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# INVESTIGATING GRINDABILITY OF STAINLESS STEEL WITH VARIOUS PROCESS PARAMETERS BY SURFACE GRINDING MACHINE

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## ABSTRACT

This paper presents a study on optimization of the exchanged grinding wheel diameter based on the analysis difference conditions of surface grinding of stainless steel. The optimum exchanged grinding wheel diameter is determined by minimizing it's radius for each experiment. An experimental design was conducted to describe the influence of the input parameters i.e., the initial grinding wheel diameter, infeed the Rockwell hardness of workpiece, and the radial grinding wheel wear per experiment. The difference of optimum wheel diameter between the initial and after the experimental process completion was 1.87 %( approx) for these results.

**Keywords:** Wheel diameter, infeed, Rockwell hardness, Workpiece material, Wheel Speed.

## 1. INTRODUCTION

Optimum grinding process parameters including wheel and machine parameters were proposed on the basis of minimizing grinding time and maximizing the volume of material removed rate. The relevance to the optimization of wheel rate, grinding and dressing parameters was presented for maximizing the material removal rate, minimizing the grinding time as well as minimizing the dressing and accurate surface roughness of specimen material. This project is studied on optimization of the exchanged grinding wheel diameter for surface grinding of stainless steel. Most significant desired output parameter in surface grinding is the surface finish followed by other parameters like material removal rate, surface hardness, rate of wheel wear. Many input parameters like infeed, depth of cut, work speed, cutting fluid used, etc control the surface finish of workpiece.

## 2. METHODOLOGY

This paper is done to study the effect of input parameters on surface finish of stainless steel in surface grinding operation. A horizontal spindle and reciprocating table type Surface grinder, White Aluminium Oxide (AA46/54 K5 V8) Carborundum grinding wheels and an average table speed (up grinding) of 0.23 m/s is used throughout the experiment. Hydro 68 water soluble oil (oil to water ratio of 1:10) is used as cutting fluid. A total of 6 experiments are done on each material by varying wheel grain size, wheel wear and depth of cut on surface roughness.


Fig: 1 Roughness Tester

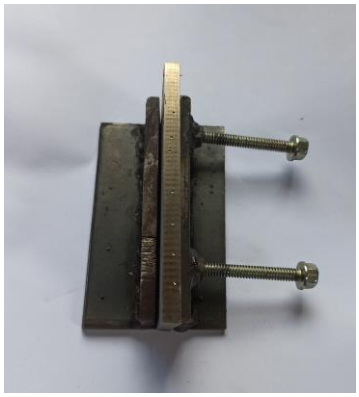

Fig: 2 Workpiece Holder

## 3. MODELING AND ANALYSIS

Two mild steel plates of thickness thinner than workpiece specimen are used to hold small workpiece specimen tightly, for stainless steel because of its non ferrous nature. Surface roughness of each experiment is checked using Mitutoyo Surface roughness tester with cut-off length as 0.25cm. Stainless steel specimen approx. size taken for experiment is 100 x 50 x 5 mm (Length xWidth x Thickness). At the time of experiment Surface Grinding Machine is used for operation and a stainless steel square plate is used for grinding. The Surface Grinding machine worked on the main equipment, tools, work piece and grinding conditions. (dry & wet)

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## 4. RESULTS AND DISCUSSION

Material: Stainless Steel
Speed: 4253 rpm (Constant Speed)
Initial Hardness of material: 17 HRC
(Diamond indenter, 150 KgF load, C scale)
Determination of roughness value after machining (for Dry Condition)

**Table: 1**

| Sl. No | Infeed (µm) | pass | Hardness after 20 pass (Avg.) | Surface roughness(µm) | | | | Initial radius of wheel | Thickness Of the ring formed(mm) | Height of metal remove(mm) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Sl. no | $R_a$ | $R_q$ | $R_z$ | | | |
| 1 | 6 | 20 | 12.6 | 1 | 2.186 | 2.758 | 10.398 | 9.93 | 0.11 | Initial – 5.5<br>Final – 5.3<br>Metal remove – 0.2 |
| | | | | 2 | 1.808 | 2.357 | 10.398 | | | |
| | | | | 3 | 2.457 | 2.973 | 11.741 | | | |
| 2 | 12 | 20 | 12 | 1 | 2.690 | 3.222 | 13.974 | 9.75 | 0 .21 | Initial – 5.5<br>Final – 5.1<br>Metal remove – 0.4 |
| | | | | 2 | 2.353 | 2.748 | 10.680 | | | |
| | | | | 3 | 2.130 | 2.710 | 11.587 | | | |
| 3 | 18 | 20 | 11.44 | 1 | 1.966 | 2.466 | 11.550 | 9.47 | 0.09 | Initial – 5.3<br>Final – 4.7<br>Metal remove – 0.6 |
| | | | | 2 | 1.803 | 2.260 | 11.014 | | | |
| | | | | 3 | 2.168 | 2.678 | 10.501 | | | |

Determination of roughness value after machining (for Wet Condition)

**Table: 2**

| Sl. No | Infeed (µm) | pass | Hardness after 20 pass (Avg.) | Surface roughness(µm) | | | | Initial radius of wheel | Thickness Of the ring formed(mm) | Height of metal remove(mm) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Sl. no | $R_a$ | $R_q$ | $R_z$ | | | |
| 1 | 6 | 20 | 14 | 1 | 1.596 | 2.083 | 11.034 | 9.95 | 0.05 | Initial – 5.3<br>Final – 5.2<br>Metal remove – 0.1 |
| | | | | 2 | 1.601 | 2.001 | 9.149 | | | |
| | | | | 3 | 1.567 | 1.897 | 2.639 | | | |
| 2 | 12 | 20 | 11.22 | 1 | 2.213 | 2.639 | 10.932 | 9.85 | 0 .09 | Initial – 5.3<br>Final – 5.0<br>Metal remove – 0.3 |
| | | | | 2 | 1.896 | 2.431 | 14.126 | | | |
| | | | | 3 | 2.233 | 2.899 | 13.086 | | | |
| 3 | 18 | 20 | 10 | 1 | 1.763 | 2.338 | 8.500 | 9.75 | 0.07 | Initial – 4.8<br>Final – 4.4<br>Metal remove – 0.4 |
| | | | | 2 | 1.797 | 2.260 | 8.849 | | | |
| | | | | 3 | 1.671 | 2.678 | 10.049 | | | |

## 5. CONCLUSION

The experimentation uses to obtain optimum machining condition for surface roughness of Stainless steel in using Surface Grinding Machine. The initial stage of experimentation consists of evaluating the effect of Surface Roughness and wheel rate, which mainly affect the input parameters. The experimentation was carried out by varying control factors which results the control factors such as wheel speed, infeed and table speed

- . • Multiple regressions have been applied to get the relation between cutting parameters and surface roughness.
- Continuous chips were obtained at the high wheel speed (4253 RPM) without built up edge formation and as a result better surface finish was obtained in both dry and wet machining.
- For the constant wheel speed as the infeed increased the surface roughness increased.
- The value of the surface roughness decreased compared to dry machining condition in the wet machining condition.

- It has been noticed that better surface finish obtained at constant wheel speed. It was also noticed that use of cutting fluid, the surface roughness found to decrease for wet machining.

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