International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 11 Issue: 09 | Sep 2024 www.irjet.net p-ISSN: 2395-0072

PERFORMANCE IMPROVEMENT THE COMPINED TECHNOLOGY IMPLANT TO CONTROL AND MONITORING AFTER ELECTRIC POWER GENERATION USING THE EXHAUST GAS FROM MAIN ENGINE

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ABSTRACT

Electrical energy production using exhaust gas from main engines represents a promising approach to increase the energy efficiency of various industrial and transportation applications. This method involves capturing waste heat from engine exhaust gases and converting it into electrical energy using thermoelectric generators or other heat recovery technologies.

The integration of such systems can lead to composite fuels. Efficiency and reduction in greenhouse gas emissions. These abstract outlines the principles, benefits, and potential applications of exhaust gas-based power generation, emphasizing its role in advancing sustainable energy practices and optimizing engine performance.

Key word: Heat Recovery System (WHRS), Combined Heat and Power (CHP), Exhaust Gas Energy Conversion Performance Optimization, Thermal Efficiency Enhancement, Engine Exhaust Monitoring, Control Systems for Waste Heat Recovery, Electric Power Generation from Exhaust

1. INTRODUCTION

In modern industrial and transportation systems, engines are at the heart of operation, but they also generate substantial amounts of waste heat through exhaust gases. This wasted energy not only represents a loss of potential power but also contributes to environmental pollution. To address these issues, innovative approaches have been developed to harness this waste heat, particularly through electrical power generation systems.

Electrical energy production from exhaust gases involves capturing thermal energy from engine exhaust and converting it into usable electrical energy. This process can be achieved through a variety of technologies, including thermoelectric generators (TEGs), organic Ranking cycle (ORC) systems, and thermodynamic cycles. By applying these technologies, it is possible to recover a portion of the energy that would otherwise be lost, thereby improving the overall energy efficiency of the engine.

The application of exhaust gas-based power generation is particularly relevant in sectors with high energy consumption such as the marine, automotive and power generation industries. For example, in marine engines, where large amounts of heat are expelled through the exhaust, integrating the power generation system can reduce fuel consumption and reduce emissions. Similarly, in automotive applications, such systems can increase the efficiency of vehicles and support the development of hybrid and electric vehicles.

This introduction will explore the mechanisms of various exhaust gas power generation technologies, their benefits, and the challenges associated with their implementation. By improving our understanding of these systems, we can better appreciate their potential to contribute to energy conservation and environmental sustainability

2.ELECTRIC HEATING

The exhaust gas is used to generate steam or heat a medium, which then powers a turbine to generate electricity. Waste Heat Recovery systems these systems can reduce fuel consumption by up to 15% and generate electricity, steam, hot water and cold air.

2.1 EXHAUST GAS SYSTEM The exhaust gas system of a marine engine to recover most of the waste energy from the unused gases leaving the cylinder.

2.2 Turbo charging This process uses the flow of exhaust gases to drive a turbine, which is mechanically connected to a compressor.

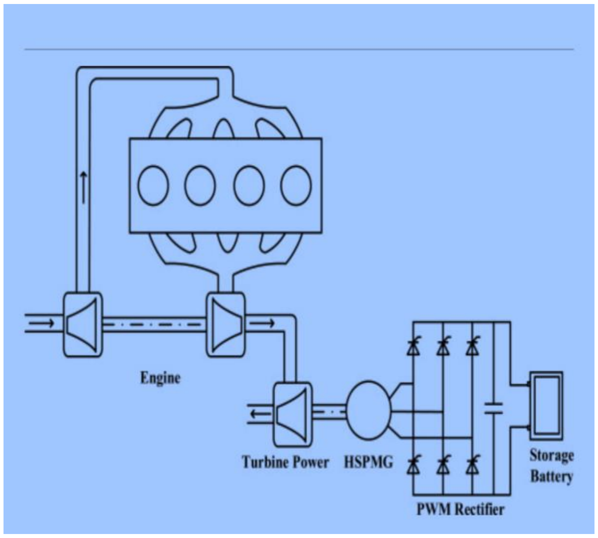

Fig.1 EXHAUST TURBINE POWER GENERATION SYSTEM

3.TURBO GENERATOR CHARACTERISTICS

Reveals the Relationship between generated power and turbo-generator speed. It is clear that the electric power increases linearly as the speed increases. Power increases gradually from 5000 rpm to 60,000 rpm with a maximum power of 1.8 kw at 60,000 rpm.

Furthermore, turbine power is investigated at various mass flow rates and speeds. The result is presented in. The power of the Turbine increases linearly as mass flow increases. The maximum achieved power is 8.9 kW at 0.18 kg/sec mass flow rate as shown. Presents variation of turbine power with turbine speed.

4. VARIATION OF POWER GENERATION WITH SPEED;

Time-varying power turbine speed at different engine speeds. It can be seen from the figure that when the speed increases from 1800 r/min to 3600 r/min, the turbine speed also increases gradually

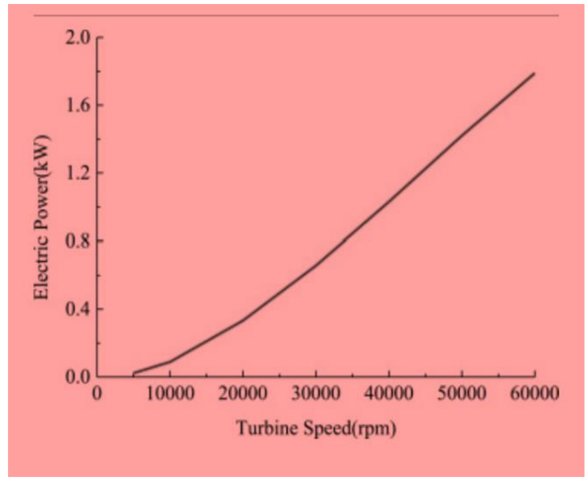

Fig.2. VARIATION OF POWER WITH SPEED

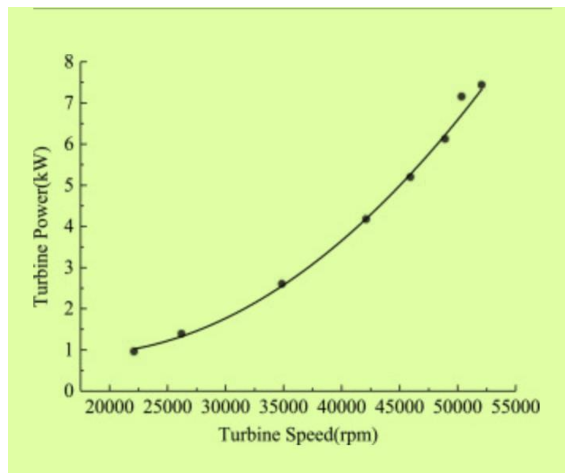

Fig.3 VARIATION OF POWER WITH TURBINE SPEED

The Relation of system efficiency with engine speed is shown in It can be found that as the engine speed increases from 1800 r/min to 3000 r/min, the system efficiency gradually increases. The system efficiency then gradually decreases from 3000 rpm to 3600 rpm and reaches a maximum efficiency of 42.8% at 3000 rpm.

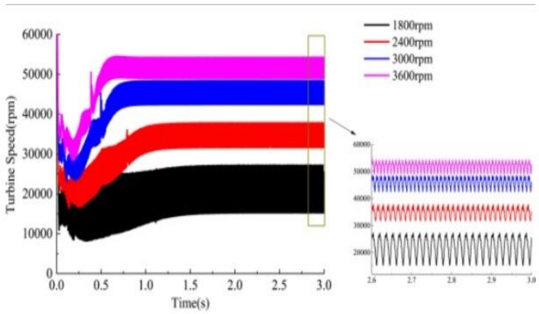

Fig.4 THE POWER TURBINE SPEED WITH TIME-VARIATION AT DIFFERENT ENGINE SPEED.

4.1THERMAL EFFICIENCY: Measures how effectively a system converts waste heat into useful energy. For example, combined heat and power (CHP) systems typically achieve 70–90% efficiency by simultaneously generating electricity and useful heat, while Organic Rankine Cycle (ORC) systems typically produce low-grade heat at about 10% efficiency. Converts to electricity with -20% efficiency.

4.2HEAT SOURCE TEMPERATURE: Higher temperature waste heat sources generally lead to better efficiency.

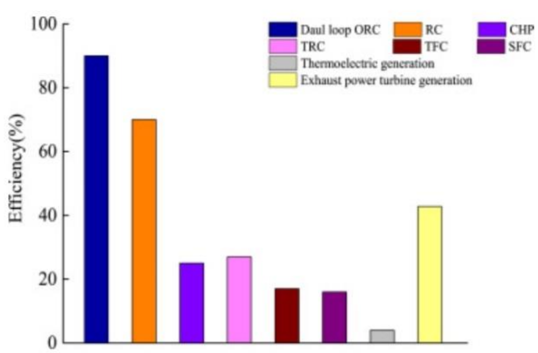

Fig.5 THE SYSTEM EFFICIENCY COMPARISON OF WASTE HEAT RECOVERYSYSTEM

5. THE INFLUENCE OF INJECTION TIMING ON THDU OF GENERATOR:

Shows the system efficiency comparison of this research with dual loop ORC system Imperia et al., 2020 Combined heat and power generation (CHP), Rankine cycle (RC), trans critical Rankine cycle (TRC), tripartite flash cycle (TFC) and single flash cycle (SFC) (Rajkumar et al., 2017), and thermoelectric production [1]. It should be noted that the efficiency in the picture is only for a certain research case, which may differ for different research objects.

Presents the effect of injection timing on the THDU of the generator. It can be seen from that when the fuel injection timing decreases from -9.93° to -5.93°, the THDU increases from 0.032 to 0.09. The change in fuel injection advance angle will cause changes in the diesel engine exhaust energy, and then the generator speed will fluctuate in different limits, and the electromagnetic performance of the generator will also change. When the fuel injection advance angle becomes smaller, the exhaust gas energy flowing into the turbine and the generator speed increases.

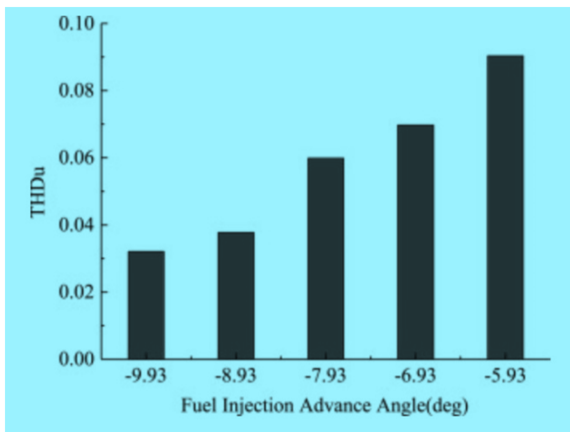

Fig.6 THE INFLUENCE OF INJECTION TIMING ON THDU OF GENERATOR:

6.CONCLUSIONS

A computational study has been conducted on using an exhaust power turbine with a high-speed permanent magnet generator to recover waste heat from engine exhaust gas. A high-speed permanent magnet generator (60,000 r/min) is designed for this purpose. A diesel engine (88 kW at 3600 r/min) is used as the primary mover. Computational models of the engine and exhaust turbine power generation systems are developed using GT-Power (for diesel engines).

REFERENCE[S]

[1] NRC. Review of the 21st century truck partnership. Washington (D.C.):

[2] Zhang XX, Zeng K, He MG. New technology of thermodynamic cycle for waste heat recovery of vehicle gasoline engine.

[3] Houn alas DT, Katsanos C, Lamaris VT. Recovering energy from the diesel engine exhaust using mechanical and electrical turbo compounding.

[4] Zhao R, Li W, Zhuge W, Zhang Y, Yin Y. Numerical study on steam injection in turbot compound diesel engine for waste heat recovery.

[5] Karvountzis-Kontakiotis A, et al. Effect of an ORC waste heat recovery system on diesel engine fuel economy for off-highway vehicles.

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