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Design of Horizontal Abrasives Belt Grinding Machine

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ABSTRACT

Grinding is a precision machining process which is widely used in the manufacturing of components which require close tolerances and smooth finish. It has become an important process for the material removal and finishing of different materials for several applications. Rapid developments in work materials and enforcement of stringent work specifications increase the demand for accuracy and surface quality of work pieces, with improved productivity and cost effectiveness. The wide spread use of new hard to machine materials also increases the demand for different grinding tools. Innovative changes in manufacturing processes and methods are other important factors, opening up new applications for abrasive machining.

The important feature that differentiates grinding from other machining processes is that the cutting points which are spatially distributed over the cutting surface. The number, geometry and dimensions, of the cutting edges can only be defined statistically. Higher cutting speeds, smaller depth of cut, specific wear behavior and high temperatures are the specific characteristics features of grinding process.

Index items/ keywords – Grinder, Abresive belt grinding machine

1. PRINCIPLES

The belt and work-piece revolve the depth of cut increases to a maximum, somewhere along the arc of contact of the belt and the work-piece and then reduces again when the chip is dislodged from the work-piece. Since the belt speed is considerably higher than the work speed, the maximum value of depth of cut is reached almost at the point where the belt leaves the work-piece. This depth of cut is termed as the grain depth of cut. In Figure 3.1, when the grain is at P it is just contacting the work-piece and the depth of cut is zero. In unit time T, the grain will advance to position R. The belt can be made to cut harder or softer by reducing or increasing the grain depth of cut.

Following are clear. i) Work speed – By increasing the work speed, the grain depth of cut increases and the bond wears out faster and the belt appears softer. When the work speed decreases, the belt appears to be harder. ii) Belt speed – By reducing the belt speed the grain depth increases and the belt appears softer. By increasing the belt speed, the belt appears harder.

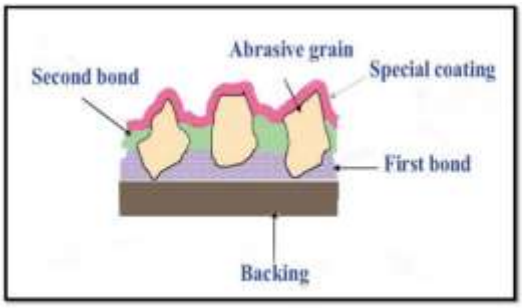

Figure: 1.1Grinding Belt Showing Edge of Abrasive Grains.

Grinding removes the metal from the work piece in the form of small chips by mechanical action of abrasive particles bonded together in a grinding belt. Rubbing, Plowing and Metal removal are the three stages of chip removal process in grinding. Grinding is a slow process in terms of unit removal of the stock. Hence, other methods are used first to bring the work closer to its required dimensions and then it is ground to achieve the desired finish. In some applications, grinding is also employed for higher metal removal rate. In such heavy duty grinding operations more abrasive is consumed. In these cases, the main objective is to remove more amount of material that too as quickly and effectively as possible. Thus, the grinding process can be applied successfully to almost any component requiring precision or hard machining and it is also one of the widely used methods of removing material from the work piece after hardening. The process quality basically depends on a large extent on the experience of the operator. sModern grinding belt and tools are generally composed of two materials, one is the tiny abrasive particles called grains or grits which do the cutting and the other is a softer bonding agent to hold the countless abrasive grains together in the solid mass.

Power is on rollers are revolve speedily. Rollers fitted with bearing. Abrasive belt mounted on rollers. It revolves around with rollers.

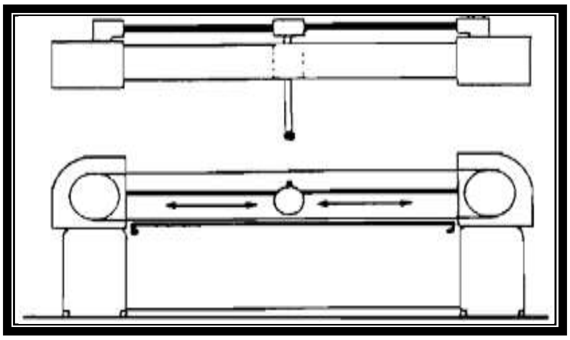

Figure 1.2: Structure of Belt Grinder

GRINDING METHODS

Wide belt grinding is the one another familiar process in industry as well as home applications. There are some basic methods for belt grinding.

- Stroke belt
- Platen belt
- Wide belt

In general, there are three basic elements of the belt-grinding machine: which are work rest support, grinding head and a regulating head. These components differ for all the methods but in general the work piece is pressed between the grinding head and the rest support. The aim of the regulating head is to coordinate the belt pressure. Wide belt grinding One of the most common methods is the wide belt grinding. The machines can be made for the wet or dry operation. a wide belt grinding machine can be constructed with the single or multiple heads. The first head is mainly used for coarse grinding and the next heads gradually make a finer finish. Wide belt grinding is also mainly used as a high stock removal method for special metals (e.g. stainless steel, titanium, and nickel alloys).[3]

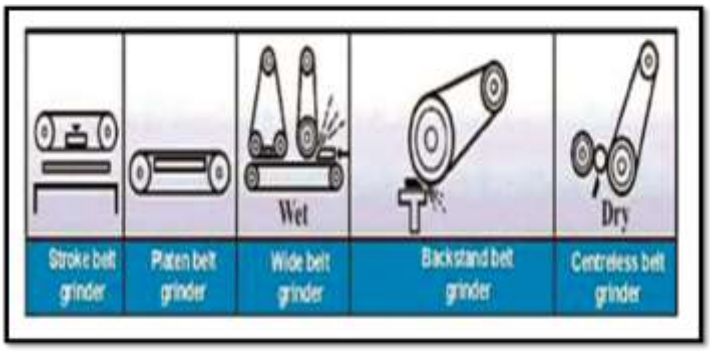

Figure: 1.3 Methods of Abrasive Belt Grinding.

2. WORKING

That type of grinding machine is generally used for polishing the small metallic component like washer. In that machine abrasive belt fitted on the two roller. The coupling is used for transmission of power from electric motor to the roller shaft. As the first roller rotated then second roller rotated with same speed because of abrasive belt wound over the surface. When we keep the any small part on abrasive belt & apply the pressure over the surface of the belt, then the small component polished. Because of that machine good quality of glassing also obtained for good look component. The abrasive belt is available in various sizes in the market. Belt grinding machine may be dry belt wet belt or combination belt. Belt grinding machine is used for heavy stock removal or for light polishing work depending upon the type of belt grade used.[3]

3. DESIGN

3.1 Classifications of Machine Design

The machine design may be classified as follows:

1. Adaptive design: In most cases, the designer's work is concerned with the acception of existing designs. This type of design needs no domain knowledge or skill and can be attempted by designers of ordinary technical training. The designer only makes some alternation or modification in the existing designs of the product.

2. Development design: This type of design needs to comes with the accurate scientific training and design ability in order to modify the existing designs into a new idea by accepting a new material or different method of manufacture. In this case, the designer starts from the existing design, but the final product may differ from the original product.

3. New design: This type of design needs lot of research, technical ability and creative thinking. Only those designers who have the qualities of a sufficiently high order can take up the work of a new design.

The designs, are depending upon the methods used, may be classified as follows:

(a) Rational design: This type of design based on mathematical formulae of principle of mechanics.

(b) Empirical design: This type of design focused on the empirical formulae based on the practice and past experience.

(c) Industrial design: This type of design mainly based upon the production aspects to manufacture any machine component in the industry.

(d) System design: It is the design of any structured mechanical system like a motor car.

(e) Element design: It is the design of any other element of the mechanical system like piston, Crankshaft, connecting rod, etc.

3 .2 General Considerations in Machine Design

Following are the general points which are consider in designing a machine component:

1. **Type of load & stresses caused by the load:** The load, on a machine component, could act in several ways due to which the internal stresses are set up.

2. Motion of the parts / kinematics of the machine: The successful operation of any machine mainly depends upon the simplest arrangement of the parts which will give the motion required. The motion of the parts may be:

(a) Rectilinear motion which includes unidirectional and reciprocating motions.

(b) Curvilinear motion which includes rotary, oscillatory and simple harmonic.

(c) Constant velocity.

(d) Constant or variable acceleration.

2. **Selection of materials:** It is essential that the designer must have a sufficient knowledge of the properties of the materials and their behaviour under working conditions.

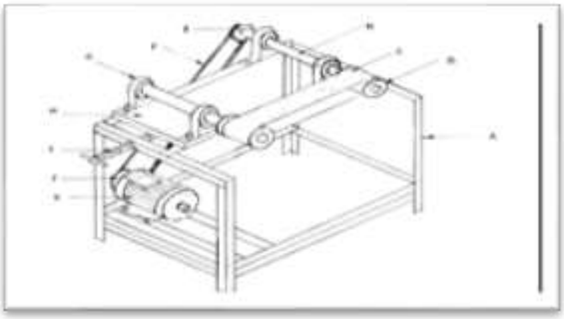

Figure: 3.1 Design of Abrasive Belt Grinding Machine.

Abbreviation

A – "L-shape angle frame.
B – Roller.
C - Abrasive Belt.
D – Shaft.
E – Driven Pulley.
K – Motor.
F - V -Belt.
G – Bearing.
H – Sliding Base.
I - Screw
J – Driving Pulley.

4. DESIGN CALCULATION

1] Length of V Belt:

- Diameter of Larger Pulley (D1) =102mm
- Radius of Larger Pulley (R1) = 51mm
- Diameter of Smaller Pulley (D2) =76mm
- Radius of Smaller Pulley(R2) =38mm
- Central Distance Between Two Pulley(x) **=790mm i.e. 0.790m**
- Length of V-belt $= \pi(R1+R2)+2x+[\frac{(R1+R2)^2}{x}] = \pi(0.051+0.038)+2\times0.790+[\frac{(0.051+0.038)^2}{0.790}]$

[Length of V Belt =1.86m]

2] Angle of Contact for Both Pulleys:

- Central distance between pulley(x) = 790mm
- Diameter of Larger Pulley (D1) =102mm
- Radius of larger pulley(R1) = 51mm
- Diameter of Smaller Pulley (D2) =76mm
- Radius of Smaller Pulley(R2) =38mm
- Angle of contact (Θ) = 180-2α

$\alpha = \sin^{-1}[\frac{R1+R2}{x}]$

$\alpha = \sin^{-1}[\frac{51+38}{790}]$

α =6.46

Angle of contact (Θ) $= 180^o-2\alpha$

$= 180^o-2\times6.46$

$= 167.08^o$

$= (167.08^o\times\frac{\pi}{180})$ rad.

[Angle of contact (Θ) = 2.91 rad.]

3] Tension in Tight Side and Slack Side:

T1 = tension in tight side

T2 = tension in slack side

Angle of contact = ϴ=2.91 rad.

By using formula's,

$\frac{T1}{T2} = e^{\mu\times\theta}$….. where, μ= coefficient of friction

∴ [T1=$e^{\mu\times\theta}$×T2]

∴ T1= $e^{0.25\times2.91}$…………………… ∴ Assume = μ =0.25

∴ [T1= 2.07 × T2 N]……………… [1]

To find T1 & T2 Use the Formulas,

P = (T1-T2) × V

3×10^3= (2.07×T2-T2) ×V…………∴

Consider P = 3×10^3

3×10^3= (2.07×T2-T2) ×$\frac{\pi DN}{60}$…………∴

Velocity = $\frac{\pi DN}{60}$

3×10^3= (2.07×T2-T2) × $\frac{\pi\times0.1\times1440}{60}$

[T2= 371.85 N]……….[2]

Put the value of T2 in equation [1]

∴ [T1= 2.07 × T2 N]……………… [1]

∴ T1= 2.07 × 371.85

[T1=769.73 N]………….. [3]

1) Tension Tight Side **T1=769.73 N**

2) Tension Slack Side **T2=371.85 N**

∴ Tmax= maximum tension in belt,

∴ Tmax= T1, SO T1 is maximum tension in belt

4] Power Transmitted By Belt

P = power transmitted by belt

Diameter of larger pulley (D) = 100 mm =0.1 mm

Speed of engine/motor shaft (N) =1440 rpm

Coefficient of friction (μ) = 0.25 (assume value)

1) V = πDN/60
= (π × 0.1 ×1440)/60
= 7.53 m/sec
2) P = (T1 – T2) × V
P = (769.73 -371.85) × 7.53

P = 2996.03 watt

[P = 2.99 Kw]

5] Speed Transmitted To Machine Shaft

N1 = motor speed in rpm = 1440 rpm

d1 = motor shaft pulley = 102 mm

d2 = machine shaft pulley =76 mm

t = inner thickness of belt = 12 mm

- when there is no sleep in V-belt ,

$\frac{N2}{N1} = \frac{d1+t}{d2+t}$,

N2 = N1 × $\frac{d1+t}{d2+t}$ = 1440 × $[\frac{102+12}{76+12}]$

[N2 = 1865 rpm]

5. CONCLUSION

The study on belt grinding has highlighted the significance of belt parameters and machining parameters on the grinding performance. In this study the belt parameters such as bond, type of backing and flexibility are identified as new innovative factors which influences the belt grinding process. The degree of influence of machining parameters such as belt speed, contact area and pressure has shown significant relation with belt parameters. The observations have clearly demonstrated the distinctive differences between rigid grinding such as wheel grinding and flexible grinding such as belt grinding especially regarding the significance of grit size, belt speed and bond. The conclusions drawn from the study are presented in this chapter.

Resin over resin bond, low speed and higher contact area facilitates enhanced material removal, while relatively lower order grinding pressure is prone to ensure minimum belt wear and good finish. Thus optimizing for G-ratio is tough task in belt grinding. Among the backing, polyester facilitate ensures good grinding performance Finer grit and medium contact area with high belt speed facilitates enhanced material removal, while finer grit and higher contact area facilitates belt wear constrained grinding again belt grinding calls for parameter constrained optimization for achieving overall belt performance. Selection of grinding parameters is relatively material specific. While finer grit facilitates enhanced material removal irrespective of the work material being ground. Medium to higher speed and low to medium speed facilitates better belt performance. This is in contrast to rigid grinding (wheel grinding) practice.

6. REFERENCES

1. Awhale M.J., “Surface belt grinding for Key – A Review.” IJRRCME, Vol. 2, Issue 2, Page (56-59), Issues, October 2015 – March 2016, ISSN 2393-8471.
2. S. Wang and C. H. Li., “Application and Development of High-Efficiency Abrasive Process.” ISAST, Vol. 47, Issues, October 2012.
3. B. K. Kandpal, “Fabrication of Wet Grinding Machine and Measure the Metal Remove Rate Using Different Grade Emery Paper.” IJETAE, Vol. 2, Issues, March 2012.
4. R. S. Khurmi and J. K. Gupta, “Machine Design.” EPH PVT. LTD., Vol. 2, Pages (2-3), issues, 2005.
5. Leonard E. Samuels, “Metallographic Polishing by Mechanical Methods”, Fourth Edition, ASM international, Vol. 3, issues, 2003.
6. J.H. Chuang, L.W. Troy and C. Chen, “International Journal of Fatigue.” Vol. 20, Page No. (531-536) Issues, 1998.