DESIGN AND ANALYSIS OF INTERNAL AND EXTERNAL GRINDING ATTACHMENT FOR LATHE

K. Velusamy[1], C. Balakrishnan[2], S. Deva[2], S. Dudiarasu[2], V. Elango[2]

[1]*Assistant professor, Dept.of Mechanical Engineering, KSR Institution for Engineering and Technology, Tamilnadu, India*
[2]*student, Dept.of Mechanical Engineering, KSR Institution for Engineering and Technology, Tamilnadu, India*

---***---

Abstract - *Grinding is the process to attain elegant surface finish, high accuracy and dimension through attachment which gets fit in the available space of lathe machine without removing the tool post. Lathe is considered as oldest machine and now widely used in small scale industries. Major operations can be done by lathe to attain good machined product. Main aim of this attachment is to decrease the time in loading and unloading of work piece with desired surface finish and need not to purchase separate grinding machine. DC Motor is employed for driving the grinding wheel and required speed can be achieved by pulley drives. The objective of this project to design a compact and economic attachment for centre lathe which provide surface finish grade N5. Various parameters such as work speed, depth of cut and material roughness were considered. After design procedure completed, model may analysis and the roughness test for different materials were conducted.*

Key Words: Internal grinding, External Grinding, Grinding Attachment, surface finish, roughness test,etc..

1. INTRODUCTION

Lathe machine is important for major operations. Turning operation was carried out on lathe machine and it transferred to grinding machine for surface finish. Grinding is science of metal cutting operation performed by the means rotating abrasive wheel, grinding which provides fine surface finish. In this paper we have selected the required grinding wheel depending on work piece to be used. The main aim of project is to obtain an accuracy of 20microns. Since grinding requires high surface finish thus proper motor is selected as required. Grinding is done on jobs not just to have an aesthetic view but it has big importance. Surface grinding and cylindrical grinding is extremely important to those parts in automobiles, which are used in I.C.Engines and gear box. The attachment is designed specifically keeping in mind the use of attachment to workshops and quality of surface finish. Special attention was concentrated on the rigidity of the machine which would result in improper functioning of the attachment if not considered unit it was that it should be capable of taking sufficient load and force which it would face while in operation. The attachment though small in size the appearance is really a unique piece of skill.

1.1 Literature Survey

According to the studies, grinding can be defined as the process of removing metal by the application of abrasives. They are bonded to form a rotating wheel. The moving abrasive particles contact the work piece, the act as tiny cutting tools, each particle cutting a tiny chip from the work piece. Grinding process is a abrasive cutting process where machining occurs with the help of geometrically unspecified cutting edges. Surface quality is the main criterion in surface grinding and is influenced by various parameters like work piece parameters, wheel parameters and process parameters. Dhavlikar et al presented the Taguchi and response method to determine the robust condition for minimization of out of roundness error of work pieces for the center less grinding process. Shaji and Radhakrishnan elaborated the use of simultaneous optimization of multiple quality characteristics which is the need in case of machining. Taguchi method considers the optimization of a single parameter at a time. Suresh et al used RSM and genetic algorithm (GA) for predicting the surface roughness and optimizing process parameters while machining mild steel using CNMG tools on a lathe .By the result of wear analysis, we achieving the accuracy and to decrease the time loss.

1.2 COMPONENTS DETAILS

Dc Motor

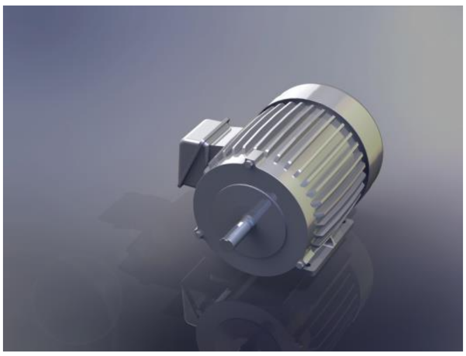


Fig -1 Dc Motor

A DC motor is a rotary electrical machine that converts direct current electrical energy into mechanical energy. That energy can produce by magnetic fields. Nearly all types of DC motors have some internal mechanism, either electromechanical or electronic; to periodically change the direction of current flow in part of the motor. DC motors were widely used, since they could be powered from existing direct-current lighting power distribution systems. Its speed can be controlled over a wide range, using either a variable supply voltage or by changing the strength of current in its field windings. The motor can operate on direct current but is a lightweight motor used for portable power tools.

Shaft

Shaft is provided to hold the wheel firmly and restrict its motion which includes bearing, collar, pulley. Keyway on shaft is made using shaper machine and finishing is obtained. Shaft can also to hold the grinding wheel properly from other end.

Fig -2 Shaft

Pulley

Pulley located on axle or shaft to support movement and change of direction of a belt, or transfer of power between the shaft and cable or belt. In the case of a pulley supported by a frame or shell that does not transfer power to a shaft, but is used to guide the exert a force.

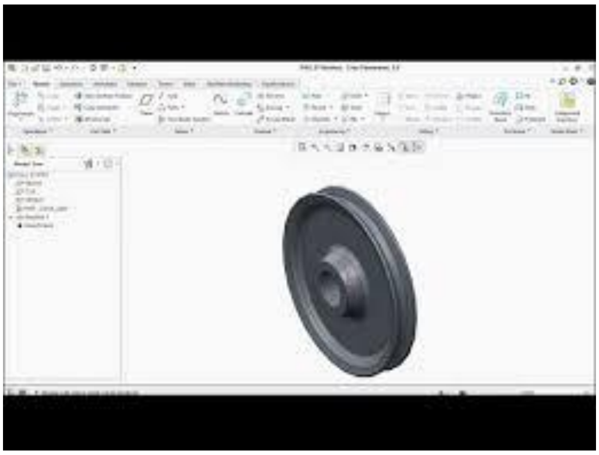


Fig -3 Pulley

V-Belt

V belts provide the best combination of traction, speed of movement, load of the bearings, and long service Life.

Fig -4 V Belt

The V belt tracks in a mating groove in the pulley with the result that the belt cannot slip. The belt also tends to wedge into the groove as the load increases, the greater the load, the greater the wedging action improving torque transmission less width and tension than flat belts. V-belts trump flat belts with their small centre distances and high reduction ratios.

Bearing

A bearing is that reduces friction between moving parts. The design of the bearing, provide for free rotation around a fixed axis it may prevent a motion by controlling forces that bear on the moving parts. Most bearings facilitate the desired motion by minimizing friction. Rotary bearings hold rotating components such as shafts or axles within mechanical systems, and transfer axial and radial loads from the source of the load to the support

A wide variety of bearing designs exists to allow the demands of the application to be correctly. Bearing design varies depending on the size and directions of the forces that they are required to support.

Fig –5 Bearing

Grinding Wheel

A grinding wheel is a wheel composed of a grinding compound and used for grinding and abrasive machine operations. Grinding wheels made from a solid steel or aluminum disc with particles bonded to the surface. Today with natural composite wheels are precise and tightly controlled process of a spinning disc, but also the composition and uniformity required to prevent that disc from exploding due to the high stresses produced on rotation. Grinding wheels are affordable, although the life span can vary widely depending on the use case, from less than a day to many years. The rate of wear in this process is usually very predictable for a given application, and is necessary for good performance.

Fig -1 Grinding Wheel

SPECIFICATIONS OF GRINDING WHEEL:

- Abrasives :Aluminium Oxide
- Grit selected : Grit is 60.
- Grade : grade K is selected
- Structure: Dense
- Bond : Vitrified bond

SELECTION OF GRINDING WHEEL

Grinding wheel is specified by its grit, grade and structure. For different type of work material and for different dimensions, the requirements of a grinding wheel are different. Thus it is important to select a proper grinding wheel. Following are some major specifications of grinding wheel.

Abrasives

For high tensile strength the abrasive should be tough and should not get fractured easily. Thus Aluminium oxide was selected as an abrasive, assuming maximum work to be done on mild steel.

Grit

Grit means grain size. Smaller grit finer is the surface finish. For high stock removal rate and better control of surface finish Grain size should be 30-60. Therefore grit is selected as 60.

Grade

Grade is to define hardness of the bond holding the grains together. For better compromise between soft and hard bond so that wheel wear and cost will be less intermediate grade P is selected.

Structure

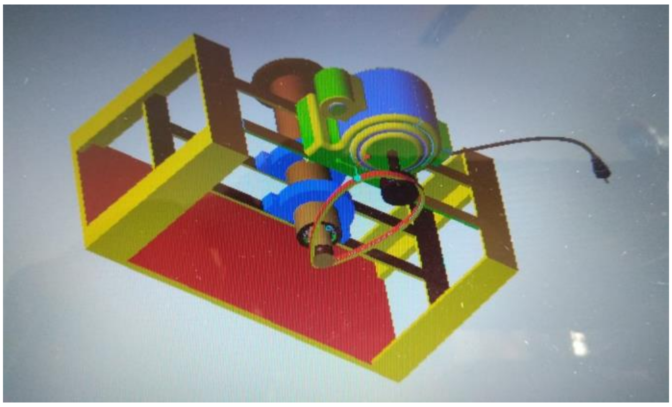
Structure is the void spacing between the grains. Lesser the structure, higher is the density of grains on the wheel. Densely packed grains are required for fine cuts. Therefore structure is selected as 5.

Bond

Bond is the type of adhesive used to hold grains together on the wheel. It depends on rate of stock removal, rigidity and required precision. For high stock removal, rigidity and suitable precision grinding vitrified bonds are preferred. Therefore V99 bond is selected.

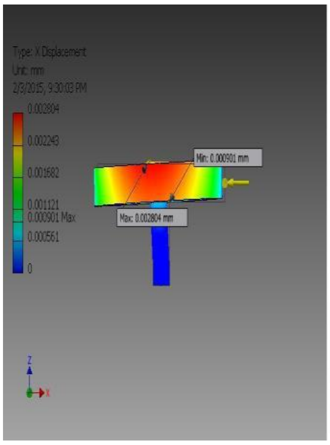
Selected wheel specification is **A60P5V99**

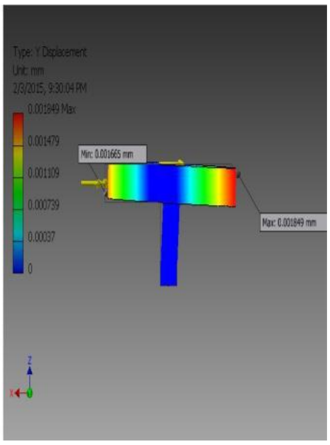
2. DESIGN



2.2 ANALYSIS

Grinding wheel





Tab.1

EXPERIMENT NO.	Process parameters			Surface roughness Ra
	V (rpm)	F_{max} (mm/rev)	D (mm)	(µm) (Stainless Steel)
1	339	3.7	0.1	1.45
2	430	2.0	0.2	1.1
3	575	2.15	0.3	1.2
4	230	1.7	0.4	1.25
5	980	2.25	0.5	1.5

`Tab.2

Symbol	Grinding parameter	Unit	*Level 1*	*Level 2*	*Level 3*
V	Wheel speed	rpm	1000	1500	2000
F	Rate of feed	mm/rev	20	25	30
D	Depth of cut	mm	0.05	0.10	0.15

2.3 GRAPH

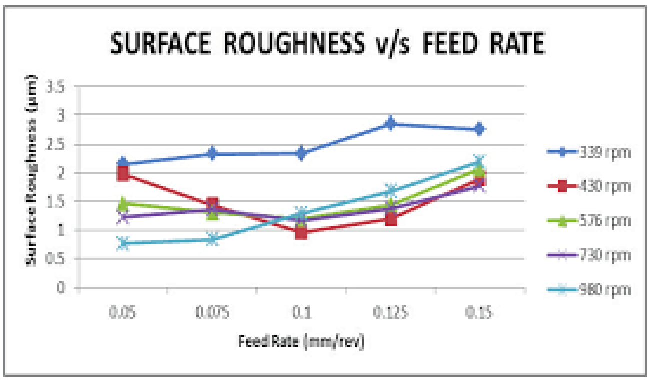


Chart 1. Ra Vs F

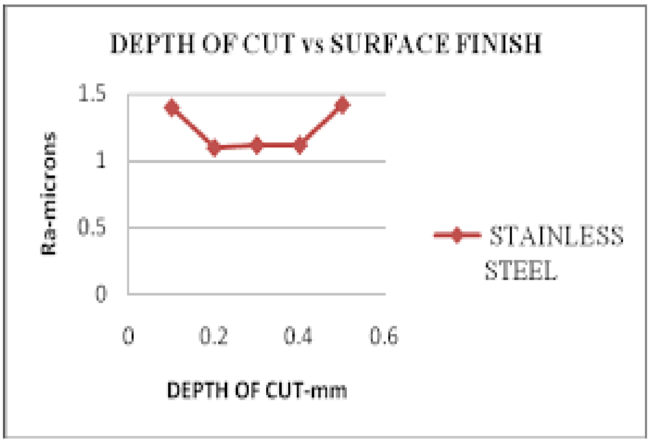


Chart 1. Ra Vs D

CALCULATION

Grinding Parameters:

- **Cutting Speed**

  $V = \pi * D * N / 60$

  $= \pi * 150 * 2880 / 60$

  = 22.61 m/sec

  =1357.16 m/min

- **Feed Rate***:* 1 mm per sec = 0.1071 mm/min
- **Depth of Cut:** ranging 0.005 to 0.04 mm
- **Grinding time:**

  $$T = \frac{L*I}{\text{feed per rpm} * \text{rpm of job}}$$

  =4.168 min

- **Material Removal Rate***:* MRR = v ∗ b ∗ d

  = 0.64mm³/sec.

- **Motor selection**

  P= 0.5 hp

  N=2880rpm

  (achieved by belt pulley transmission)

- **Selection of standard v-belt** – A 25
- **Selection of standard v-belt pulley**

  D_1 = Diameter of Larger Pulley = 4 Inch

  D_2 = Diameter of Smaller Pulley = 2 Inch

- **selection of shaft**

  Material selction of shaft

  Mild steel **ASTM-A- 36**

  Ultimate Tensile Strength , σ_{ut} **=** 450MPa

  Yield Tensile Strength , σ_{yt}= 250

  $\Gamma_d = 0.3*\sigma_{yt}$

  = 0.3*250

  =75 N/mm^2

RESULT AND DISCUSSION

Cutting Speed	=1357.16 m/min
Feed Rate	= 0.1071 mm/min
Depth of Cut	= 0.04 mm

Grinding time =4.168 min

Max.Surface roughness for stainless steel
Using this conventional grinding
= 0.40micro meter

3. CONCLUSIONS

We are fitting the grinding attachment in the center lathe to enable the machine to perform one additional operation. At present this attachment is purely operated and controlled by means of mechanical and manual. It can eliminate the rescue work of the operator and make away to semi-skilled operator can also perform the counter making operation and at the same time increase the productivity of the machine. We present out idea for mechanism in manual namely "Design and Analysis of Internal and External Grinding Attachment for Lathe" has been completed successfully to our entire satisfaction.

REFERENCES

[1] Fabrication Of Cylindrical Grinding Attachment On Lathe Machine And Optimization Of Grinding Parameters By Regression Analysis by Devarakonda Harish Kumar

[2] Jayakrishnan J and Suraj R, Effect of Roller Burnishing Process on Tool Steel Material Using CNC Lathe. International Journal of Design and Manufacturing Technology (IJDMT), 7(4), 2016, pp. 281– 288.

[3] M.N. Dhavlikar; M.S. Kulkarni; V. Mariappan. (2003) Combined Taguchi and dual response method for optimization of a centerless grinding operation, Journal of Materials Processing Technology, 132 (1–3); 90–94.

[4] P.V.S. Suresh; P.V.V. Rao; S.G. Deshmukh.(2002) A genetic algorithmic approach for optimization of surface roughness prediction model, International Journal of Machine Tools and Manufacture, 42 (6); 675–680.