

INTISARI

STUDI EKSPERIMEN TENTANG PENGARUH LOKASI REGENERATOR, FREKUENSI BUNYI DAN DAYA LISTRIK MASUKAN TERHADAP UNJUK KERJA PENDINGIN TERMOAKUSTIK GELOMBANG BERJALAN

Oleh

ALI HAMIDI

10/300220/PA/13180

Telah dilakukan penelitian tentang pengaruh lokasi *regenerator*, frekuensi sumber bunyi dan daya masukan sumber bunyi terhadap unjuk kerja pendingin termoakustik gelombang berjalan. Pendingin termoakustik gelombang berjalan terdiri atas sebuah *regenerator*, sebuah simpal pipa (*looped-tube*) dan sebuah pelantang (*loudspeaker*). *Regenerator* dibuat dua buah dengan panjang 4 cm terbuat dari susunan rapat lembaran-lembaran kasa kawat baja antikatrat masing-masing dengan ukuran kasa #40 dan #50. Simpall pipa terbuat dari pipa PVC (*polyvinyl chloride*) komersial berdiameter dalam 55,0 mm dan tebal 2,6 mm. *Loudspeaker* yang digunakan memiliki diameter 10 inchi dan impedansi 4 Ω dan dihubungkan dengan simpal pipa dengan menggunakan pipa PVC lurus sepanjang 15 cm. *Regenerator* diletakkan di dalam simpal pipa yang letaknya divariasikan untuk mencari lokasi *regenerator* terbaik. Posisi *regenerator* 0,1 ternormalisasi menghasilkan penurunan suhu terbesar yaitu sebesar $(3,6 \pm 0,5) ^\circ\text{C}$. Pada rentang frekuensi yang lebar, yaitu 30 Hz - 400 Hz, teramati adanya pembalikan sisi panas dan sisi dingin pada *regenerator* ketika frekuensi divariasikan. Hal ini disebabkan oleh adanya perubahan dominansi arah perambatan gelombang bunyi. Pada frekuensi 43 Hz dan 147 Hz diperoleh penurunan suhu terbesar yaitu $(4,0 \pm 0,5) ^\circ\text{C}$. Selain itu, diperoleh juga hasil bahwa besar penurunan suhu sisi dingin dan kenaikan suhu sisi panas *regenerator* berbanding lurus dengan kenaikan daya listrik masukan *loudspeaker*. Karena eksperimen ini tidak menggunakan komponen penukar kalor panas (*hot heat exchanger*) di sisi panas *regenerator*, daya listrik masukan dibatasi hanya sampai 60 W untuk menghindari aliran kalor balik dari sisi panas ke sisi dingin *regenerator*.

Kata-kata kunci : pendingin termoakustik, gelombang berjalan, lokasi *regenerator*, frekuensi bunyi, daya masukan

ABSTRACT

EXPERIMENTAL STUDY ON THE EFFECTS OF REGENERATOR LOCATION, SOUND FREQUENCY AND INPUT ELECTRIC POWER TO PERFORMANCE IN A TRAVELING WAVE THERMOACOUSTIC REFRIGERATOR

By

ALI HAMIDI

10/300220/PA/13180

A research on the influences of regenerator position, sound frequency and input electric power to the performance of a traveling wave thermoacoustic refrigerator has been conducted. The traveling-wave thermoacoustic refrigerator consists of a regenerator, a loop-tube, and a loudspeaker. In this experiment, it has been made two units of regenerators which the length of each regenerator is around of 4 cm. The regenerator was made by stacking layer by layer of some stainless-steel wire-mesh screens which has the size of #40 and #50. The loop-tube are was made of a commercial PVC (polyvinyl chloride) pipe which has of 55.0 mm inner diameter and 2.6 mm wall thickness. The loudspeaker, which has diameter of around 10" and impedance of $4\ \Omega$, is connected to the PVC loop tube by using of 15 cm straight PVC pipe. The location of regenerator in the loop-tube was varied in order to determine the optimal location. The 0.1 regenerator's normalized-position produces the largest temperature decrease is of around of $(3.6 \pm 0.5)\ ^\circ\text{C}$. By varying the sound frequency in a wide range, i.e. 30 Hz - 400 Hz it was found that the cold and hot side's position on regenerator was reversed. It was caused by the change of the dominant direction of the sound wave propagation along the looped-tube. At the frequencies of 43 Hz and 147 Hz, it was obtained the largest temperature decrease of around $(4.0 \pm 0.5)\ ^\circ\text{C}$. In addition, it was also found that the largest temperature decrease at cold side and temperature increase at hot side were proportional to the increase of the input electric power of the loudspeaker. Because in this experiment a hot heat-exchanger was not installed at the hot-end of regenerator, the input power was limited up to 60 W to avoid heat flowing back from the hot-end to the cold-end of the regenerator.

Keywords : thermoacoustic refrigerator, traveling wave, regenerator location, sound frequency, input power