Proceedings of Conference On Insights in mechanical Engineering (IME-19)
In Association with Novateur Publications IJIERT-ISSN No: 2394-3696
ISBN. No. 978-93-87901-04-9
March, 1st March 2019

Paper ID MD 01

VIBRATION MONITORING AND ANALYSIS IN MACHINING

Khatake Pranali B
Assistant Professor, Department Of Mechanical Engineering, ICEM, Pune
* pranali.khatake@gmail.com

Admane Ashwini A
Assistant Professor, Department Of Mechanical Engineering, ICEM, Pune
* ashwini.admane@indiraicem.ac.in

ABSTRACT
In day to day life, we all realise the vibration in one or the other form. Different types of vibration, we observe in many things. Vibrations occurred in Machines, Engines etc are creating problems in manufacturing industry, to resolve these problems, vibration analysis is important. This Paper gives the information about the conditional monitoring and factors that determine the characteristics of machine vibration and elaborate the measurement and control of cutting tool vibrations.
KEY WORDS-vibration response, vibrating system, damper, analyser.

1. Introduction
Vibration analysis is used to determine the operating and mechanical condition of equipment. A major advantage is that vibration analysis can identify developing problems before they become too serious and cause unscheduled downtime. This can be achieved by conducting regular monitoring of machine vibrations either on continuous basis or at scheduled intervals. Regular vibration monitoring can detect deteriorating or defective bearings, mechanical looseness and worn or broken gears. Vibration analysis can also detect misalignment and unbalance before these conditions result in bearing or shaft deterioration. Trending vibration levels can identify poor maintenance practices, such as improper bearing installation and replacement, inaccurate shaft alignment or imprecise rotor balancing. All rotating machines produce vibrations that are a function of the machine dynamics, such as the alignment and balance of the rotating parts. Measuring the amplitude of vibration at certain frequencies can provide valuable information about the accuracy of shaft alignment and balance, the condition of bearings or gears, and on the machine due to resonance from the housings, piping and other structures. Vibration measurement is an effective, non-intrusive method to monitor machine condition during start-ups, shutdowns and normal operation.
Vibration analysis is used primarily on rotating equipment such as steam and gas turbines, pumps, motors, compressors, paper machines, rolling mills, machine tools and gearboxes. Recent advances in technology allow a limited analysis of reciprocating equipment such as large diesel engines and reciprocating compressors. These machines also need other techniques to fully monitor their operation.
A vibration analysis system usually consists of four basic parts:
1. Signal pickup(s), also called a transducer
2. A signal analyzer
3. Analysis software
4. A computer for data analysis and storage.

1.1Vibration Monitoring
Condition monitoring is concerned with the analysis and interpretation of signals from sensors and transducers installed on operational machinery, employing sensors positioned outside the machine, often remove from the machine components being monitored, normally does the monitoring of a machine condition and health, using established techniques, the analysis of information provided by the sensor output and interpretation of the evaluated output is the needed to establish what actions to be taken.

1.2 Vibration Analysis-Benefits
Vibration analysis can identify improper maintenance or repair practices. These can include improper bearing installation and replacement, inaccurate shaft alignment or imprecise rotor balancing. As almost 80% of common rotating equipment problems are related to misalignment and unbalance, vibration analysis is an important tool that can be used to reduce or eliminate recurring machine problems. Trending vibration levels can also identify improper production practices, such as using equipment beyond their design specifications

(higher temperatures, speeds or loads).These trends can also be used to compare similar machines from different manufacturers in order to determine if design benefits or jaws are reflected in increased or decreased performance. Ultimately, vibration analysis can be used as part of an overall program to significantly improve equipment reliability. This can include more precise alignment and balancing, better quality installations and repairs, and continuously lowering the average vibration levels of equipment in the plant.

2 LITERATURE REVIEW

1. Yao et al.[1] developed a chatter suppression method based on parametric excitation The effect of parametric excitation on self-excited vibration was investigated based on a model of a vanderPol-Mathieu-Duffing oscillator with a time delay.It reveals that there can be a zero solution for the oscillator under the effect of parametric-excitation, while it is impossible to have a stable zero equation without parametric excitation. The stability of a parametrically excited vibration system regarding the regenerative effect in the cutting processes was studied by the averaging method. The stability analysis shows that parametric excitation with an appropriate frequency and large amplitude has a chatter suppression effect no matter whether the waveform is a sinusoidal wave, square wave or triangular wave. To validate the effect of parametric excitation for chatter suppression, experiments were conducted based on a magneto rheological (MR) fluid-controlled boring bar, which can generate high-frequency parametric excitation based on the quick response of the MR fluid. Cutting experiments with an excitation current of different waveforms and diverse frequencies show that chatter can be significantly suppressed by the effect of parametric excitation.

1. K. Ramesh and T. Alwarsamy [2] found that the regenerative chatter occurs whenever cuts overlap and the cut produced at a particular time and leaves small waves in the material that are regenerated with each subsequent pass of the tool. It limits cutting depth and surface finish which causes premature tool failure. The main objective of the work is to reduce the chatter then by changing the boring bar design. In order to improve stiffness and damping capability of boring tool, an impact damper is provided. In this investigation, improvement of the damping capability of boring tool and suppression of chatter is obtained with four different types of damping materials based on their availability, strength, density, Young's modulus, thermal conductivity, poison's ratio.

3 VIBRATION MEASUREMENT

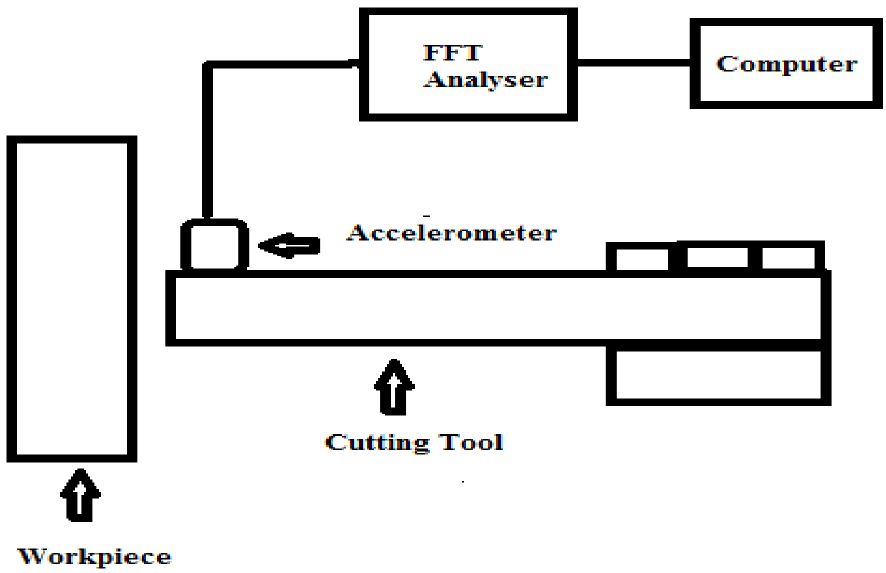

Fig 3.1 Schematic diagram of Experimental Setup for vibration Measurement in Machining

1. Transducer (Accelerometer)-Among the transducers piezoelectric transducers are most popular. A piezoelectric transducers can be designed to produce signals proportional to either force or acceleration.In an accelerometer, the piezoelectric material acts as a stiff spring that causes the transducer to have a resonant and natural frequency.Usually the maximum measurable frequency of an accelerometer is a fraction of its natural frequency.

Fig 3.2 Accelerometer

2. Analyser-The response signal after conditioning is sent to an analyser for signal processing .A commonly used analyser is called a Fast Fourier Transform (FFT) analyser, such as analyser receives analog voltage signals (representing displacement, velocity, acceleration strain or force

Fig 3.3 FFT Analyser

3.1 Vibration Control:-

The response of a structure to a time-varying input depends on the stiffness, damping, and mass of the structure. Therefore the reduction of the vibration response might be possible by using one or several of the following solutions:

i Reducing input,
ii increasing stiffness and mass and
iii increasing damping.

In machining the input energy is difficult to control since it depends on the operational Conditions. A reduction of the input energy will affect, in most cases, the productivity of that particular machining operation. High stiffness and damping are both necessary, but not individually sufficient requirements for a machining operation. In recent years it has been observed that the trend in machine tool design is going towards lightweight structures. This means that vibrations are transmitted with higher Intensity. However, low mass can help to increase the controllable bandwidth, but, on the other hand, high mass does diminish high-frequency vibration. Increasing stiffness would cause a mode to shift upwards in frequency; however, given the random excitation of machine tool structures due to the dynamic cutting force, this solution would not secure a vibration-free machining. The major restrictions on the implementation of the damping treatment are;

i Weight
ii The treatment has to be applied without disassembly of the components.

The benefits of passive damping for vibration suppression are well established in various fields of mechanical engineering applications. Engineered passive damping for structures is usually based on one of four damping technologies

i Viscoelastic polymers,
ii Viscous fluids,
iii Magnetic and
iv Passive piezoelectric

All passive damping treatments work by absorbing significant amounts of strain
energy from the vibration modes of interest and dissipating this energy through mechanism. The principle of passive damping is to enhance the damping ability of the tool without actively compensating for the upcoming vibrations. A common way to achieve passive damping is by using viscoelastic materials to dissipate the energy that causes vibration. Viscoelastic polymers provide high energy dissipation. Viscoelastic ally damped structures have been successfully applied in many engineering fields.

4 Conclusion:-

We can monitor and measure vibration in machining by the above technique, to minimize vibration in machining, tool vibration reduction should be the main thing. To minimize the tool vibration different techniques are there, Observations obtained from reviewed papers that viscoelastic dampers gives the better effect in reduction of tool vibration.VE dampers are easy to manufacture and cheap in cost. They gives high damping effect also. The most important advantage of VE polymers is their high loss factor and low storage modulus.

5 REFERENCES:-

1) 1 Zhehe Yao, Deqing Mei, Zichen Chen, “Chatter suppression by parametric excitation: Model and experiments", Journal of Sound and Vibration, (Vol. 330, pp.2995-3005, 2011).
2) K. Ramesh, T. Alwarsamy, “Investigation of Modal Analysis in the Stability
3) of Boring Tool using Double Impact Dampers Model Development", European
4) Journal of Scientific Research, (Vol. 80, pp. 182-190, 2012).
5) 3 G. Suresh Babu, Dr. V. Chittaranjan Das“Condition Monitoring and vibration analysis of boiler feed pump” International Journal of Scientific and Research Publications, (Volume 3, Issue 6, June 2013 1 ISSN 2250-3153)
6) 4 Satish V. Dawange1, V. L. Kadlag “A Review Paper on Vibration Analysis of DI Engine” International Journal of Science and Research (Volume4, Issue 2 Feb 2015 ISSN 2319-7064) 5.Vishnu Kv,Anoop Bk, Adarsh Ks“Vibration Analysis: A Literature Review”IOSR
7) (Volume 10,Issue 5, Oct 2015 ISSN 2278-2834)