Name: Siddhesh Dilip Khairnar
PRN: 22110398
Roll no: 1421

Experiment No. 2

Title: Experiment on Ultrasonic Interferometer for determination of compressibility of liquid

Aim: To determine the compressibility of liquid, at room temperature, by using an Ultrasonic Interferometer.

Apparatus: Ultrasonic Interferometer, given liquid.

Formulae:

1. Velocity, $v = f \times \lambda$

where, f = frequency of ultrasound produced by quartz crystal.

$\lambda = 2d$, d is the average distance between two consecutive maxima.

2. Compressibility, $\beta = 1 / (\rho v^2)$ Where, v is the velocity of ultrasonic waves through liquid and ρ is density of liquid.

Observations and observation table:

1. Density of liquid (Water), ρ =....1000 kg/m^3....

2.Natural frequency of the quartz crystal, f = 2 MHz = ...2*10^6... Hz

3. Smallest division on the main scale = 0.5mm

No. of divisions on the circular scale = 50 divisions

$Least\ count\ LC$ = Smallest division on the main scale/ No.of divisions on the circular scale = …0.01…mm

Name: Siddhesh Dilip Khairnar
PRN: 22110398
Roll no: 1421

Sr.no.	Micrometer reading (MSR)	Micrometer reading (CSR)	Position of reflector at maximum current TR (mm) =MSR+(LC×CSR)	Distance between consecutive maxima d (mm)	Average 'davg' (mm)	Wavelength of ultrasonic waves, λ (mm)= 2davg
1	9.0	24	9.24	0	0.378	0.756
2	8.5	36	8.86	0.38	0.378	0.756
3	8.5	48	8.48	0.38	0.378	0.756
4	8.0	10	8.10	0.38	0.378	0.756
5	8.0	22	7.72	0.38	0.378	0.756
6	7.5	22	7.72	0.38	0.378	0.756
7	7.0	34	7.34	0.38	0.378	0.756
8	6.5	47	6.97	0.37	0.378	0.756

Wavelength of the ultrasonic waves, = 0.756mm

= 756 *10^-6 m

Calculations:

1. Velocity $v = f\lambda$ = 2*10^6*756*10^-6

= **1512 m/s**

2. Compressibility = β = 1/ ρv ^2

= 1/1000*(1512) ^2

= **4.374178*10^-10** m^2/N

Results: Compressibility of liquid(water) at a temperature of 30 degree Celsius is **4.374178*10^-10** m^2/N

Conclusions: Compressibility of liquid(water) at a temperature of 30 degree Celsius is **4.374178*10^-10** m^2/N

Hence, according to the formula we can determine compressibility of liquid at room temperature using ultrasonic interferometer.

Name: Siddhesh Dilip Khairnar
PRN: 22110398
Roll no: 1421

Questions and answers:

1. Compare the present experiment with Resonance tube experiment carried out in XII standard. What are the commonalities and what are the differences?

Ans: 1) The resonance tube experiment aim was to note the velocity of sound 2) Ultrasonic interferometer is a device which gives accurate data from which one can determine the velocity of ultrasonic sound in a liquid medium and is a system in which it is made to oscillate about its mean position when and external unbalanced force is applied by using a cylindrical tube used to find its velocity.

2. Tabulate the values of Compressibility, Elastic modulus and density for Air, Water, hydraulic oil and stainless steel and discuss the trend.

Ans:

	Air	Water	Hydraulic oil	Stainless Steel
Compressibility	7.56*10^-2	4.35*10^-5 l/bar	Nearly zero because it does not exhibit this property	163*10^9 Pa
Elastic modulus	101 kPa	2.2 GPa	Huge value in GPa	200 GPa
Density	1.225 kg/m^3	997 kg/m^3	833.34 kg/m^3	7.85 Mg/m^3

3. What is the role of compressibility in pneumatic and hydraulic machines?

Name: Siddhesh Dilip Khairnar
PRN: 22110398
Roll no: 1421

Ans: Pneumatics uses an easily compressible gas such as air or a suitable pure gas— while hydraulics uses relatively incompressible liquid media such as oil. Most industrial pneumatic applications use pressures of about 80 to 100 pounds per square inch (550 to 690 kPa).

4. Connect this experiment with Unit I on Vibrations.

Ans: 1) Ultrasonics, vibrations of frequencies greater than the upper limit of the audible range for humans—that is, greater than about 20Khz
2) An ultrasonic transducer is a device used to convert some other type of energy into an ultrasonic vibration

3) Electromechanical Transducers include piezoelectric devices. piezoelectric crystal, which converts an oscillating electric field applied to the crystal into a mechanical vibration

4) When electricity is passed through a certain material, vibrate very quickly. This is called piezoelectricity.

5)An ultrasonic transducer converts other forms of energy into an ultrasonic vibrations.eg mechanical into electrical and vice versa

6)It is a type of sound related sensor. The transducer sends electrical vibrations to the object, the object reverts back the signal.

7)In this process the distance of the object, velocity, compressibility can be calculated too.

8)The mechanical vibration are nothing but stationary waves forming nodes and antinodes and by knowing the distance between two nodes and antinodes we can easily calculate the velocity of the waves and eventually we get the value of compressibility of liquids, hence the concept of vibrations from unit one is used in this experiment.