

Comparative Vibration Analysis on a Drilling Machine by using Piezoelectric Sensor

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Abstract— Vibrations are common in every machine and structure. There are many causes of vibration like misalignment, imbalance, wear etc. Due to these vibrations and chatter the components made by machines have considerable variation in dimension as compared to basic dimension. Efforts are made to analyze and minimize vibration so that productivity can be improved. Drilling machine is no such exception. Mainly machining parameters are feed, depth of cut and cutting velocity. So by varying these parameters different vibration data can be obtained. By Using the specific way, the vibration data can be collected, the data can be helpful in controlling the performance of the machines. This work present the way of recording the vibration signals for different materials by using specific software and device. To establish the connection between data acquired in computer and drilling machine which is attached to piezoelectric sensor Visual Basic (VB) based programme is used. Finally a comparative study of vibration signals between different materials has been made in this work.

Key words: Feed, Depth of Cut, Drilling Machine, Piezoelectric Sensor Etc

I. INTRODUCTION

Vibration is defined as the to and fro movement of machines or machine components. Any component that moves

To or fro or oscillates about a mean position is a Vibrating machine. Vibration can take various forms. A machine component may subject to vibration over large or small distance results in dissipation of heat and energy. Machine vibration can often be intentionally designed like in case of washing machine. On other hand machine vibration can be unintended and lead to machine damage. Not all kind of machine vibration is undesirable. For example, conveyors, surface finisher compactors are often used in the industry.

Some of the most common machinery problems that cause vibration include:

- 1) Misalignment of couplings, bearings and gears
- 2) Unbalance of rotating components which may occur due to manufacturing defect
- 3) Looseness of parts
- 4) Deterioration of rolling-element bearings
- 5) Mating part wear like wear of gear
- 6) Rubbing
- 7) Aerodynamic/hydraulic problems in fans, blowers and pumps
- 8) Electrical problems (unbalance magnetic forces) in motors
- 9) Resonance
- 10) Eccentricity of rotating components such as "V" belt pulleys or gears.

Vibrations occur in conventional drilling machine because there are residual forces that are applied onto

structures and machines. In drills for deep hole machining, chatter vibration tends to occur because their bending stiffness and viscous damping are much lower than with the other cutting tools. Due to this chatter vibration not only there is reduction in tool life but also accuracy of machined hole decreases. Vibration signals that are obtained from machining processes contain very useful information and offer excellent possibilities for the analysis.

Therefore, the vibration analysis is carried out on a conventional drilling machine.

C. sanjay [1] in his work of Vibration signature analysis performed the Drill Wear Monitoring and made an attempt to identify suitable parameters, the monitoring of which will ensure prediction Of drill failure. M. Ubartas et.al. [2] in his work done analysis on Experimental investigation of vibrational drilling and tried to maximize the degree of reduction of surface roughness as well as axial cutting force and torque. M. S. H. Bhuiyan et. al. [3] have done several experiments to develop a more promising tool condition monitoring system using the acoustic emission and vibration phenomena. Krishna Mohana Rao. G et. al. [4] conducted an Experimental Analysis of Passive Damping Technique on Conventional Radial Drilling Machine tool bed using Composite Materials and gave some useful results for the comparative study of vibration signals with and without the use of layer of composite materials below the mild steel specimen. Sharad Kumar Shukla et. al. [5] analyzed the vibration on radial drilling machine using piezoelectric sensor and gave some experimental results for the comparative study of vibration signals for different sites of a radial drilling machine.

The aim of the present work is to record the vibration signals by taking three different materials and by using two different drill bits. Also analysis have been done by using signals as the input and make a comparative study between all materials on the basis of vibration signals obtained during the drilling operation.

II. EXPERIMENTAL SETUP

For the experimental purpose the Drilling operation is performed on three different types of materials (Wood, Aluminium and Mild steel). The drilling operation is performed by using two different types of drill bit (5mm and 7.5mm). The other working parameters are shown below in Table 1.

S. No	Material	Depth of Cut	Drill bit Diameter	Speed (rpm)	Feed Rate (mm/rev)
1	Wood	5 mm	5mm & 7.5mm	260	.0256
2	Aluminium	5 mm	5mm & 7.5mm	260	.0256
3	Mild Steel	5 mm	5mm & 7.5mm	260	.0256

Table 1: Setup

To record vibration signals, piezoelectric sensor is attached that can detect vibration behavior of a body that is being measured. In the present work the sensor is attached directly on the work piece. Various types of vibration sensors are available, but a type called piezoelectric sensor is used in this research work as it has several merits over other sensors. The sensor passes the received signal to the Analog to digital converter (ADC Converter) which is followed by the microcontroller and finally the output data can be obtained on a LCD display simultaneously a graph between Time Vs Amplitude can be obtained on the system.

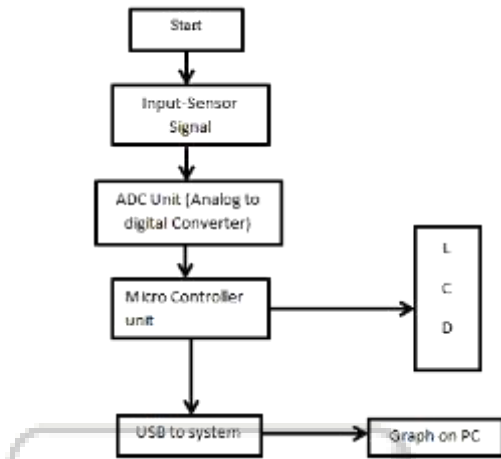


Fig. 1: Experimental Setup Diagram

III. RESULT AND DISCUSSION

The comparative chart for all the three materials that is wood, aluminium and mild steel using a 7.5 mm drill bit is shown in Chart (a) and (b) respectively. In both the chart speed, feed and depth of cut is kept constant so that direct variation of drill bit diameter with material can be obtained.

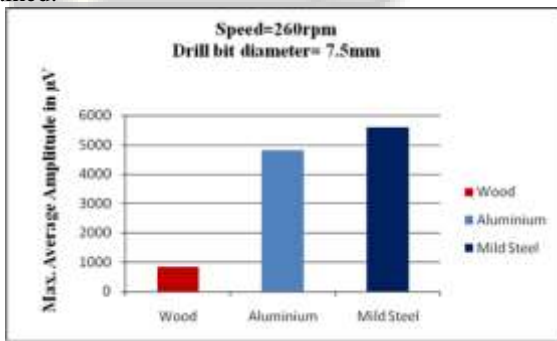


Fig. 2: Chart (a) Comparative chart for Wood, Aluminium and mild steel

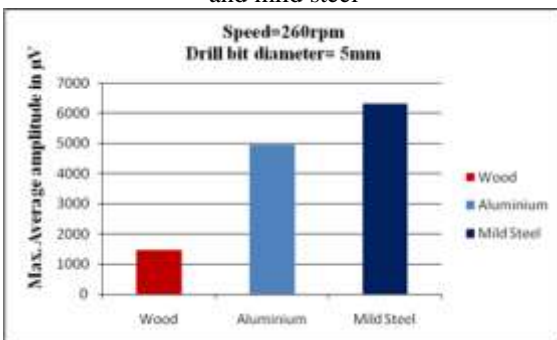


Fig. 3: Chart (b) Comparative chart for Wood, Aluminium and Mild steel

In this research work vibration amplitude analysis on three different types of materials that is on Wood, aluminium and mild steel is done on a bench drill by using piezoelectric sensor. For each material three trials have been taken for the analysis of the vibration Signals. The average amplitude of vibration as obtained for all the materials using 7.5 mm and 5 mm drill diameter respectively are shown in Chart (a) and (b) respectively. From the chart (a) it is clear that the average magnitude of vibration in three trials of wood using 7.5 mm drill diameter is 823µV whereas the average amplitude of vibration of Aluminium using 7.5 mm drill diameter is 4821µV and finally the average amplitude of Mild steel using 7.5 mm drill diameter is 5581µV. Similarly from Chart (b) average magnitude of vibration in three trials of wood using 5 mm drill diameter is 1462µV, whereas the average amplitude of Aluminium using 5 mm drill diameter is 4930µV and finally the average amplitude of Mild steel using 5 mm drill diameter is 7366.66µV.

IV. CONCLUSION

The current work aimed to apply a technique to understand the vibration characteristics of different materials in drilling process using a low cost piezoelectric sensor. The VISUAL BASIC (VB) based graph on three different types of materials (Wood, Aluminium, Mild steel) shows the amplitude of vibration (in µV). Three trials were made for each material by keeping the speed, feed and depth of cut constant but using two different drill bits of diameter 5 mm and 7.5 mm respectively. The study reveals that the intensity of vibration varies from material to material that is when we change the material keeping other parameters constant, amplitude of vibration also goes on changing. By performing repeated experiments conclusion is made that the intensity of vibration is maximum for mild steel, medium for Aluminium and minimum for wood. At last on the basis of analysis we also conclude that as wood itself is a soft and high impact resistant material therefore vibration is minimum for wood and maximum for mild steel. In other words it can be said that vibration amplitude follows the order of hardness of material as Mild steel is more harder than Aluminium and Aluminium is more harder than wood.

REFERENCES

- [1] C. Sanjay “Drill wear monitoring by vibration Signature analysis”, Journal – The Institution of Engineers, Malaysia (Vol. 68, No. 1, March 2007)
- [2] M. Ubarta, V. Ostasevicius, S. Samper, V. Jurenas and R. Dauksevicius “Experimental Investigation of Vibrational Drilling” ISSN 1392 -1207. Mechanika. 2011. 17(4): 368-373.
- [3] M. S. H. Bhuiyan, I. A. Choudhury, and Y. Nukman “Tool Condition Monitoring using Acoustic Emission and Vibration Signature in Turning”, Proceedings of the World Congress on Engineering 2012 Vol. III
- [4] Krishna Mohana Rao. G, and Vijay Mohan. S “Experimental Analysis of Passive Damping Technique on Conventional Radial Drilling Machine Tool Bed using Composite Materials”, International Journal of Mining, Metallurgy & Mechanical Engineering (IJMME) Volume 1, Issue 2 (2013) ISSN 2320–4060.

- [5] Sharad Kumar Shukla and Akhilesh Lodwal
“Experimental Analysis Of Vibration On Radial
Drilling Machine Using Piezoelectric Sensor”, Bookman
International Journal of Mechanical and Civil
Engineering, Vol. 2 No. 1 (2013) ISSN 2319-4286.

