

METHODS TO REDUCE THE VIBRATIONS OF HYDRAULIC SURFACE GRINDING MACHINE WHILE REVERSING THE TABLE.

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ABSTRACT

The grinding operation is one of the abrasive machining process; the material removing process is done by the action of hard abrasive particles and provides fine surface finish. The grinding machines are classified depends upon process or method of grinding the work piece and position of spindle.

There are basically following types of surface grinding machine a) Horizontal spindle and reciprocating table b) Vertical spindle and reciprocating table c) Horizontal spindle and rotary table d) Vertical spindle and rotary table.

Here we consider the horizontal spindle and reciprocating table surface grinding machine. The surface grinding is used mainly to grind the flat surfaces only. Hydraulic Surface Grinding Machine provides better surface finish with respect to manual surface grinding machine, its traverse movement of table is controlled by hydraulic system. The table with magnetic chuck have reciprocating motion. The table speed of grinding machine is controlled by mechanical flow control valve; and reversing of the table is controlled either by mechanical direction control valve or by proportional direction control valve. In this research paper focus on the causes of vibration and its effects on surface roughness while reversing the table. While reversing the table it produces the vibration or jerk to the machine. Vibration produces bad effects on machine as well as surface finish to the work-piece. There is an excessive jerk or vibration while reversing the table besides regular working vibration. This type of jerk/impact force produces vibration at the end of table traverse and remains for certain distance. At the point of reversing of table, its amplitude is high and getting normal or damped out to normal working position in certain distance. The present paper focus on different input parameters that are direction control valve and hydraulic oil viscosity and its effects to reduce the jerk or vibration while reversing the table and reduced to the certain extent. The controlled outputs are surface roughness value (Ra value) of work piece, displacement of machine are measured by surface roughness tester, FFT analyser and wattmeter respectively. And finally found out optimum value. Vibration does not eliminate completely.

KEY WORDS: HYDRAULIC SURFACE GRINDING MACHINE, VIBRATION ANALYSER, SURFACE ROUGHNESS TESTER, HYDRAULIC OIL, VIBRATION ISOLATORS, VIBRATION ABSORBERS, HYDRAULIC SYSTEM.

I. INTRODUCTION

Free Vibration is the motion of a particle or a body or system under go only due to initial disturbance and displaced from a steady position. The forced vibration is the motion of the body displace from due to frequent disturbing force acting on the machine while reversing the table of surface grinding machine. The forced vibration in case of hydraulic surface grinding machine while reversing the table is also known as jerk to the machine.

In general, vibration is said to be oscillations occurred from a stable position. Vibration is one of the major problems in grinding operation. Accuracy and productivity of the machine are affected due to this vibration. Chattering is one of the reasons for reduced accuracy in the grinding machine.

In general, vibration is classified in to two types in hydraulic surface grinding machine.

- i. Forced vibration. in
- ii. Self- excited vibration.

i) Forced vibration: The reversing of table causes forced vibration for each interval of movement. Hydraulic systems installed in grinding machines will also cause forced vibration. Misalignment of grinding wheel is also the cause of the forced vibration. Unbalance and eccentricity of grinding wheel are the other causes of forced vibrations.

ii) Self- excited vibration:

These vibrations are caused from the cutting process in grinding machines. Regenerating effect is the main cause of this vibration. On the rotation of the grinding wheel, there is the chance of formation of waviness between the grinding wheel and work piece. A characteristic feature of grinding chatter is, however, that such regenerating effect possibly exists on both the work piece and grinding wheel surfaces. [3]

The vibrations are undesirable in machines and structures they produce increased stresses, energy losses, cause more wear, increase bearing loads, induce fatigue strength and absorb energy from the system, it also causes poor surface finish in grinding machine. Here we considered that rotating machine parts that are spindle, wheels, gears shaft of motors required properly balanced in order to prevent damage due to vibrations and considering the same for different input.

Here single degree of free damped vibration system considered. It occurs when a system is displaced from a position of stable equilibrium. The system tends to return to this equilibrium position under the action of restoring forces (such as an elastic force arise from a machine arise from a machine considered as a structure, damping force from sliding parts of machine and damping force of footing also). The system keeps moving back and forth across its position of equilibrium. A system is a combination of elements, some of consider as input parameters are intended to change and to act together to accomplish an objective. [5]

II. NEED OF ANALYSIS OF JERK TO MACHINE

The analysis of vibration is done for finding the causes and its effect on the performance of machine. Its effect on the final product. So it has special significance.

- 1) It assists to improve the machine design to reduce the vibration.
- 2) To find the causes of poor surface finish.
- 3) It assists to improve the life of machine.
- 4) To find the natural frequency and forced frequency of machine and avoid the resonance condition of machine.
- 5) It assists to improve the design, changes to related elements to reduce the jerk.

III. CAUSES OF VIBRATION (JERK)

The vibration or jerk is in the form of energy; it does not diminish completely but will try to reduce it. There are following causes are found out the vibration (jerk) while reversing the table.

- 1) The resonance of the whole system. (Vibration frequency of the table while reversing and natural frequency of the grinding machine should not be the same)
- 2) **To apply improved hydraulic system with proportion control valve (flow, pressure and direction) to reduce the vibration or jerk while reversing the table of grinding machine.**
- 3) The thickness of base of grinding machine.
- 4) The height of grinding machine and increase the height of foundation to achieve ergonomics condition of grinding machine. More the height more is the vibration.
- 5) Balancing of rotating parts (i.e. electric motor, spindle, leading screw etc.)
- 6) To increase the area of sliding (V-flat side ways) between moving table and grinding machine.
- 7) **Use proper viscosity hydraulic oil.**
- 8) Regular dressing of Grinding wheel it also improves the surface finish of work piece.

- 9) Use Gas or spring accumulators in hydraulic system.

There are so many factors creating the vibration on machine, however here we focused on the direction control valve of hydraulic system and oil viscosity which contribute more to the vibration or jerk and did comparative study and investigated the better one.

IV. LITRETURE REVIEW

Go through the various journals papers on study done on the concept of hydraulic surface grinding machine and hydraulic oil viscosity as variable input to the machine. Many research paper illustrate the parameter of depth of cut, surface speed of grinding wheel, table speed, work piece material and depth of cut etc. and its effects on surface finish. Only few of the research paper are available on considering the above variable input parameters. This topic covers the jerk, impulse cause vibration while reversing the table of hydraulic surface grinding machine.

1] Karl-Erik Rydberg: For getting the higher efficiency and better workability of hydraulic unit, the new components have been developed for long time. However, the most important component in a hydraulic system, which has major impact on system efficiency and wear are the fluid itself. The major attention on hydraulic fluid development. He focused on and try to answer the question "How to select the best fluid for a specific application?" The hydraulic fluid must be environmentally adapted.

In order to maximize energy efficiencies in hydraulic systems, mechanical and volumetric losses must be balanced so the sum of these losses is minimized. Since the mechanical losses in sealing gaps are proportional to the fluid viscosity and volumetric losses inversely proportional to the viscosity, it is clear that optimal viscosity exist. Fluid viscosity is not the only parameter that improves energy efficiency. Also, friction coefficient provided by the fluid in sealing gaps. The hydraulic fluid is one of the most important design factors in a hydraulic system and should be considered as a machine element, possible to develop as well as the other hydraulic components in the system.

2] Raj Reddy: presented the paper on analysis of resonance of a surface grinder. The vibration of structure depends on response of structure to the excitation (external source) applied. The vibration parameters may change either alteration in structure or excitation or both. It is necessary to control the vibration to get required surface finish. The natural frequency of structure and frequency of excitation should not be the same to avoid resonance. In order to avoid resonance, the dimensions are changed in such a way that the natural frequency of the model is either reduced or increased. One method of investigation is through the experimental approach. However, this approach is expensive and requires good amount of lead time. There are two factors which control the amplitude and frequency of vibration in a structure which are the excitation applied and the response of the structure to that particular excitation. Changing either the excitation or the dynamic characteristics of the structure will change the vibration stimulated. The excitation arises from external sources such as ground, cross winds, earthquakes and sources internal to the structure such as moving loads and rotating or reciprocating engines and machinery. These excitation forces and motions can be periodic or harmonic in time or due to shock or impulse loadings or even random in nature.

3] AVS Ganeshraja, T. Dheenathayalan consider forced vibration and self-excited vibration occurred in grinding machine. The forced vibration due to unbalance of grinding wheel. Self-excited vibration due to cutting operation. They classify the surface roughness in different categories that are a) good b) acceptable c) monitor closely d) unacceptable.

4] Ning Chenxiao, Zhang Xushe Hydraulic system used for hydraulic gate is the important equipment in Large scale water conservancy. The vibration and noise of hydraulic hoist hydraulic system can effect the working performance of the hydraulic system and components that are Motor and coupling, Hydraulic pump, Directional valve, Connection and reduce the service life of the equipment and components, which affects the secure and reliable operation of the gate opening and closing system. At the same time, the noise cause irritability, fatigue, impact. Therefore, it is very necessary to research on vibration and noise causes of the hydraulic system and puts forward the effective measures of reducing noise and vibration.

To prevent cavitation induced vibration and noise The system shall be provided in the air exhaust device, exhaust system in the air, to prevent the hydraulic shock caused by vibration and noise limiting pipeline fluid velocity and the velocity of moving parts. Prevent system flow pressure pulsation induced vibration and noise When design the hydraulic pump, to prevent the pipeline and tank vibration and noise a circular should be transited with arc.

V. PROBLEM DEFINITION

Measuring the jerk or vibration of hydraulic surface grinder with magnetic bed size 20'X08' displaced to 95 microns with frequency 12.25 Hz from its mean position as per experiment. This vibration is underdamped out up to certain milliseconds. This vibration or jerk reflect on the surface finish having Ra value 0.31 for mechanical

control valve on hydraulic oil viscosity VG 68. This problem of vibration could reduce by replacing the mechanical direction control valve with proportional control valve.

There are two basics problems which contribute more to the vibration due to reversing of table, so focus on this two input parameter only.

1. Manually operated Direction Control Valve
2. Viscosity of Oil

VI. METHODOLOGY

The hydraulic surface grinding machine of model HYD 208 means its magnetic bed size 20'X 08' taken for experiments. Its total weight approx. 900 kg. and height is 6' with table weight 90-100 kg. We shall consider the surface grinding machine as vertical column structure and is consider symmetric about vertical axis its center of gravity act at a certain point from the base. The study is done and compare reciprocating tables with conventional hydraulic system with unconventional system. The jerk or vibration caused due to improper hydraulic fluid controlled table movements at the end of strokes. The more pressure developed due to hammering of hydraulic fluid and produce jerk while reversing the table. Here experiment done with hydraulic oil viscosity ISO VG 46, ISO VG 68, ISO VG 100, which are available in market and keep the table is moving with speed range 0.178 m/s to 0.304m/s. Here we found hydraulic oil viscosity ISO VG 68 have optimal value. The output parameter that are vibrational amplitude, surface roughness value and power is measured by an instrument FFT analyzer, roughness value tester and multi meter respectively. By keeping rest of the parameter same.

VII. RESULT

In hydraulic surface grinding machine vibration is reduced by various techniques. In this case we got better result as compared of hydraulic system with mechanical direction control valves to proportional control direction control valve, optimal hydraulic oil viscosity grade 68, by keeping the other parameters, machine parts tolerance and foundation etc. constant. These parameters control the jerk or bump efficiently at reversing the table. The dampers used to minimize the kinetic energy of table along with the time or traverse of table. As well as the hydraulic system with various proportional direction control valves absorbs the excess energy of hammering of fluid while reversing. The results obtained by implementing the above methods are better. The amplitude of the vibration will get shorter and the wave diminishes early.

Following two table give comparative result of experiments conducted on Hydraulic grinding machine while reversing the table.

1)Hydraulic System with Mechanical direction control valve for Grinding Machine.**For Viscosity – 68**

Sr.No.	Table Speed (m/s)	Vibr. Displacement (μ)	Ra Value (μ)	Power (Kw)
1	0.178	43	0.19	1.515
2	0.223	58	0.22	1.558
3	0.261	76	0.3	1.594
4	0.304	95	0.3	1.612

2) Hydraulic System with Proportional direction control valve for Grinding Machine.**For Viscosity – 68**

Sr.No.	Table Speed (m/s)	Vibr. Displacement (μ)	Ra Value (μ)	Power (Kw)
1	0.178	35	0.14	1.478
2	0.223	50	0.18	1.484
3	0.261	66	0.22	1.551
4	0.304	82	0.28	1.551

VIII. CONCLUSION

In this experimental work we discussed about different input parameters like table speed, hydraulic oil viscosity and hydraulic system and their influence on vibrational displacement and surface roughness (Ra value) and some findings are found as follows. The vibration does not eliminate completely; it is because of energy conservation law. Experimental result can be concluded as follows:

In this project work, measurement of displacement of is done by FFT Analyzer and it is directly proportional to the table speed. The surface roughness is checked by surface roughness tester. The surface roughness is highly influenced by surface speed of grinder as the surface speed of grinder is more, surface finish is more fine means have low Ra value. The power consumption is almost stable for various table speed, it dependent on hydraulic oil viscosity. It is observed that the optimum value for the different parameters is on Hydraulic oil no. 68. The above tests are carried out while keeping the other parameter constant. The output parameters are better for proportional hydraulic system than mechanical hydraulic system. So company switched over to the proportional direction control valve of hydraulic system from mechanical direction control valve of hydraulic system.

Following findings (say conclusion) are drawn from present study.

- Amplitude of vibration is in the form of energy conversion is directly depends on table speed or momentum of table and produce a jerk while reversing the table.
- Surface roughness (Ra value) is directly depend on surface speed of grinding wheel, so for lower table speed produce good surface means lower the (Ra value)
- Power consumption is directly depending on thickness of hydraulic oil i.e. viscosity of oil. Power consumption is more at higher number of viscosity. So among VG 46, VG 68, VG 100, company used VG 68 hydraulic oil for better performance.

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