OPTIMAL FUNCTIONING PARAMETERS FOR A STIRLING ENGINE HEATER

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Abstract:

World population is actually facing a major problem of energy production, recovery and conservation. In this field a great progress can be made by coupling systems with high losses (thermal, mechanical, etc.) and systems that can valorize these losses, and especially in power plants. This research is in the area of Thermal Energy Conversion, and more specifically, in the conversion and recovery of waste thermal energy. The recovered heat can be exploited for production of energy by using thermo-mechanical conversion systems, like Stirling engines for example. The advantage of such systems is in their capability to work on low and high temperature differences and with any kind of external thermal sources. The Stirling engine can be designed in different configurations, and then can be adapted for special installation.

A Gamma Stirling engine, which can be filled with an initial pressure using compressed air as a working fluid was experimented. It can support a maximum charge pressure of 10 bar and can provide a maximal rotation speed around 600rpm for a maximum mechanical brake power of 500W.

The aim of this work is to optimize the Gamma Stirling engine performances. A special care was given to the heater. The heater consists of 20 tubes in order to increase the exchange surface between the working gas (air) and the hot source (electrical resistance providing energy heat). Different parameters are chosen to evaluate the heater. The selected four independent parameters are: the heating temperature (between 300 and 500°C), the initial filling pressure (3bar to 8bar), the cooling water flow rate (0.2l/mn to 3 l/mn) and the operation time (4 to 20mn after reaching the steady regime). The efficiency and the thermal energy exchanged in the heater are very sensible to the temperature and pressure variations.

Keywords: Energy waste, Stirling engine, heater optimization, efficiency.

Acknowledgement: This work was supported by the laboratories TEMPO (University of Valenciennes, France), GEPEA (University and École des Mines of Nantes, France) and LESTE (ENIM, University of Monastir, Tunisia). These supports are gratefully acknowledged.

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