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"A REVIEW PAPER ON ELECTRIC MOTOR HEATING"

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ABSTRACT

Parametric warm investigation of super durable magnet coordinated engine by thinking about constant driving cycle is introduced. Permanent magnet motors have a high power density and high efficiency when used as electric vehicle driving motors. Under extreme thermal conditions, however, they are susceptible to irreversible demagnetization and coil insulation failure. As a result, accurately predicting heat losses and temperature distribution in driving motors during a real-time driving cycle is crucial. Thermal parametric techniques are used to examine the driving motor's thermal behavior. Here, we are measuring the temperature distribution and heat losses in the driving motor with simulation software. When an electric motor is used for a certain amount of time, it produces heat. This heat affects the motor's performance, efficiency, and reliability. utilizing the method of analysis on the motor that has been designed in accordance with parameters like power output, torque, efficiency, dependability, and sustainability.

Key Words: *Motor, Coil, Failure, Temperature, Heat.*

I. INTRODUCTION

Overview of electric motors:

Electric motors are devices that convert electrical energy into mechanical energy. They are ubiquitous in various applications, from powering household appliances to driving industrial machinery and vehicles. Here's an overview of electric motors:

Basic Principle

Electric motors operate based on the principle of electromagnetic induction. When an electric current flows through a conductor placed in a magnetic field, a force is exerted on the conductor, causing it to move. This movement is harnessed to produce mechanical motion.

Components: Electric motors typically consist of several key components:

Stator: The stationary part of the motor that generates a magnetic field.

Rotor: The rotating part of the motor that interacts with the magnetic field to produce motion.

Windings: Conductive coils wound around the stator and rotor, which carry the electric current.

Shaft: The output shaft connected to the rotor, which delivers mechanical power to external devices.

Types of Electric Motors: There are various types of electric motors, each suited for different applications:

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DC Motors: Direct current motors operate on DC power and are commonly used in applications requiring variable speed control, such as in automotive systems and industrial machinery.

AC Motors: Alternating current motors operate on AC power and are widely used in household appliances, pumps, fans, and HVAC systems.

Induction Motors: An AC motor type where the rotor is energized by electromagnetic induction from the rotating magnetic field of the stator.

Synchronous Motors: AC motors where the rotation speed is synchronized with the frequency of the applied AC voltage.

Brushless DC Motors (BLDC): DC motors that use electronic commutation instead of brushes for improved efficiency and reliability, commonly found in appliances, computer peripherals, and electric vehicles.

Efficiency and Performance: Electric motors vary in terms of efficiency, power output, speed, torque, and size. Efficiency is a crucial factor in motor design, with modern motors designed to maximize energy conversion while minimizing losses due to friction, heat, and electrical resistance.

Applications: Electric motors are used in a wide range of applications across industries, including:

Transportation: Electric vehicles, trains, ships, and aircraft.

Industrial: Pumps, compressors, conveyors, machine tools, and robotics.

Household: Appliances such as refrigerators, washing machines, vacuum cleaners, and air conditioners.

Renewable Energy: Wind turbines, hydroelectric generators, and solar tracking systems.

Fig.1 Motor heating

II. FUNDAMENTAL OF HEAT TRANFER IN ELECTRIC MOTORS

A. Modes of heat transfer (conduction, convection, radiation)

B. Basic principles of thermal conduction in motor components (stator, rotor, bearings, etc.)

C. Convection heat transfer in motor cooling systems (natural convection, forced convection)

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III. Literature Review

Selvakumar, R et al (2021) This project is to develop a compact system to identify and display pollutants in a vehicle. The level of emissions can be monitored and inspected by this system. Database of each vehicle emissions test can be recorded and the report can be obtained to create an awareness to the drivers and owners about the pollution caused by the vehicle. An IoT (Internet of Things) based air pollution observing framework incorporated a MQ series sensor interfaced to a node MCU set with an ESP8266 WLAN connector to send the sensor reading to an Ubidots cloud. This outline is used for noticing pollutions in demeanour of specific territory and to get the air peculiarity or property examination. The obligated framework will focus on checking the air pollutants concentration with the help of a mixture of internet of things with wireless sensor systems. The investigation of emissions should be possible by figuring out the air quality index (AQI).[1]

Raja, S., et al (2021) Increase in the use of fossil fuel results in the depletion of underground reserves and responsible for increase in pollution. This demand for an alternate fuel resources which provide performances close to fossil fuels with less emissions. Waste Cooking Oil (WCO) is found as one such alternate fuel which possesses properties close to diesel fuel. In addition, ease of availability, non-toxicity, and biodegradability makes WCO a more desiring alternate fuel source. This work aims to focus on studying the performance, emission, and combustion properties of WCO in Compression Ignition (CI) engine. In this first phase of the work, neat diesel and WCO were tested in a single-cylinder water cooled diesel engine at different load conditions. In the second phase, WCO was converted in to its emulsion and tested in the test engine. Finally, the test engine was operated with above mentioned said fuels at two different compression ratio (i.e., 17.5:1 and 18:1), and results were compared. It comes to know that compression ratio is a strong function of performance, emission, and combustion characteristics of the test engine operated with different test fuels. It is concluded that the WCO and its emulsion give trade-off between brake thermal efficiency and oxides of nitrogen (NOx).[2]

Mayakrishnan, J. et al [2021] One of the challenging issues in the world today is waste management. Improper waste management could be the main source of environmental pollution. In this context, an attempt has been made to prevent the disposal of large quantities of Waste Cooking Oil (WCO) from hotels and restaurants and utilize them as a fuel in diesel engines. WCO is one of the viable alternative fuels, used by researchers in Compression Ignition (CI) engines due to its low cost, no toxicity, biodegradability and renewability. In this research, copper oxide (CuO) nano fluids were prepared by an one-step chemical synthesis method in different mass fractions of 15 ppm, 25 ppm, 35ppm and 50 ppm and blended with WCO. Based on the fuel stability, WCOCN25 and WCOCN50 test fuels are considered. The diesel and WCO were considered as base fuels. A fully equipped, single cylinder, four stroke, water cooled, direct injection, variable compression ratio diesel engine was used for experimentation. The compression ratio of the engine was varied from 16:1 to 18:1. The engine was loaded at different loading conditions by an eddy current dynamometer to measure the performance and emission parameters for the test fuels. The experimental results have shown that the addition of CuO nano fluids and increasing the compression ratio improved the Brake Thermal Efficiency (BTE) of the engine. It is observed that the combustion parameters have been improved due to the higher ignition delay and catalytic activity of CuO nano fluids. In addition, CuO nano fluids have a major role in controlling hydrocarbon (HC), carbon monoxide (CO), oxides of nitrogen (NOx) and smoke emissions.[3]

Mayakrishnan, J. et al [2020] Waste cooking oils (WCOs) are renewable and in nature can be directly used as fuel into the compression ignition engines. However, the reduction in brake thermal efficiency and increasing smoke emission and oxides of nitrogen need to be solved. There are more techniques used past researchers to improves the performance and reduced the emissions characteristics of WCO. In this present work, an experimental investigation made on the effect of ethanol on engine's behavior using Waste Cooking oil (WCO) based dual fuel diesel engine. A single-cylinder diesel engine was operated and modified the intake to operate dual fuel mode at the maximum power output of 3.54 kW. Ethanol is introduced as primary fuel into the intake manifold and WCO as pilot fuel. The ethanol energy share (EES) of the total fuel was varied from 5% to 40% with a step of 5%, at fixed engine speed equal to 1500 rpm. The test results show that significant improvements in brake thermal efficiency (BTE) of the engine at maximum brake power also the oxides of Nitrogen (NOx), and smoke emissions decreased with an increasing percentage of EES.[4]

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Factors Affecting Heat Generation in Electric Motors

A. Electrical losses (copper losses, iron losses)

B. Mechanical losses (friction losses, windage losses)

C. Influence of operating conditions (speed, load, ambient temperature)

D. Material properties and their impact on heat generation

Thermal Analysis Techniques for Electric Motors

A. Analytical methods (thermal resistance network, lumped parameter models)

B. Computational fluid dynamics (CFD) simulations for thermal analysis

C. Experimental techniques (thermal imaging, temperature sensors)

Heat Dissipation Techniques and Cooling Systems

A. Passive cooling techniques (heat sinks, thermal conduction pads)

B. Active cooling methods (fan cooling, liquid cooling)

C. Advanced cooling strategies (phase change materials, hybrid cooling systems)

Thermal Management Strategies

A. Temperature monitoring and control systems

B. Thermal insulation and optimization of motor design

C. Predictive maintenance for thermal management

Challenges and Future Directions

A. Emerging trends in electric motor design and materials

B. Integration of thermal management with overall motor performance

C. Research gaps and areas for future investigation

Case Studies and Applications

A. Review of case studies demonstrating heat transfer analysis in specific motor applications

B. Real-world examples of effective thermal management strategies.

IV. CONCLUSION

This outline covers the fundamental aspects of heat transfer in electric motors, including factors affecting heat generation, thermal analysis techniques, cooling systems, management strategies, challenges, and future directions. It also includes case studies and applications to provide practical insights into the topic.

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