Journal of Acoustical Engineering Society of Iran, vol. 3, no. 1, 2015

(Technical Note)
Design, manufacturing and testing of a low power helium standing wave thermoacoustic system for air-conditioning applications

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Abstract

Thermoacoustics is a science dealing with conversion of thermal energy into sound energy and vice versa. Thermoacoustic systems use thermoacoustics rules for heat transfer by sound. These devices include a loudspeaker, a standing wave tube with a length of a fraction of a wavelength and a stack which its temperature gradient is the cause of heat transfer. In this study, design and construction of a low power thermoacoustic system for air conditioning applications, were considered. This paper consist of two parts: design of a thermoacoustic system based on numerical analyses, and its construction plus its performance analysis. Numerical analyses reveals that the length and position of the stack in the resonator, the working frequency and the input acoustic power, have major contributions to the total performance of the system. In this system, helium at the standard pressure and temperature was used as working fluid. The acoustic driver was a 25 watts loudspeaker that works in 378Hz. Based on numerical analyses and a 20 °C temperature gradient quota, the length of the stack and the position of its center were found to be 38 mm and 85 mm, respectively. Our experimental results indicated a 14 C temperature gradient across the stack.

Keywords: Thermoacoustic, Stack, Resonator, Working fluid, Temperature gradient

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[DOR: 20.1001.1.23455748.1394.3.1.2.2]

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