LOW COST POROUS MATERIAL FOR REGENERATOR APPLICATION

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ABSTRACT-Identifying alternative ways to fulfil fuel needs as well as excessive use of it and overcome the issue of depleting fossil fuel storages in nature is a real need. This work aims to develop and fabricate the thermoacoustic engine that will demonstrate the possibility of converting heat energy into mechanical energy by utilizing sound waves and in turn help address the fuel crises.

To evaluate suitability of identified three porous material as regenerative material for the thermoacoustic engine application, experiments were carried out Identified materials were stainless steel wool, stainless steel scourers and wire mesh screens. For meaningful comparison, materials selected were kept with similar geometrical dimension and filled in the regenerator. Temperature difference between hot end and cold end of the regenerative porous material as input and rotation of the flywheel as output in this thermoacoustic engine experiment. DAQ and LabVIEW is used for data collection

Performance of each regenerative porous material under same heat input in terms of the rotation of the flywheel and the cost of each material used in thermoacoustic engine are the parameters of the comparison. Stainless Steel Wool material was found good among these three materials. Ceramic regenerators may be one of the future options to enhance the performance of thermoacoustic engines further

INTRODUCTION

Thermoacoustic engine converts thermal energy of fuel to acoustics energy by generating sound waves. The sound waves are generated by creating temperature difference across the regenerative material. A regenerative material has special property that if it is continuously heated at one end while the other end of regenerative material is kept cold so as to get the temperature difference. Due to this temperature difference between both the ends as well as porosity and other properties of the regenerative material sound waves generated inside the test tube. Intensity of generated sound waves is directly proportional to the temperature difference.

Three different materials have been proposed as low-cost regenerative materials in this work. Proposed materials have been tested for their performance in terms of rotations of flywheel. RPM of the flywheel attached is key indicator of the sound waves generated. Different materials were tested on the basis of two parameters like RPM of the flywheel and economy of that material.

METHODOLOGY

The literature was reviewed to get incite of thermoacoustic engines. The soft model of the engine was developed, and the model was fabricated. The experiments were performed, and the results are presented. The methodology is as follow:

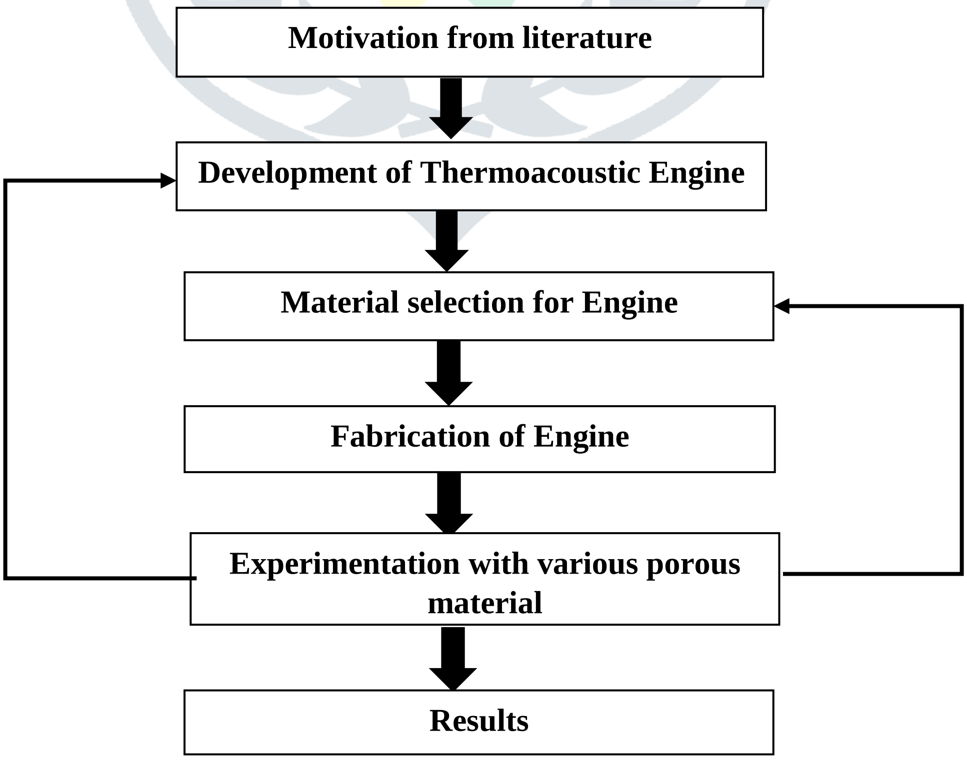


Fig 1: Flow chart of experiment

DEVELOPMENT AND FABRICATION

Modeling software Solid works 14.5 is used to develop and assemble the parts of the thermoacoustic engine. After completing the model the actual fabrication was done By using old or new materials each part of the engine is fabricated which under goes different machining process like turning, cutting, drilling etc. Then these parts were assembled to form a Thermoacoustic engine as shown in Fig 2.

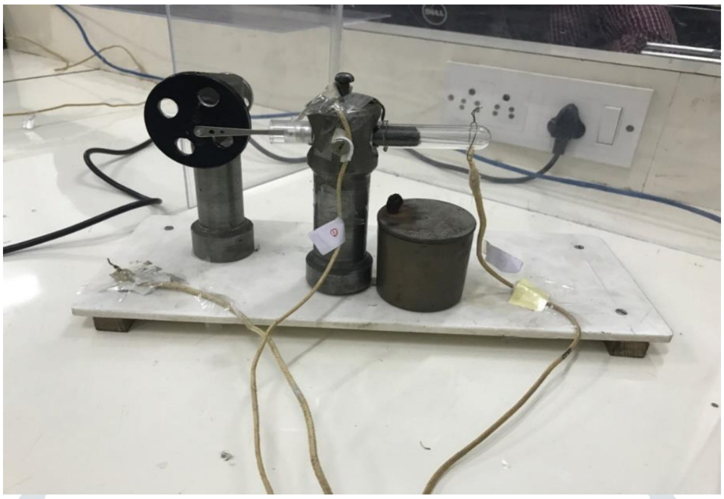
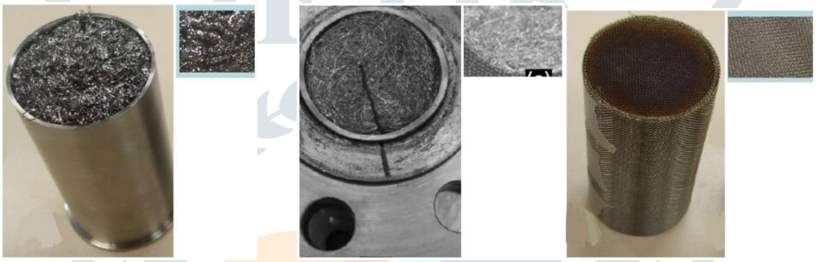


Fig 2: Actual Image of Thermoacoustic Engine



a b c

Fig 3: Regenerator Stack a) Stainless steel wool b) Stainless steel scourers c) Wire mesh screens

RESULTS AND DISCUSSION

Performance of the thermoacoustic engine equipped with stainless steel wool regenerative material. After supply of heat to the regenerative material flywheel start rotating with small initial torque then observation of readings starts in the system. Regenerative material are compare on the basis of the material cost and rotation produce by the engine (rpm).

Temperature difference across the hot end and cold end of the regenerative material is the input supplied to the thermoacoustic engine as shown on the horizontal axis (X-axis). Initially cold end and hot end of the material as same temperature after supplying heat, the difference between hot end and cold end drastically increases with increase in heat supplied in the first reading from graph you can easily recognize that. After some time as per physical property of respective material heat starts flowing through the material so the difference between hot end and cold end start reducing that shows in next part of the graph. After some time due to materialistic property of the regenerator temperature difference across it goes on decreasing. In further parts of the graph the temperature varies with time and gives the result with respect to material property. From below graph, we compare the each material with performance of the thermoacoustic engine and concluded the best and economical material.

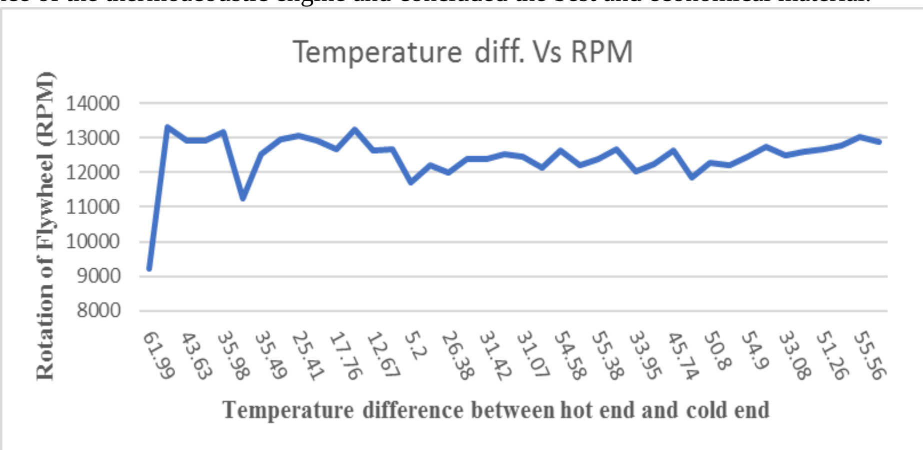


Fig 4: Graph of Temperature diff. Vs RPM (Continues Reading)

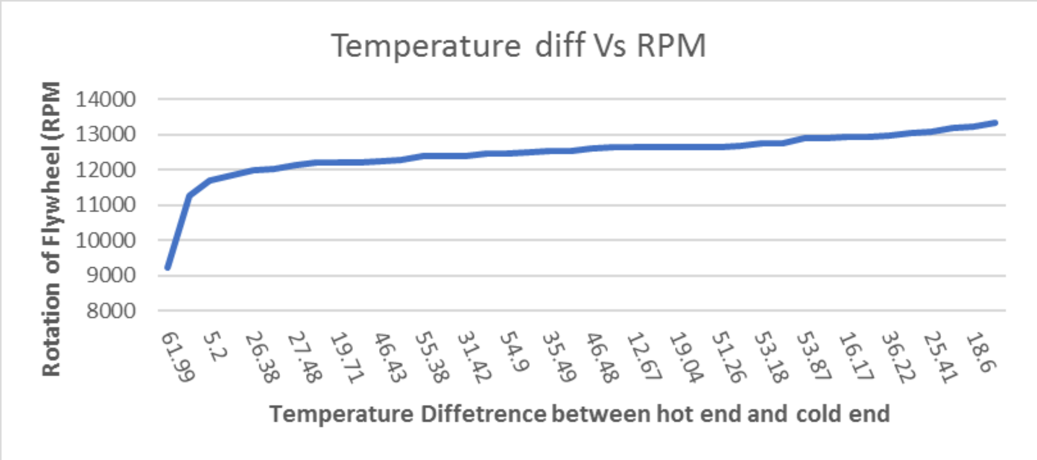


Fig 5: Temperature diff Vs RPM (RPM is in Descending Order)

Fig 5 shows temperature difference v/s RPM of flywheel in which rpm arrange in the descending order and temperature difference arranged with respect to it. Here we can easily get idea about the variation of rpm with respect to the temperature difference across the regenerative material.

By observing both graphs we can easily compare the performance of all the material tested in the thermoacoustic engine as regenerative porous material. As temperature difference across the regenerative material varies the rpm of the flywheel also varies with respect to porosity and properties of material.

CONCLUSION

The thermoacoustic engine is develop and fabricated. Earlier day's only one material used in this type of the thermoacoustic engine but here in this experiment three regenerative porous materials have been tested and later on compare their performance. The motivation behind this thermoacoustic engine experiment is to find the low cost regenerative porous material for regenerator application. In this experiment thermoacoustic engine has input as temperature difference between hot end and cold end of the regenerative porous material and output as rotation of the flywheel. LabVIEW used to take input reading and digital tachometer used to take output reading then further both input and output together combine in the excel sheet for comparison. After comparing in excel sheet on the basis of performance and cost of the regenerative material used for testing out of the three "one" is best suitable regenerative material for the thermoacoustic engine. In this experiment regenerators made with different materials, with different geometrical configurations and different pore structure compare with each other.

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