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Determination of Damping Coefficient of Engine Oil by Adding Viscosity Index Improver

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Abstract

Oil acts as good damping material. Three types of engine oil 10W30, 15W40 and 20W50 are taken. Two type of viscosity index improver (olefin copolymers) are added in the three types of oil by varying the percentage weight of additive. Free vibration test is carried out for all the above mentioned types of oil at different percentage weight of additives for finding the damping coefficient in Universal Vibration testing machine. It can be seen that as the percentage weight of additive increases the damping coefficient of respective engine oil also increases.

Keywords*: Damping coefficient, engine oil, free vibration, viscosity index improver, etc.*

1. Introduction

Viscous damping is the most common used damping mechanism in vibration analysis. When mechanical system vibrate in a fluid medium such as air, gas, water and oil, the resistance offered by the fluid to the moving body causes energy to be dissipated. In this case, the amount of dissipated energy depends on many factors, such as the viscosity of the fluid, the frequency of vibration and velocity of vibrating body. The viscosity of a fluid is resistance to gradual deformation by shear stress. An ideal fluid has no resistance to shear stress. However, a viscous liquid has substantially greater viscosity than that of water. Engine oil is used for lubrication of internal combustion engines. Lubricants reduce wear on moving parts. The other properties are to clean, inhibit corrosion, improve sealing, and for cooling of the engine.

Friction and wear is caused due to vibration of the component. Form the study it can be seen that there is no experimental evaluation of effect of engine oil viscosity on damping coefficient. The principal of viscous damping is to convert kinetic energy due to vibration to heat. Dampers have been widely used to reduce the amplitude of vibration by absorbing or dissipating energy. Viscous damper designs are adaptable to many applications such as shock absorber in vehicle, viscous torsional damper in engine. Hydraulic oil used for viscous damping is also used to reduce engine wear under severe operating conditions, reduced bearing related wear, good piston deposit control, protection against rust and corrosion. We will focus on viscous damping in this paper and carry out experimental investigation of damping coefficient of different engine oil after adding additives.

2. Material and Method

Oil samples were prepared by adding viscosity index improver. The experiments were preformed in room temperature for different experimental combination for different oil samples. The experiments were performed three times for each run and average of damping coefficient is considered.

2.1 Selection of Viscous Fluid

The viscous fluids are engine oil of viscosity grade SAE10W30, SAE15W40 and SAE20W50 used in four stroke engine with and without additives with the purpose of obtaining the damping coefficient.

The physical properties of engine oil are shown below in table-1 as

Table 1. Typical Properties of Engine Oil

Sr. No	Properties	Grades		
		10W30	15W40	20W50
1	Density @ 15C g/ml	0.72	0.8	0.88
2	Viscosity index	150	140	121
3	Viscosity, Kinematic @ 100C mm^2/s	10.5	14	17.5
4	Viscosity, Kinematic @ 40C mm^2/s	68	107	158.1

2.2 Selection of Additives

Copolymers of ethylene and propylene are called olefin copolymers. The optimum ratio of ethylene-propylene contributes to thickening efficiency. OCP has an important application in engine oils due to high viscosity.
The physical properties of additives are shown below in table-2 as

Table 2. Typical Properties of Additive (OCP)

Sr. No	Properties	Grades	
		A1	A2
1	Appearance	Light golden	Clear to hazy greenish tan
2	Viscosity, Kinematic @ 100C mm^2/s	160	200
3	Viscosity, Kinematic @ 40C mm^2/s	2200	2750

2.3 Experimental Apparatus and Procedure

The apparatus for measuring damping coefficient consist of a drum container, freely vibrating disc, wire, etc. in Universal Vibration Testing Machine. With no oil in the container allow the disc to oscillate and measure the time for some oscillation. Put oil in the drum and note the depth of immersion. Put the sketching pen in the bracket. Allow the disc to vibrate. Allow the pen to descend and see that it is in contact with the paper. Measure the time for some oscillations by means of stop watch. Determine amplitude (X_n) at any position and amplitude(X). The apparatus is shown in the Fig.1.

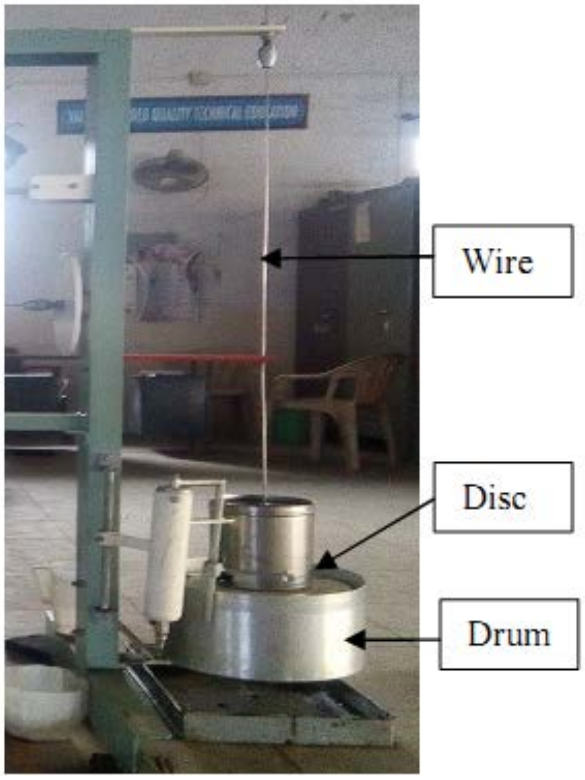

Fig.1. Apparatus for Free Vibration Testing of Engine Oil

2.4 Given data and Formulae for damping coefficient

Mass *(m)* = 6.3 kg
Diameter of container *(D)* = 25cm
Diameter of wire *(d)* = 0.3cm
Length of wire *(L)* = 120cm
Here, polar moment of inertia $(J) = (\pi d^4) / 32$
Moment of inertia $(I) = mk^2$
Hence, $k_t = (G\ J)/L$
Therefore, Critical damping co-efficient $(c_c)=(4\ k_t\ I)^{1/2}$
where, G = Modulus of rigidity
Logarithmic decrement $(\delta) = ln(x_1/x_2)$
Damping co-efficient $(c) = (\delta\ c_c) / 2\pi$

3. Results and Discussions

Damping coefficients of oil samples with and without both additives are determined separately. Fig. 2, 3, 4 shows the damping coefficient of SAE10W30, SAE15W40 and SAE20W50 oil samples respectively with additives 1 & 2.

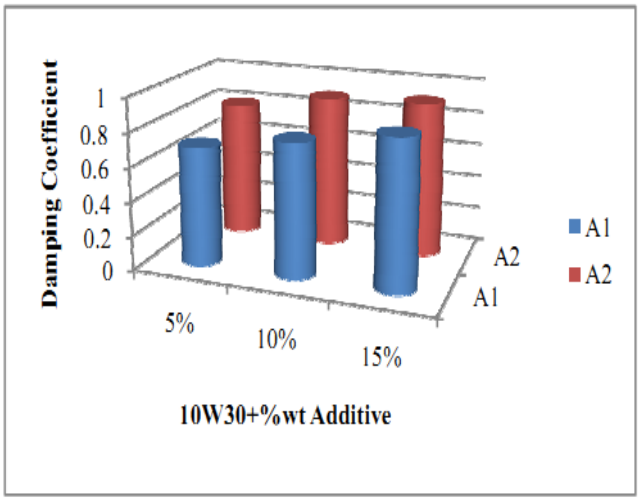

Fig.2. Damping Coefficient of 10W30 with Additive 1&2

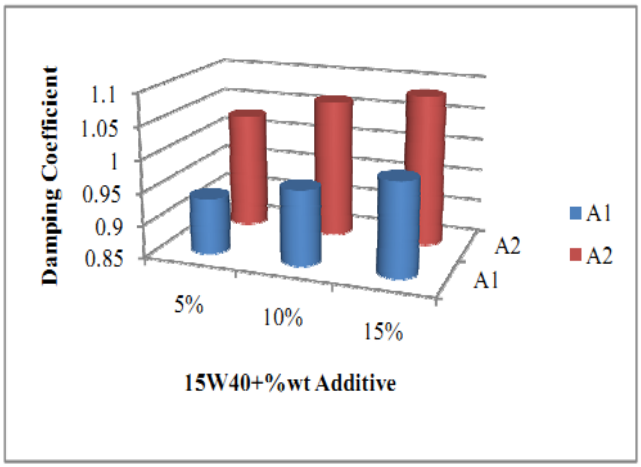

Fig.3. Damping Coefficient of 15W40 with Additive 1&2

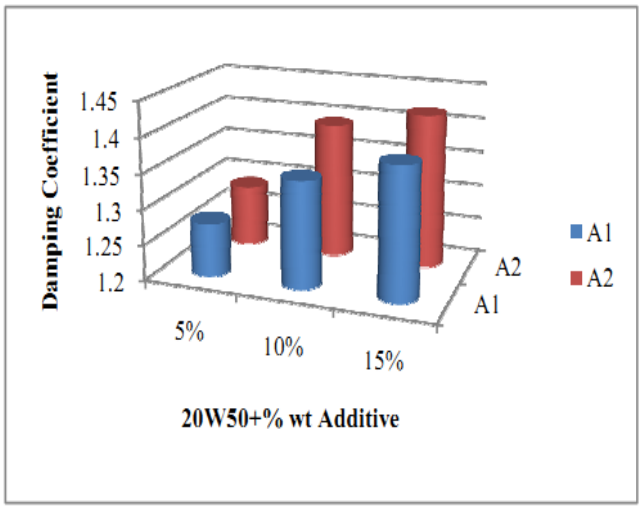

Fig.4. Damping Coefficient of 20W50 with Additive 1&2

4. Conclusions

Engine oil are tested in order to verify the damping coefficient when two additives with different percentage weight are added. The main conclusions are:

- Damping coefficient of oil samples with additive 2 is greater than oil samples with additive 1.
- It can be seen that damping coefficient is directly proportional increase in concentration of additive.
- Maximum damping effect can be obtained with higher damping coefficient of SAE20W50 with additive 2.

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References

[1] Singiresu S. Rao," Mechanical Vibrations", 2004 Pearson Education, Inc., publishing as Prentice Hall, 1 Lake Street, Upper Saddle River, NJ 07458, Fifth edition
[2] Meena Laad, Vijay Kumar S. Jatti, "Titanium oxide nanoparticles as additives in engine oil", Journal of King Saud University – Engineering Sciences, 2016
[3] Mohd Azman Abdullaha, S.A. Salemana, Noreffendy Tamaldina, Muhammad Shahmi Suhaimia, "Reducing Wear and Friction by Means of Lubricants Mixtures", Procedia Engineering, 2013, pp. 338-344
[4] Pavlo Rudenko, Amit Bandyopadhyay, "Talc as friction reducing additive to lubricating oil", Applied Surface Science, 2013, pp. 383-389
[5] Avinash A. Thakre, Ananta Shinde, Ganesh Mundhe, "Improvement in Boundary Lubrication Characteristics of SAE20W40 Oil Using Aluminum

Oxide Nanoparticles", ASME, 034501-4 / Vol. 138, July 2016

[6] Bryan O'Rourke, Donald Radford, Rudolf Stanglmaier, "Tri-Axial Force Measurements on the Cylinder of a Motored SI Engine Operated on Lubricants of Differing Viscosity", ASME, 092807-6 / Vol. 132, September 2010

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