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Using Helium as the Working Fluid in Thermoacoustic Engines[1]
NATHANIEL WELLS, BONNIE ANDERSEN, Utah Valley University — The efficiency of thermoacoustic engines can be improved by using helium as the working fluid because it reduces viscous losses, has a higher thermal conductivity and speed of sound. The engine in this study has a bottle-shaped resonator. The neck consists of a brass cylinder, closed at the top end and a copper cylinder, open at both ends, with copper mesh screens heat exchangers between them (ID of 1.91cm and total length of 5.24 cm). A small amount of steel wool (20 mg) functions as the stack. The neck opens into an aluminum cavity (10 cm long with an ID of 4.13 cm). A combination of two types of heat-shrink tubing and Teflon were used to connect the brass and copper pieces. The engine was evacuated of air and backfilled with helium as much as the setup would tolerate. Using an input power of 14.8 W over intervals of 0.5-3 hours, it was observed that the frequency decreased in time, indicating that the helium was leaking out slowly. From the frequency data, the volume fraction of helium was calculated, indicating that the engine was able to achieve 64% volume fraction of helium and decreased to 6%. The intensities of the sound over this range of volume fractions averaged at 155 W/m^2 compared with air at an average of 118 W/m^2.

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