UNIVERSITI TEKNOLOGI MARA

THERMOELECTRIC POWER GENERATIONS FROM VEHICLE EXHAUST GAS BY USING TIO_2 NANOFLUID COOLING

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ABSTRACT

Vehicle engine efficiency is a big challenge today since it is considered low by approximately around 30% only. More than half of the energy is loss in exhaust piping and heat dissipated through cooling systems. There is an urgent need to tackle these issues in order to reduce the world energy consumption. One alternative approach is the application of waste heat recovery which specifically emphasize on the conversion from heat energy to electrical energy. This is possible with the use of thermoelectric modules. The challenges of using thermoelectric generator (TEG) in application are due to its low thermal conversion and low power output. In order to increase the efficiency of TEG, cooling fluid nanofluid specifically titanium oxide (TiO_2) was introduced into the system. Nanofluids have been tested in the past in many heat exchanger applications and have showed heat transfer improvements. The study was conducted through series of testing a designed thermoelectric generator onto vehicle exhaust system and cooling fluid water and titanium oxide with varying engine idling conditions speed of 700-800, 1000 and 1500 RPMs. The aim of this project is to investigate and conduct experiment on waste heat power generation using thermoelectric cells from vehicle exhaust gas by considering the different parameters which includes the thermal performance of cooling systems and the analysis of heat transfer effect of using TiO_2. It was found that TiO_2 has positively enhance TEG thermal conversion and electrical power output when compared to base fluid, through various engine speeds.

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CHAPTER ONE
INTRODUCTION

1.1 Waste Heat Recovery (WHR)

A typical vehicle uses an internal combustion engine, which works on the principle of heat engine. The engine converts the chemical energy from the air fuel mixture and into thermal and mechanical energy by burning it under specific pressure. However, the engine generally utilizes approximately only 30% of the total energy to move the vehicle as well as to power up the accessories related to its engine and instrumentations (Senapati et al, 2014). The other 70% of energy will eventually loss in the form of exhaust and heat dissipated by the engine cooling systems. Engine efficiency correlates directly to waste energy. Thus, by recovering the waste energy dispersed into the surrounding, the efficiency of the engine can be increased. By right, the waste energy from the vehicle exhaust gas contains more than half energy in total based on various load condition of the engine. This project describes the application of conversions of thermal energy into electrical energy directly by using a design of thermoelectric generator with different cooling mediums.

Thermoelectric cell or generator (TEGs) is a solid state device that provides conversion of energy from thermal energy (M.F Remeli et al, 2015) due to a temperature differences into electrical energy based on the concept of "See beck effect". Vehicle manufacturers have been designing and testing some of the applications of TEGs to be applied at exhaust temperatures. However, there are still no commercially available TEG modules which have the capability of withstand extreme temperatures of vehicle exhaust (Martins et al, 2011) and have high electrical output. By varying the design of the thermoelectric generator by different cooling mediums for the system, we can produce a varying amount of electricity.

By using a simple thermal conversion, electricity can be produced without compromising the power from the engine. The temperature of the exhaust gas after passing through its catalytic converter is approximately 300°C to 600°C when the engines run around 10 seconds (Senapati et al, 2014). Although the high temperature of the vehicle exhaust gas which can go up to 1000^0C makes them suitable for potential source of energy recovery, rather than by using the heat from the engine