Applying Helmholtz resonator to determine speed of sound

P Disrattakit[1]* and J Disrattakit[2]*

Division of Physics, [1]Mahidol Wittayanusorn School, Nakhon Pathom, 73170, Thailand
[2]Department of Physics, Srinakharinwirot University, Sukhumvit 23, Bangkok, 10110, Thailand
* pranee.dis@mwit.ac.th

Abstract

Helmholtz resonance is a resonance phenomenon in a container such as an empty bottle with an open hole. A sound is produced by blowing across the top of an empty bottle and the air near the open hole and in the bottle is vibrated. The resonance frequency, f, is determined by the shape and dimension of cavity. The volume of the empty bottle is denoted as V, the cross-sectional area of the open hole or the neck of bottle is defined as S, the length of the neck is denoted as L, and the speed of sound in the air is defined as v. The resonance frequency of Helmholtz resonator is $f = \frac{v}{2\pi}\sqrt{\frac{S}{VL}}$. In this work, Helmholtz resonance frequency of different bottle shapes were measured. The relation between the first harmonic resonance frequency and the volume reciprocal of the empty bottle was plotted. Then, the speed of sound in the air was determined from the graph. The results obtained from this study suggests that determining the speed of sound using a simple resonance experiment by blowing across empty bottle can be used as an experimental practice for secondary and undergraduate student.