Acoustic wave/propagation

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Acoustic waves

Acoustic waves are a type of longitudinal waves (same direction of vibration as the direction of propagation) which propagate by adiabatic compression and rarefaction.

Propagation speed

The acoustic waves travel with the speed of sound, depending on the properties of the substance they’re passing through.

- In **solids**, the speed of this waves depend on the shear deformation under shear stress, the density of the medium and compressibility.

- In **fluids**, only the medium's compressibility and density are the important factors, since fluids do not tolerate shear stress.

- In **gases**, compressibility is directly related to pressure through the heat capacity ratio (adiabatic index); pressure and density are inversely related at a given temperature and composition, making only the latter independent properties (temperature, molecular composition, and heat capacity ratio) important. In low molecular weight gases, such as helium, the propagation of sound is faster than in heavier gases, such as xenon (for monatomic gases the speed of sound is about 75% of the mean speed that molecules move in the gas) Concerning to an ideal gas the sound speed depends only on its temperature. At a constant temperature, the ideal gas pressure has no effect on the speed of sound, because pressure and density have equal but opposite effects on the speed of sound, and the two contributions cancel out. In non-ideal gases, such as a van der Waals gas, the proportionality is not exact, and there is a slight dependence on the gas pressure.

Furthermore, humidity though in small proportion can has an effect on the speed of sound, causing it to increase about 0.1%-0.6%, because oxygen and nitrogen molecules of the air are replaced by lighter molecules of water.

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