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COMPARATIVE STUDY OF VIBRATION ISOLATORS USING PARAMETER TRANSMISSIBILITY

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ABSTRACT

In this paper, the concept of the output frequency response curve (OFRC) is applied to conclude the transmissib ility of vibration isolators with a non-linear anti-symmetric damping curve. Materials wood, natural rubber, pol yurethane, wood with rubber pad combination used for damping the vibrations from test rig. The results reveal t hat a non-linear anti-symmetric damping can significantly reduce the transmissibility of the vibration isolators over the resonant frequency region. FFT analyser is used for Vibration and frequency measurement. Results ind icate that non-linear vibration isolators that are, increasing the level of damping to reduce the transmissibility a t the resonance could increase the transmissibility over the range of higher frequency.

Keywords: Wood, natural rubber, polyurethane wood combination, transmissibility, resonant frequ ency, FFT analyser.

I. INTRODUCTION:

A vibration isolator is a device that is use inserted between a support base and equipment to reduce the vibration energy transmission from the support base so as to protect the equipment from non-linear vibrations. A magnitu de (force, displacement, or acceleration) which oscillates about some specified reference where the magnitude o f the force, displacement, or acceleration is alternately smaller and greater than the reference. Vibration is comm only expressed in terms of frequency (cycles per second or Hz). [1]

The FFT spectrum analyser samples the input signal, computes the magnitude of its sine and cosine components , and displays the spectrum of these measured frequency components.

The advantage of this technique is its speed. Because FFT spectrum analysers measure all frequency component s at the same time, the technique offers the possibility of being hundreds of times faster than traditional analog s pectrum analysers. In the case of a 100 kHz span and 400 resolvable frequency bins, the entire spectrum takes o nly 4 Ms to measure. To measure the signal with higher resolution, the time record is increased. But again, all fr equencies are examined simultaneously providing an enormous speed advantage. In order to realize the speed ad vantages of this technique we need to do high speed calculations. And, in order to avoid sacrificing dynamic ran ge, we need high-resolution ADCs. SRS spectrum analysers have the processing power and frontend resolution needed to realize the theoretical benefits of FFT spectrum analysers. [2]

II. SPECTRUM

The spectrum is the basic measurement of an FFT analyser. It is simply the complex FFT. Normally, the magnit ude of the spectrum is displayed. The magnitude is the square root of the FFT times its complex conjugate. (Squ are root of the sum of the real (sine) part squared and the imaginary (cosine) part squared.) The magnitude is a real quantity and represents the total signal amplitude in each frequency bin, independent of phase. If there is phase information in the spectrum, i.e. the time record is triggered in phase with some component of the signal, then the real (cosine) or imaginary (sine) part or the phase may be displayed. The phase is simply the arctangent of the ratio of the imaginary and real parts of each frequency component. The phase is always relative to the start of the Triggered time record. [2]

- **Damping**: Damping is the phenomenon by which energy is dissipated in a vibratory system. Fourier's theorem states that any waveform in the time domain can be represented by the weighted sum of sine and cosines.
- **Damping Coefficient**: Damping for a material is expressed by its damping coefficient.

$$\text{Damping coeff.} = C = \frac{\text{lb} \cdot \text{sec}}{\text{in}}$$

- **Critical Damping:** A system is said to be critically damped when it is displaced from its static position and most quickly returns to this initial static position without any over-oscillation. The damping coefficient required for critical damping can be calculated using

$$C_c = 2\sqrt{KM}$$

- **Damping Factor:** The non-dimensionless ratio which defines the amount of damping in a system.

$$\text{Damping factor} = \frac{C}{C_c} = \zeta$$

- **Resonance:** When the forcing frequency coincides with the natural frequency of a suspension system, this condition is known as resonance.
- **Transmissibility:** Defined as the ratio of the dynamic output to the dynamic input. In order to obtain a low transmissibility over a wide frequency range, the elastic stiffness of the isolator should be as small as possible.to reduces transmissibility at the resonance, it is better to introduce a higher damping in the isolator. This may cause deterioration to the transmissibility over the higher frequency range.[3]

  When resonance occurs

$$T_{\max} = \frac{1}{2\frac{C}{C_c}}$$

III. SPECIMEN

1. **Plywood**-

Plywood is a sheet material manufactured from thin layers or "plies" of wood veneer that are glued together with adjacent layers having their wood grain rotated up to 90 degrees to one another. It is an engineered wood from the family of manufactured boards which includes medium-density fibreboard (MDF) and particle board (chipboard). [4]

2. Polyurethane-

Polyurethane (PUR and PU) is a polymer composed of organic units joined by carbonate (urethane) links. Whil e most polyurethanes are thermosetting polymers that do not melt when heated, thermoplastic polyurethanes ar e also available. [5]

3. Natural rubber-

Rubber exhibits unique physical and chemical properties. Rubber's stress-strain behaviour exhibits the Mullins effect and the Payne effect, and is often modelled as hyperplastic. Rubber strain crystallizes. Due to the presenc e of a double bond in each repeat unit, natural rubber is susceptible to vulcanisation and sensitive to ozone crac king. [6]

4. Combination of natural rubber and Plywood

IV. SPECIFICATION

Dimmer: max. Load-12 amp

Input-240V.50Hz

Output: 0-270V.

Dimensions:

1. Plywood-
2. Polyurethane-
3. Natural rubber-
4. Combination of natural rubber and Plywood -

Sensor used: Accelerometer

Test Rig: Single Rotor system

Fig. Experimental setup

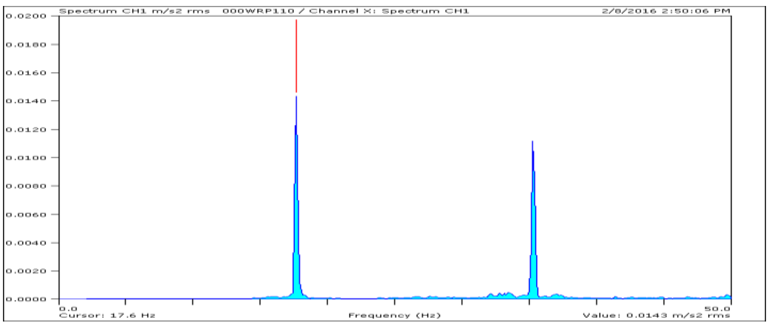

Fig. Combination of Plywood and rubber

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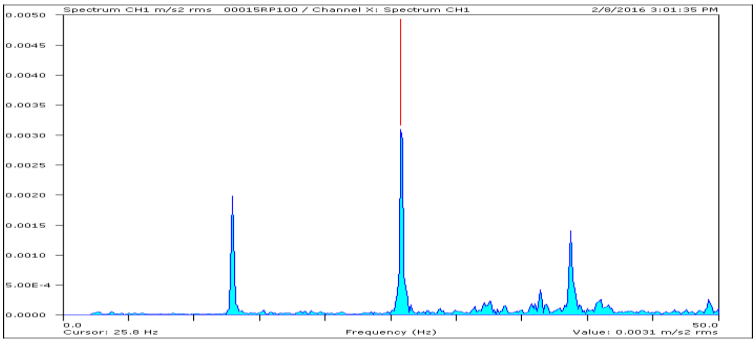

Fig. Natural rubber

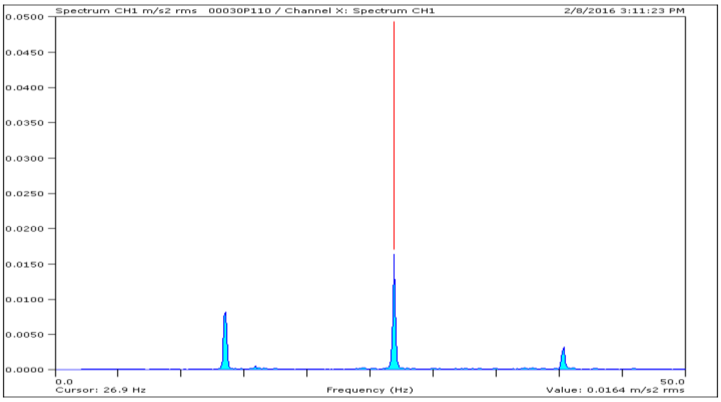

Fig. polyurethane

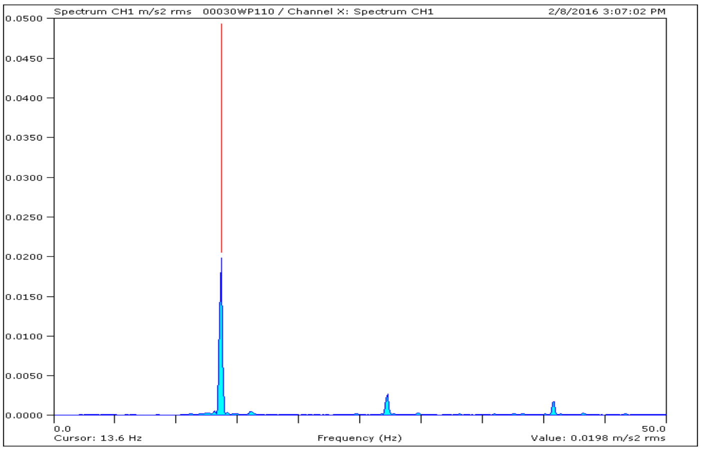

Fig. plywood

Result:

Sr.no	Material	Speed (RPM)	Frequency (Hz)	Overall Acceleration (m/s^2 RMS)
1.	Plywood	100	13.6	0.0198
2.	Natural rubber	100	25.8	0.0031
3.	Polyurethane	100	26.9	0.0164
4.	Combination of plywood and r ubber	100	17.6	0.0143

V. CONCLUSION

1. Vibration transmission through isolators changes by materials.
2. Maximum vibration damping is done by plywood>Combination of plywood and rubber>Natural rubber>Poly urethane.
3. Elasticity and hardness plays important role in vibration transmission.
4. Slots and change in surface area differs the transmissibility

REFERENCE

[1] https://www.google.co.in/url?sa=t&source=web&rct=j&url=http://www.novibration.com/isoselect.pdf&ved=0ahUKEwie_J7rotHLAhUOGI4KHQowA8EQFggZMAA&usg=AFQjCNETAZ-zCo65THqqfsEj6u7QmBEa4A

[2] https:// https://www.google.co.in/url?thinkSRS/about/fftspectrum_analyzers

[3] https://www.google.co.in/search?q=absorbtivity&oq=a&aqs=chrome.0.69i59l3j5l2j69i57.3628j0j4&client=ms-android-htc-rev&sourceid=chrome-mobile&ie=UTF-8

[4] https://en.m.wikipedia.org/wiki/Plywood

[5] https://googleweblight.com/?lite_url=https://en.m.wikipedia.org/wiki/Polyurethane&ei=dwZj50eE&lc=en-IN&s=1&m=239&host=www.google.co.in&ts=1458529982&sig=APY536wdXmRH59GISSX3NRFvMeKSgqQ9-Q

[6] https://en.m.wikipedia.org/wiki/Natural_rubber