PROJECT 5

AIM

To compare the effectiveness of different materials as absorbers of sound.

APPARATUS AND MATERIALS REQUIRED

An audio frequency oscillator, cathode ray oscilloscope (CRO), two transformers, a microphone, a speaker (8 Ω), absorbing materials such as glass sheet, cardboard, plywood and fibre board having roughly the same thickness, 4 cardboard sheets of different thicknesses, screw gauge, vernier calipers and a metre scale.

PRINCIPLE

When sound waves travel through a material, part of its mechanical energy is absorbed by the material. The degree of absorption of sound energy by a material depends upon

(i) the nature of material and

(ii) the thickness of the material through which sound waves are made to pass.

PROCEDURE

1. Take sheets of different absorbing materials such as glass sheet, cardboard, plywood and fibre board sheets.

2. Measure the thickness of each material with the help of screw gauge/vernier calipers/metre scale.

3. Make the circuit arrangement of various components as shown in Fig. P 5.1. High impedence coils L_1 and L_4 of the two transformers are to be connected to an audio frequency oscillator and a CRO respectively. Speaker and the microphone are to be connected to the low resistance coils L_2 and L_3 of the two transformers in order to achieve impedence-matching of the coils.

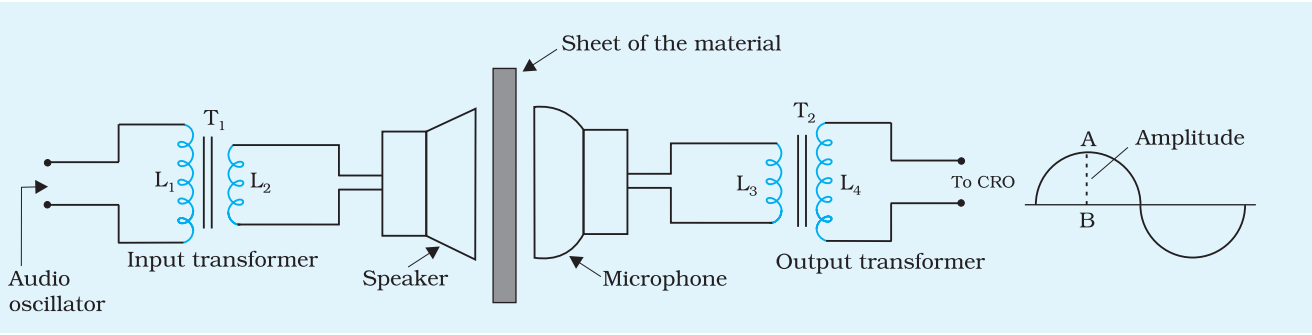

Fig. P. 5.1: *Circuit arrangement for comparing effectiveness of different materials as absorbers of sound*

4. Adjust the CRO such that a suitable wave form appears on the screen.
5. Feed an audio signal of known frequency from the audio oscillator to the speaker and note the amplitude of the corresponding audio signal on the CRO, without any sheet between the speaker and microphone.
6. Without changing the distance between speaker and microphone, insert one by one sheets of different materials, i.e., glass, cardboard, plywood, fibreboard (having same thickness) in between the speaker and the microphone and each time note the amplitude of the corresponding audio signal on the CRO graduated screen.
7. Record the observations in tabular form to analyse the relation between the degree of absorption of sound energy and the nature of the absorbing material.
8. Insert four sheets of different thicknesses of the same material (say cardboard) one by one in between the speaker and the microphone.
9. Repeat Steps 5 and 6 of the experiment.
10. Record the observations in tabular form to analyse the degree of absorption of sound with the thickness of the absorbing material.

OBSERVATIONS

1. Least count of screw gauge/vernier valipers = ... mm
2. Thickness of cardboard = ... mm

   Thickness of glass sheet = ... mm

   Thickness of fireboard = ... mm

   Thickness of plywood = ... mm
3. Frequency of the audio signal used = ... Hz

Table P 5.1: Degree of absorption of sound in different absorbing materials of same thickness.

No. of observations	Name of absorbing material	Amplitude of wave on CRO (mm)		
		Before insertion of absorbing material A_0	After insertion of absorbing material A_1	$\frac{A_1}{A_0}$
1.	Glass			
2.	Card board			
3.	Fibre board			
4.	Plywood			

Table P 5.2: Variation in degree of absorption of sound for different thicknesses of the same absorbing material

No. of observations	Thickness of absorbing material	Amplitude of wave on CRO (mm)		
		Before insertion of absorbing material A_0	After insertion of absorbing material A_1	$\frac{A_1}{A_0}$
1.				
2.				
3.				
4.				

CALCULATION

1. Find the ratio of amplitude of the waveform before and after insertion of the absorbing material from the experiment data recorded in Table P 5.1.
2. Find the ratio of amplitude of the waveform before and after insertion of the absorbing material of different thicknesses and infer its dependence on absorption of sound.

RESULT

1. Degree of absorption of sound waves is maximum in .... (material) and minimum in ... (material).

2. Degree of absorption of sound waves increases/decreases with increase in the thickness of absorbing material (cardboard).

PRECAUTIONS

1. The amplitude of the input audio signal is kept constant while performing the experiment, with different absorbing materials of same thickness.
2. The thickness of absorbing material should not be so high that the corresponding output signal on the screen of CRO is no longer measurable.
3. The respective positions of the speaker, microphone and absorbing material sheets for all sets of experiment should be kept unchanged.

SUGGESTED ADDITIONAL EXPERIMENTS/ACTIVITIES

1. Plot a graph between the density (along x-axis) and the ratio of the amplitudes of the waveform (along y-axis) after and before insertion of the absorbing material (Table P 2.1). Study the nature of the graph and interpret it.
2. Plot a graph between the thickness (along x-axis) of the absorbing material and the ratio of the amplitude of the wave form (along y-axis) after and before insertion of the absorbing material (Table P 5.2). Study the nature of the graph and interpret it.