precise surface roughness because of use in chemical handling pipelines or equipments. Due to this reason surface grinding for this application requires to be optimum. Hence for this work this application is under consideration.

A software package may be utilized which integrates these various models to simulate what

### 1.1 PROJECT DEFINATION

Application selected for work i.e. rigid flange used in chemical handling pipelines or equipments, requires surface roughness value generally between 0.5 to 1.8 µm This work is started with the aim to optimize surface roughness value for process parameters i.e. wheel speed, feed (table speed), and depth of cut. Optimum value of surface roughness is also depending on material removal rate (MRR), but practically MRR and surface roughness value are opposite parameters or they are inversely proportional to each other. So work is defined to optimize surface roughness value by considering above mentioned parameters.

### 1.2 OBJECTIVE

The main objective of this work is to predict the grinding behavior and achieve optimal operating processes parameters.

## 2. METHADOLOGY

The goal of experimental work is to investigate the effect of grinding parameters with the process parameters of cutting speed, feed rate and Depth of cut influencing the metal removal rate of AISI 304 Austenite stainless steel

### 2.1 TAGUCHI METHOD

The Taguchi method involves reducing the variation in a process through robust design of experiments. The overall objective of the method is to produce high quality product at low cost to the manufacturer. the experimental design proposed by Taguchi involves using orthogonal arrays to organize the parameters affecting the process and the levels at which they should be varies. Instead of having to test all possible combinations like the factorial design, the Taguchi method tests pairs of combinations. this allows for the collection of the necessary data to determine which factors most affect product quality with a minimum amount of experimentation, thus saving time and resources. The Taguchi method is best used when there are an intermediate number of variables (3 to 50), few interactions between variables, and when only a few variables contribute significantly .

The data from the arrays can be analyzed by plotting the data and performing a visual analysis, ANOVA.the data from the arrays can be analyzed by plotting the data and performing a visual analysis, ANOVA.the data from the arrays can be analyzed by plotting the data and performing a visual analysis, ANOVA.the S/N ratio for each level of process parameters is computed based on the S/N analysis. Regardless of the category of the quality characteristic, a larger S/N ratio corresponds to a better quality characteristic. Therefore, the optimal level of the process parameters is the level with the highest S/N ratio. Furthermore, a statistical analysis of variance (ANOVA) is performed to see which process parameters are statistically significant. The optimal combination of the process parameters can then be predicted. Finally, a confirmation experiment is conducted to verify the optimal process parameters obtained from the process parameter design.

### 2.2 ORTHOGONAL ARRAY

Total Parameters-3

1) Rotational speed- e.g. A, B, C

2)Feed (Table speed) - e.g. P, Q, R

3)Depth of cut- e.g. L, M, N

| Ex.No. | Rotational Speed | Feed | Depth of Cut |
|---|---|---|---|
| 1 | A | P | L |
| 2 | A | Q | M |
| 3 | A | R | N |
| 4 | B | P | L |
| 5 | B | Q | M |
| 6 | B | R | N |
| 7 | C | P | L |
| 8 | C | Q | M |
| 9 | C | R | N |

**Table -1:** Orthogonal Array

### 2.2 PROCESS PARAMETER RANGES

| Sr. No. | Process Parameter | Range | Level 1 | Level 2 | Level 3 |
|---|---|---|---|---|---|
| 1 | Rotational Speed | 400-1100 rpm | 400 | 750 | 1100 |
| 2 | Feed | 3-15 m/min | 3 | 9 | 5 |
| 3 | Depth of cut | 3-18 µm | 3 | 10.5 | 18 |

**Table -2:** Process parameter ranges.

### 2.2 TAGUCHI ORTHOGONAL ARRAY DESIGN IN MINI TAB SOFTWARE

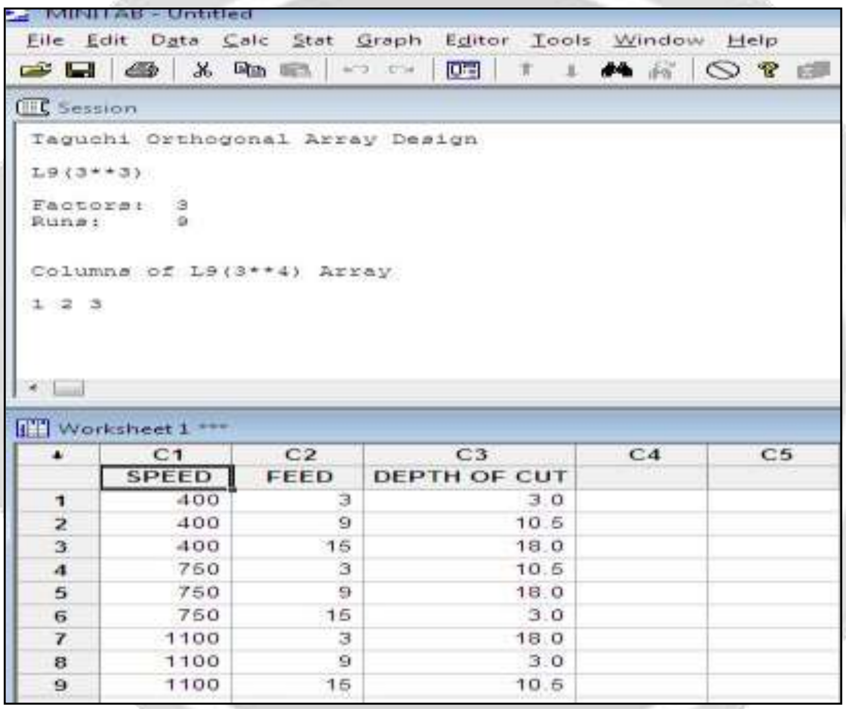


**Fig -1**: Taguchi orthogonal array design

## 3. MATERIAL REMOVAL RATE

To find material removal rate we have to calculate weight of workpiece before and after grinding test

Let, Wb=Weight of workpiece before grinding,

Wa= Weight of workpiece after grinding and

t= time required for process.

Then material removal rate (MRR) is calculated by,

**MRR= (Wb - Wa) / t (g/min).**

## 4. MATERIAL USE FOR INVESTIGATION

**Name of material :- Alloy 304**

**Name of material :- 300 X 50 X 6 MM thick**

## 5. EXPERIMENTAL PROCEDURE

**Machine Used: ALEX H310 Series**

1) First of all clamp the specimen on the machine bed.
2) Now Set the feed,rotational speed of spindle and depth of cut.
3)Take first test with first range mention above. And note down the reading.
4)Follow the procedure for next series of reading.
5)compare result with previous data.

**Fig -2**: Surface grinding machine

## 6. MEASUREMENT MACHINE FOR SURFACE ROUGHNESS

**Fig -3**: Surface grinding machine

## 7. RESULT AND DISCUSSION

In proposed work an experimental investigation can be carried out to predict the surface roughness and MRR parameters of AISI 304 steel in surface grinding operation. The output responses considered for evaluating the results which are influenced by input parameters such as cutting speed, feed rate and depth of cut can be obtained from the experiments and this can be optimized using Response surface methodology.

In this study, an application and adaptation of the Taguchi optimization and quality-control method can be established for the optimization of the surface roughness in a grinding process. The Taguchi method provides a systematic and efficient methodology with fewer experiments and trials.

- An austenitic stainless steel can produces better surface finish during surface grinding process in grinding process parameters
- Austenitic stainless steel has good machinability property.

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