Experimental study of heat recovery from parked vehicles

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Abstract. *The current trend in the energy sector is strongly geared towards reducing the consumption of fossil fuels and carbon dioxide emissions. This purpose could be achieved by using the recovery of waste energy for better management of energy consumption. The purpose of this article is dedicated to demonstrate the feasibility of recovering energy from under-hood of parked cars. The measurements that are made on the V6 engine shows that the temperature could reach 48 ° C and decreases to 40 °C after 60 min. Finally, the hot air is used to heat water using a heat exchanger where the heat rate could reach around 500 W.*

Keywords: Energy Recovery, Environment, Automotive, Heating

1. Introduction

In the face of increasing population, the evolution of technology is evolving which will increase the demand of energy. Recovering energy from waste energy remains one of the solutions to reduce consumption as well as pollution. Today, energy management and renewable energy remain the best solutions to this problem. Energy recovery starts when reusing the waste energy which is considerably high according to the domain of application [1-3]. A large amount of energy is lost in mechanical systems by exhaust gases, such as in internal combustion engines, industrial furnaces, generators, boilers and other applications. Heat is lost in heating, ventilation and air conditioning systems, as well as in hot water [4-9]. In this context, the present project is dedicated to show the feasibility of recovering heat from engines of the vehicles during their stop after certain driving times. Moreover, the duration of the parked cars could be estimated in average between 1 and 3 hours. During this period, car engines are considered as a hot thermal source. For this reason, a system is composed of a fan to aspirate heat from the engines then hot air will be used to heat the water using an Air-Water heat exchanger. Therefore, in the present study, an experimental setup used will be presented in order to recover the wasted heat from the parked car engines. Tests are carried out on a V4 engine and others on a V6 engine to quantify the aspirated air temperature finally, hot air is used to heat the water by using an Air-Water heat exchanger.

2. Experimental study and validation

In this part, the experimental setup will be presented. The figure 1 shows the assembly of heat recovery system which used to conduct the aspirated hot air from the engines of the vehicles. It consists of an air duct, a fan and, heat exchanger and thermocouples.

Fig.1. The experimental setup installed under the hood of a real car

3. Heating water feasibility

The water temperature at the inlet of the heat exchanger is about 21 °C. Water circulates in the heat exchanger with a flow rate of 0.01 kg / s. Figure 3 demonstrates that in case of a V4 engine the water is heated 12 °C to reach a maximum temperature of 32 °C. Figure 4 shows the evolution of air temperature and water in the case of a V6 engine. We find that the water temperature can reach a maximum value of 38°C. The outlet temperature of water is higher in this case due to increasing of engine size. Figure 5 shows that the power gradually increases to reach 500 W with a relatively low mass flow rate (0.01 kg / s).

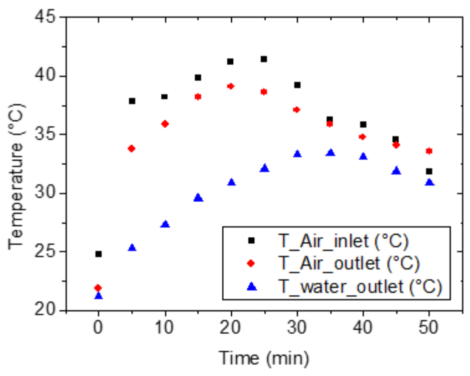

Fig.3. Evolution of water and air the temperature as a function of time in the case of V4 engine

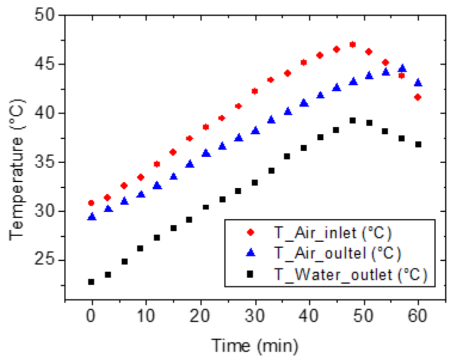

Fig.4. Evolution of water and air the temperature as a function of time in the case of V6 engine

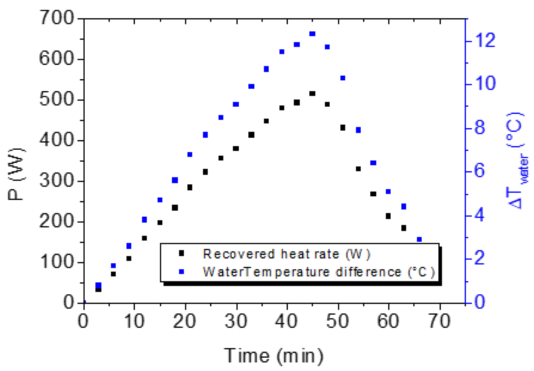

Fig.5. Water temperature difference and the recovered heat rate evolution with respect to time.

4. Conclusion

In this study, a simple experimental setup is presented. It is dedicated to recover energy from packed V4 and V6 engines. It has been shown from the results obtained that after certain driving times, it is possible to transform the engine into a non-negligible heat source that can be used for several applications. In the present work, we have shown the feasibility of heating water using an air duct, fan and heat exchanger and thermocouples. The power recovered to heat water from 21°C to 38°C can reach 500 W in about 60 minutes.

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