

A REVIEW ON EXPERIMENTAL ANALYSIS OF THERMOACOUSTIC REFRIGERATOR

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Abstract --- *Thermoacoustic cooler is new refrigeration innovation which does not require any moving parts and destructive refrigerants in its task. This innovation utilizes acoustic waves to siphon heat over a temperature slope. By far most of Thermoacoustic iceboxes to date have utilized electromagnetic amplifiers to produce the acoustic information. In this proposition, the plan, development, activity of a Thermoacoustic cooler is nitty gritty. As it doesn't contain any moving part other than speaker which increment the life expectancy of item and reduction the support cost. So it doesn't utilize ointment. It just uses the sound wave which is weight wave for cooling. The main weakness of this Thermoacoustic refrigeration is it has low COP contrast with other regular techniques. Be that as it may, most effective framework are endeavored to be made. Heaps of research is going on here. The present work depicts hypothetical examination and test examination of standing wave Thermoacoustic cooler and fundamentally centers around improving the execution of Thermoacoustic fridge by manufacture of stack with two distinctive material low warm conductive material at virus side and high conductive material at hot side.*

Keywords --- *Hybrid Stack, Stack Materials, Pressure of Working Fluids, Positions of stack, Heat Exchanger, frequency*

I. INTRODUCTION

Thermoacoustic is the investigation of an exquisite designing field that includes the two acoustics and thermodynamics - at the end of the day, the investigation of fields that include both acoustic waves and the transformation of one type of vitality into another, for example, heat into movement. Thermoacoustic in this way portrays vitality change forms started by the connection of the temperature wavering join by the weight swaying in a sound wave with strong limits.

The importance of the term Thermoacoustic, as indicated by Nicholas Rott's (1980) (who laid a significant part of the hypothetical establishment for the field) is genuinely plain as day. As its name proposes, Thermoacoustic is a science that is worried about the associations between warmth (Thermo) and weight motions in gases (Acoustics). This field can be broken into two subcategories. The first is the forward impact which is worried about the age of weight motions from warmth. This impact is fundamentally used to make motors that are generally alluded to as Thermoacoustic motors in the writing. The second subcategory or invert impact is worried about utilizing acoustic waves to siphon heat. This switch impact is principally used to make coolers known as Thermoacoustic fridges which are the current theme.

Advantages of Thermoacoustic refrigerator are that it is environmental friendliness, potentially high reliability due to simple structure and minimum number of moving parts, and reasonable efficiency. These characteristics could lead to low manufacturing and maintenance costs.

II. LITERATURE REVIEW

Swift G (2002) published a comprehensive article addressing the major aspects of Thermoacoustic devices in the year 1988. He showed that the addition of a porous media into a Sondhauss tube such as a stack of parallel plate increases the Thermoacoustic efficiency and power output.

This concept was the major milestone in the development of the experimental Thermoacoustic engine. The condensed Matter and Thermal Physics group of Los Alamos National Laboratory (LANL) started an intense and very effective research program. They focused on applying Rott's theory to build functional devices.^[1]

OrestGS (1994) developed a miniature Thermoacoustic refrigerator for cooling electronic components. The refrigerator was driven at 5,000 Hz by a piezoelectric driver and it consists of an acoustic resonator, a stack, and copper heat exchangers. The working fluid was pressurized helium gas between 10 to 20 atmospheres. Since the operating frequency is high, the refrigerator is compact, being about 10 cm long. Temperature differences of 12°C across the stack were achieved at sound levels of 160dB. The performance of the refrigerator scaled with frequency according to existing models of Thermoacoustic heat engines.^[2]

Tijani M H (2001) in his paper shows the manufacturing of the different components of the Thermoacoustic refrigerator. He also suggested step by step method for the design of Thermoacoustic refrigerator which is followed in present work. He performed a

number of studies on the effects of varying individual components of Thermoacoustic refrigerators and a low temperature of 65 °C was achieved which is one of the lowest reported temperatures up to date. [3]

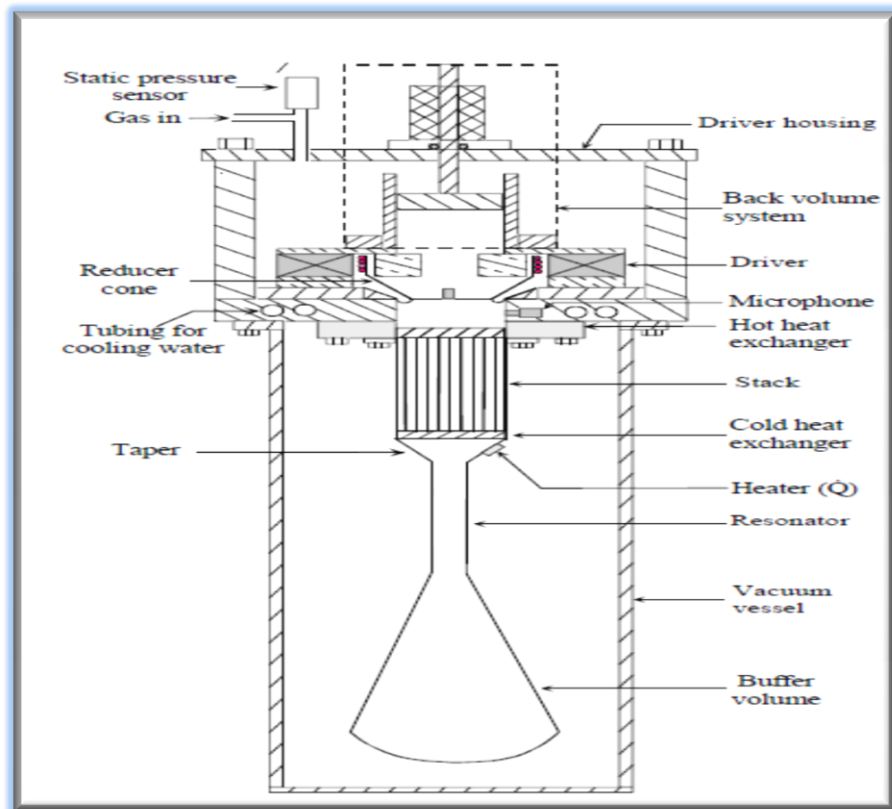
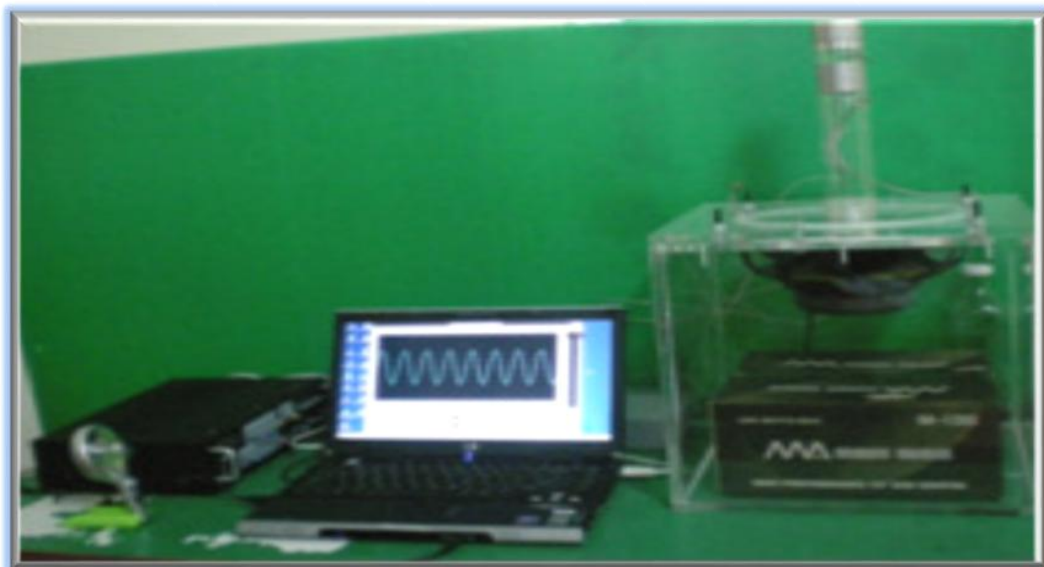


Fig. 1 Illustration of the Thermoacoustic refrigerator

Yousif A. Abakret. al. (2011) had done design and experimental study of the influence of wave patterns and frequency on thermo-acoustic cooling by fabricating Thermoacoustic refrigerator with the help of resonator of acrylic tube, stack of 35 mm film as shown on figure below. He had done his experiment by using sine, square and triangle wave pattern with frequency range of 365 Hz to 425 Hz. He found maximum temperature difference of 28oC using square wave at frequency of 405 Hz. [4]



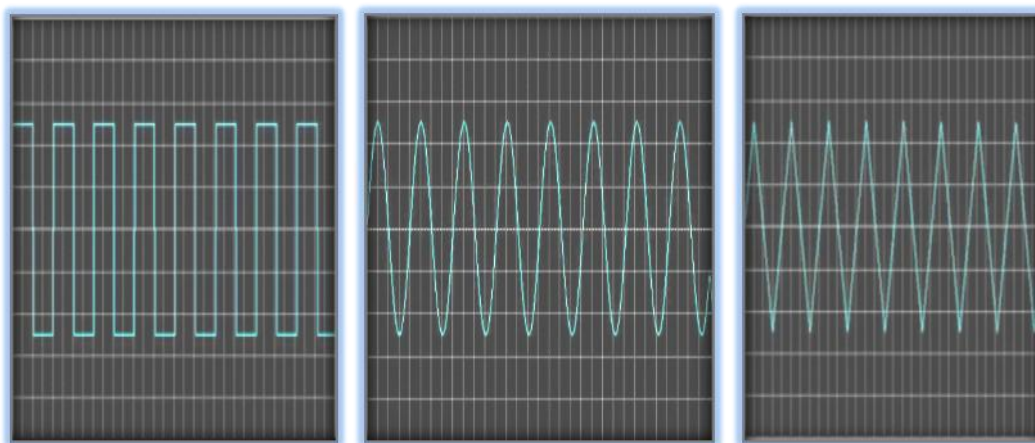


Fig. 2 Square, sine and triangle wave [4]

B G Prashantha (2013) had done experimental study of effect of mean operating pressure on the performance of stack-based Thermoacoustic refrigerator. The objective of their work was to reduce the length of the resonator so as to make the device compact and hence there is a scope for increasing the performance of the refrigerator. In their design, the dry air was used as working substance through spiral stack and heat exchangers on either side of the stack within the resonator. The loud speaker attached to one end of the resonator tube, generates acoustic pressure amplitude, which was closed at the other end. From their experimental result they conclude that the performance of stack-based Thermoacoustic refrigerator improves if we operate the device at higher mean operating pressure.^[5]

III. CONCLUSIONS

Most of the researchers had worked on different parameters like fluid mean pressure, stack position, resonator length, operating frequency, inert gas type and investigated influence of these parameters on the performance of thermo-acoustic refrigerator. But it is seen that the main component of the thermo-acoustic device is stack, where heat transfer process takes place and which is mainly responsible for working of the refrigerator.

Literature review reveals that the researchers have carried out most of the work related to position of stack. It is observed that fabrication of stack for specific application was done using low thermal conductivity material like drinking straws, camera film, ceramics and Mylar sheet. The reason behind choosing low thermal conductivity material is to prevent flow of heat from hot side of the stack to cold side but it has to make compromise with thermal effusivity (The effusivity of a material is the square root of the product of the thermal conductivity, density and heat capacity. The effusivity measures the rate at which a material can absorb heat) and thermal diffusivity (The diffusivity is a material specific property and its value describes how quickly a material reacts to a change in temperature) so less value of this two properties affect the performance of Thermoacoustic device.

Using high thermal conductive material will increase the value of these two properties and may influence the performance of the Thermoacoustic device, and for avoiding heat transfer from hot side of stack to cold side we can use insulator between them. So, using high thermal conductive material at hot side and low thermal conductive material at cold side, and providing insulation between them will definitely influence the performance of thermo-acoustic device.

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