CALIFORNIA STATE SCIENCE FAIR
2005 PROJECT SUMMARY

Name(s)
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Project Number
J1503

Project Title
Using Sound to Measure Temperature

Abstract

Objectives/Goals
To determine the temperature of the air inside a pipe by measuring the speed of sound.

Methods/Materials
Microphone, speaker, oscilloscope, audio generator, thermometer, hairdryer, and a 3.6 (3 ft and 7 in) foot pipe.

Procedure
· After placing the speaker and microphone at each end of the pipe, measure the length of the pipe, which is the distance between the speaker and the microphone.
· To find the lag time between the speaker input and output for the temperatures from 0 to 100 degrees Celsius, combine the equations: v (sound) =331+0.6T and v=d/t, where d=1.1 meters, and T= temperature in degree Celsius. These two equations would combine to create d/t=331+0.6T.
· Calculate the time it takes sound to travel through the pipe at 0(C), and the time it takes sound to travel through the container at 100(C), and subtract them. Divide this number by a hundred.
· Use a hair dryer to heat the air in the pipe to the desired temperature and turn on the sound waves. Mark the intersection of the wave on the oscilloscope grid before and immediately after the hairdryer has been used. This will indicate the lag time. Now, for every 5 microseconds of lag, add one degree Celsius.
· Calculate the temperature, and compare the number with the thermometer.
· Wait until the pipe cools down, and then repeat the procedure.

Results
After repeating the experiment 10 times, I found out that my calculated and actual temperatures derived from a thermometer differed on average by 2.8(C). My average percent of error was 4.89%.

Conclusions/Discussion
I concluded that I was able to accurately predict the temperature by the velocity of the sound that passed through it. Whenever the temperature was increased, the speed increased; conversely, as the air slowly cooled, the speed decreased. I think this is due to the fact that with a higher temperature, more energy is in the air. With more energy, particles are able to vibrate faster, thus increasing the speed of sound.

Summary Statement
I have determined the temperature of air by using the fact that temperature has an effect on the speed of sound.

Help Received
My mother helped set up my board. My dad helped me understand the theory behind the project. My mentor helped me throughout the entire project.