

# EXPERIMENTAL INVESTIGATION OF REDUCING THE VIBRATION OF HYDRAULIC SURFACE GRINDING MACHINE WHILE REVERSING THE TABLE

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**ABSTRACT:** Hydraulic Surface Grinding Machine used for fine surface finishing of job. It consists of base, column, reciprocating table with magnetic chuck, spindle with grinding wheel, electric motor and hydraulic system with electric motor. Vibration produce bad effect on machine as well as produce chattering effect means bad surface finish on work piece. It is necessary to investigate causes and respective measures to control the vibration. 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 to normal working position. The present paper focus on different parameters and its effects to reduce the jerk or vibration while reversing the table. Vibration in grinding machine is hard to measure while reversing the table. Such vibration occurs due to impulsive force of table. This vibration further damped by varies means. The vibrations of table of hydraulic grinding machine are minimizing by controlling the speed and pressure of fluid.

Vibration occurs when a system is displaced from a position of stable equilibrium. The system returns to equilibrium position under the action of restoring forces (such as the elastic forces, as for a mass attached to a spring, or gravitational forces, as for a simple pendulum). The system keeps moving back and forth across its position of equilibrium. A system is a combination of elements intended to act together to accomplish an objective.

Vibration in grinding machine is hard to measure. It is observed from the formation of waviness on the work piece and grinding wheel. The major causes of vibration in grinding machine are misalignment and unbalancing. These unwanted vibrations will reduce the life of both machine and tool, resulting in loss of production. Vibration measurement is done by different approaches. This paper explains the vibration measurement done by vibrometer. The vibrations are minimized by introducing dampers, made of rubber and springs. The vibration is isolated due to the elasticity and energy absorbing property of rubber. The vibrations of table of hydraulic grinding machine are minimizing by controlling the speed and pressure of fluid.

**KEY WORDS:** HYDRAULIC SURFACE GRINDING MACHINE, VIBRATION ANALYSIS, DAMPERS, 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 position of equilibrium. Most of vibrations are undesirable in machines and structures because they produce increased stresses, energy losses, cause more wear, increase bearing loads, induce fatigue strength, create passenger discomfort in vehicles and absorb energy from the system, it also causes poor surface finish in any grinder. Rotating machine parts need careful dynamic balancing in order to prevent damage due to vibrations.

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 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 intended to act together to accomplish an objective.

Reciprocating, impacting and rotating equipment create shock and free or forced vibration which is induce in machine and further transmitted into their support systems. Rotating machines and equipment that are not properly balanced produce unbalance centrifugal forces creating vibration. Machines generating pulses or impacts such as surface grinding machine, forging presses, injection molding, impact testers, hammers, centrifugal pumps and compressors are the most predominate sources of shock and vibration. In metal cutting process vibration can cause chatter, which leads to a poor surface finish.

## II. NEED OF ANALYSIS

The vibration analysis has special significance in view of following views:

- 1) It helps to improves surface finishing quality of finished products.
- 2) It helps to improve the design of machine parts to improve the life of machine.
- 3) It helps to modify the design of vibration dampers (thickness of tursite layer, sliding surface area etc.) by analyzing the amplitude and its frequency.
- 4) In some cases it helps to avoid resonance condition of machine.

## III. CAUSES OF VIBRATION

Amplitude and frequency are the two factors which cause damage the components of machine. The sources which produce or tend to produce the amplitude and frequency of vibration are the causes of vibration. The sources are known as excitation. These sources or

excitation arises from imbalance in rotating machine parts, reciprocating tables, improper alignments in couplings, improper in designing of parts, available tolerances in parts, bad surface finish for machine parts (which have relative motion with respect to one another) etc. These sources can be periodic or a periodic in nature. Periodic excitation means impulsive force acting to produce force vibration.

#### IV. LITRETURE REVIEW

Through this, focus on the various journals papers on study done on the concept of hydraulic surface grinding machine. Most of literature covers the related parameters such as grinding wheel specifications, RPM of grinding wheel, depth of cut, feed, materials to be machined there effects on surface finish as well as vibration. This topic covers the jerk , impulse cause vibration while reversing the table of hydraulic surface grinding machine.

- 1) **Simranjit Singh, Amandeep Singh** presented a paper on free vibration analysis on cantilever beam. They have done vibration analysis on calculation of natural frequency and damping ratio on cantilever beam on different material under free vibration. The aim of their study was to calculate the vibration nature of various materials. They also consider the effect cracks on vibration values.
- 2) **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.
- 3) **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.
- 4) **Kamaldeep Singh, DR. Beant Singh, Mandeep Kumar** have done experiments on machining characteristics of surface grinding machine with AISI D3 tool steel. They have done experiments to obtain good surface finish by changing various working parameters. They prepared charts for working parameters with surface finish. And finally come to the conclusion that depth of cut and vibration incurred is major factor of surface finish.

#### V. PROBLEM DEFINITION

Measuring the jerk or vibration of hydraulic surface grinder with magnetic bed size 20'X08' displaced to 8.81  $\mu\text{m}$  with frequency 13.79 Hz from its mean position as per experiment. This vibration damped out up to certain milliseconds. This vibration comes on the surface finish and observed waviness surface finish.. This problem of vibration could not eliminate completely but could be reduced to some extent and to improve surface finish and to save machine time. This problem of vibration while reversing the table occurs due to the following reasons.

- 1) Hydraulic system with conventional directional control valve.
- 2) Hydraulic system with conventional flow and pressure control valve.
- 3) Improper dampers between table and machine.
- 4) Not using proper structure design for hydraulic surface grinder.
- 5) Check oiling system for table and machine.

#### 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. The table is moving with velocity 0.167 m/s. The vibration measurement instrument FFT analyzer is used to analyzing the vibration in frequency versus displacement form. We shall consider the surface grinding machine as vertical column structure and is consider symmetric about vertical axis its centre of gravity act at a certain point from the base. The vibration analysis of reciprocating tables with conventional hydraulic 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. The proportion control hydraulic valve or electro hydraulic valve can regulates the excess pressure developed due to hammering. The first measures to control vibrations is try to change the sources (e.g. hammering of hydraulic fluid, centre of gravity of machine here consider as structure, tolerance between the moving parts, oiling between the moving parts, damping materials etc.) caused to vibration so that it produces less vibration. This technique may or may not be feasible. On the other hand, certain source such as unbalance in rotating can be altered to reduce the vibrations.

#### VII. RESULT

Vibration control of hydraulic surface grinding machine is done by various techniques. In this case hydraulic system with proportional control valves, proper damping and machine parts tolerances. These parameters control the jerk or bump efficiently at reversing the table. The dampers are made up of the rubber or elastomer. 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 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. It shows that severity of vibration is less by using above methods.

#### VIII. CONCLUSION

The complete solution of vibration of hydraulic surface grinding machine is not feasible. The vibration occurs not only by the reciprocating table but also by moving the table in feed while reversing. It means to control the vibrations while reversing the table, to consider the vibrations in both directions. In this topic this paper focus on the vibration only along the table is moving. Here we calculate the frequency and amplitude in one direction only and study the respective measures to minimize the vibration. The main objective is to reduce the amplitude and the length or time of wave so that the grinding time will be less and the surface finish of the job would be in tolerance.

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