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ORIGINAL

Impact of internal combustion engine overheating on lubricant oil degradation in a 2011 MAZDA bt50 vehicle

Incidencia del sobrecalentamiento del motor de combustión interna en la degradación del aceite lubricante en un vehículo MAZDA bt50 2011

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ABSTRACT

Introduction: overheating of an internal combustion engine is a common problem that can cause deterioration of the lubricating oil, and overheating of internal combustion engines is a common problem in automobiles.
Objective: to characterize aspects related to overheating of the internal combustion engine in a 2011 MAZDA bt50 vehicle.
Method: a qualitative study was conducted to find out how overheating of an internal combustion engine affects the operation of radiators, coolant conductors and water conductors in a 2011 MAZDA bt50 vehicle.
Results: it is important to note that engine temperature. An engine overheat can be harmful and lead to serious damage. Coolant is crucial to the cooling system. Many modern engines, including those of the Mazda BT-50, use multigrade oils. It is recommended to change the oil according to the recommended maintenance schedule.
Conclusions: overheating of the combustion engine is a problem that significantly affects the operation of the engine, so proper maintenance is important, as well as an adequate cooling system to avoid power loss, increased fuel consumption and also overheating accelerates oil oxidation, loss of viscosity, formation of deposits and increased engine wear.

Keywords: Overheating; Internal Combustion Engine; Lubricating Oil.

RESUMEN

Introducción: el sobrecalentamiento de un motor de combustión interna es un problema común que puede provocar el deterioro del aceite lubricante, siendo el sobrecalentamiento de los motores a combustión interna es un problema común en los automóviles.
Objetivo: caracterizar aspectos relacionados con el sobrecalentamiento del motor de combustión interna en un vehículo MAZDA bt50 2011.
Método: se realizó un estudio cualitativo para saber cómo incide el sobrecalentamiento de un motor a combustión interna en el funcionamiento de radiadores, conductores de refrigerantes y conductores de agua en un vehículo MAZDA bt50 2011.
Resultados: es importante tener en cuenta que la temperatura del motor. Un sobrecalentamiento del motor puede ser perjudicial y conducir a daños graves. El líquido refrigerante es crucial para el sistema de enfriamiento. Muchos motores modernos, incluidos los de la Mazda BT-50, utilizan aceites multigrado. Se

recomienda cambiar el aceite según el programa de mantenimiento recomendado.
Conclusiones: el sobrecalentamiento del motor de combustión es un problema que afecta significativamente el funcionamiento del motor, por lo que es importante el mantenimiento adecuado, un adecuado sistema de refrigeración para evitar pérdidas de potencia, aumento del consumo de combustible y además el sobrecalentamiento acelera la oxidación del aceite, perdida de viscosidad, formación de depósitos y mayor desgaste del motor.

Palabras clave: Sobrecalentamiento; Motor de Combustión Interna; Aceite Lubricante.

INTRODUCTION

Overheating an internal combustion engine is a common problem that can cause deterioration of the lubricating oil. However, research on the effects of this phenomenon on oil degradation is limited.[1] Therefore, it is necessary to analyze the effect of overheating of internal combustion engines on the degradation of lubricating oil. To do this, laboratory tests will be conducted, exposing the lubricating oil to different working temperatures.

Overheating internal combustion engines is a common automobile problem with increasing urbanization and traffic congestion. Coolant and water pumps, as well as radiators, play a key role in regulating engine temperature. Understanding how these components work and preventing malfunctioning is essential to ensure optimal vehicle performance and avoid costly repairs. In addition, significant advances in automotive technology have occurred in recent years, such as using more efficient engines and sophisticated cooling systems. Knowing how engine overheating occurs and how to fix it is essential to take full advantage of these new technologies and ensure efficient and long-lasting vehicle operation.

Studies have been conducted on the importance of radiators in dissipating heat generated by the engine. This research has shown that radiator malfunctions, such as the accumulation of dirt or the obstruction of fins, can significantly reduce their cooling capacity. In addition, it has been proven that the choice of materials with good thermal properties, as well as the optimal design of the radiator structure, improves the efficiency of the cooling system.[2]

Overheating in an engine refers to the excessive increase in the temperature of the vehicle's cooling system, exceeding normal operating limits. In the case of a 2011 Mazda BT-50, the engine is experiencing higher than recommended temperatures, leading to severe damage if not appropriately addressed.[2]

Research has analyzed the coolant lines, also known as hoses, that carry the coolant between the radiator and the engine. It has been found that wear or a leak in these hoses can cause a loss of coolant and, consequently, an increase in engine temperature. For this reason, inspection and preventive maintenance techniques, such as the periodic replacement of hoses, have been proposed to avoid overheating situations.[3]

This information can be used to develop new lubricants that are more resistant to overheating, providing new and valuable information on the effect of engine overheating on lubricant degradation. It can also improve the efficiency and longevity of internal combustion engines and help engine manufacturers design engines that are more resistant to overheating and, therefore, require less maintenance.

Given the above, this article aims to characterize aspects related to overheating the internal combustion engine in a 2011 MAZDA bt50 vehicle.

METHOD

A qualitative study was conducted to find out how the overheating of an internal combustion engine affects the functioning of radiators, coolant pipes, and water pipes in a 2011 MAZDA BT50 vehicle.

Approximation, identification, and causal analysis were used to obtain the corresponding information. The qualitative data was analyzed using a thematic approach, identifying patterns, themes, and significant relationships in the information collected.

RESULTS

Table 1 shows the relationship between indicators associated with overheating in a 2011 Mazda BT50 engine model, highlighting engine temperature, cooling and coolant, oil change intervals, and type of oil used.

Table 1. Analysis according to where overheating begins and in which elements it occurs in an engine with a 2011 Mazda BT50 model

Variables	Conceptualization	Dimensions	Indicator
Engine overheating Mazda BT50 2011	Overheating in an engine refers to the excessive increase in the temperature of the vehicle's cooling system, exceeding normal operating limits. In the specific case of a 2011 Mazda BT-50, this implies that the engine is experiencing higher than recommended temperatures, which can lead to serious damage if not addressed properly.	Proper engine temperature Mazda BT50 2011	The proper engine temperature of a vehicle, including the 2011 Mazda BT50, is usually between 190 and 220 degrees Fahrenheit (87 to 104 degrees Celsius). The Most modern engines are designed to operate efficiently within this temperature range. within this temperature range. It is important to note that engine It is important to note that engine temperature may vary depending on driving conditions, vehicle driving conditions, vehicle load and climate. Engines are designed to to operate at higher temperatures during normal operating situations, as this helps to improve efficiency and reduce emissions.
		Measurement of heat in the engine and operation	Optimal engine performance is found in a specific temperature range. The following are some key points about motor temperature and motor operation: Normal Operating Temperature: Most engines operate efficiently at a normal temperature of approximately 190 to 220 degrees Fahrenheit (87 to 104 degrees Celsius). This range allows the lubricating oil to reach its ideal viscosity and the engine to operate efficiently. Cooling: The cooling system, which includes the radiator, water pump and thermostat, helps keep the engine within this temperature range. Coolant circulates through the engine and radiator, dissipating heat generated during combustion. Overheating: Overheating of the engine can be harmful and lead to serious damage. It can be caused by problems in the cooling system, such as leaks, thermostat malfunction, faulty fans or lack of coolant. Initial warm-up: It is normal for the engine temperature to rise after a cold start. This is because the engine needs time to reach its normal operating temperature. During this time, it is advisable to drive in moderation until the engine reaches its optimum temperature.
		Coolant and its performance at high temperatures	Coolant, also known as antifreeze or coolant, is crucial to a vehicle's engine cooling system, including the 2011 Mazda BT50. Here is information about coolant and its performance at high temperatures: Coolant Composition:Coolant is usually a mixture of water and antifreeze chemicals. The mixture helps prevent the water from freezing in extreme cold conditions and keeps the engine from overheating in hot conditions. High Temperature Performance: Modern coolants are formulated to withstand high temperatures and protect the engine from overheating. In addition to providing freeze protection in winter, these fluids also have additives that help dissipate heat in extremely hot conditions. Change Intervals: It is important to follow the vehicle manufacturer's recommendations for coolant change intervals. Over time, the additives in the coolant can become depleted, affecting its ability to protect the engine from heat and cold.

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	Type of engine oil	Oil Type: In general, many modern engines, including those in the Mazda BT-50, use multigrade oils that meet the manufacturer's recommended specifications. These may be something like a 5W-30 or 10W-30 oil. The viscosity of the oil can affect its performance in different weather conditions. High Temperature Performance: Multigrade oils are formulated to provide stable performance in a variety of temperatures, including high temperatures. Modern oils contain additives and viscosity index improvers that enable them to maintain adequate viscosity even at elevated temperatures. This is crucial to ensure effective engine lubrication, even in extremely hot conditions. Oil Change Intervals: Although modern oils are capable of withstanding high temperatures, it is important to follow the manufacturer's recommendations for oil change intervals. Changing oil according to the recommended maintenance schedule helps maintain engine performance and prolong engine life.
	Structured elements in this type of engine	Engine Block: The engine block is the main structure containing the engine cylinders. It is usually made of cast iron or aluminum and provides the structural base for the rest of the components. Cylinder Head: Also known as the cylinder head, the cylinder head is located at the top of the engine block and seals the cylinders. It contains the intake and exhaust valves, as well as the combustion chamber. Crankshaft: The crankshaft is a critical part of the connecting rod and piston system. It converts the linear motion of the pistons into rotary motion that drives the vehicle's wheels. Pistons and connecting rods: Pistons move up and down inside the cylinders. Connecting rods connect the pistons to the crankshaft and transfer the energy generated by combustion. Camshaft: The camshaft controls the opening and closing of the valves. There may be one camshaft for the intake valves and another for the exhaust valves. Valves: Valves control the flow of air and fuel into the cylinders and allow exhaust gases to exit. Intake valves open to allow air and fuel mixture to enter, while exhaust valves open to allow exhaust gases to exit. Fuel System: Includes the fuel injection system that supplies the fuel-air mixture to the cylinders for combustion. Exhaust System: Transports exhaust gases out of the engine. Includes the exhaust manifold and exhaust pipe. Cooling System: Includes the radiator, water pump and thermostat, and is responsible for maintaining the engine temperature within a suitable range. Lubrication System: Includes the oil pump and oil sump. Lubricates the moving parts of the engine to reduce friction and wear. Timing Belt or Chain: Controls the synchronization between the crankshaft and the camshaft to ensure the correct timing.

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	Technological progress presented by engine optimization	Some relevant technological aspects of the 2011 Mazda BT-50 engine optimization: Common Rail Diesel: The 2011 BT-50 is available with diesel engines, and many of these models use Common Rail technology for fuel injection. This system allows for more precise and efficient fuel injection, improving engine power and efficiency. Intercooler: Some 2011 BT-50 models may be equipped with an intercooler, which cools the air before it enters the engine, improving air density and therefore combustion efficiency. Electronic Engine Control (ECU): The ECU, or engine control unit, is responsible for managing various aspects of engine performance. It can adjust fuel/air mixture, ignition timing and other parameters to optimize efficiency and emissions. Optimized Exhaust System: The 2011 BT-50 may have incorporated an optimized exhaust system to improve exhaust gas flow, which contributes to better engine performance. Advanced Transmission: Depending on configuration, some 2011 BT-50 models could feature more advanced automatic or manual transmissions to improve fuel efficiency and provide smoother performance. Direct Injection System: On some diesel engines, direct injection, a technology that improves fuel atomization for more efficient combustion, could be present. Traction Management System (on some models): If equipped with all-wheel drive, the BT-50 could feature traction management systems that allow drivers to adjust power distribution to suit various driving conditions.
	Technological accessibility for diagnostics	There are some technology accessibility options that could be useful: OBD-II (On-Board Diagnostics) scanner: Modern vehicles, including the 2011 Mazda BT-50, are equipped with an OBD-II connector that allows the reading of diagnostic codes and engine data. An OBD-II scanner can provide information on possible fault codes related to the cooling system and other engine components. Advanced Scan Tools: Some more advanced scan tools allow a real-time readout of engine parameters such as coolant temperature, fan speed, and other data related to the cooling system. This can help identify specific problems. Infrared Thermometer: An infrared thermometer can be useful for measuring the temperature in various parts of the engine and cooling system. You can identify areas that are hotter than normal, which may indicate a problem with a specific component. Coolant Pressure Monitoring System: Some vehicles have a coolant pressure monitoring system that alerts you to pressure problems in the cooling system. Check to see if your 2011 Mazda BT-50 has this feature. Thermal Cameras: Thermal cameras can be useful for identifying hot spots in the engine and exhaust system. They can be particularly useful in detecting overheating problems. Exhaust Gas Analysis: An exhaust gas analyzer can provide information on combustion and engine efficiency, helping to identify temperature-related problems.

DISCUSSION

Overheating an internal combustion engine is a common problem that can lead to deterioration of the lubricating oil. Internal combustion engines operate at very high temperatures, and lubricants protect the engine's metal parts from wear and corrosion. However, if the engine overheats, the oil will lose its protective properties and cause damage to the engine.[4]

The tubes that carry the coolant inside the engine are the water pipes. Research has shown that the accumulation of sediment and minerals inside these pipes can obstruct water flow, causing a deficit in the cooling process and overheating. Therefore, techniques for cleaning and purging the water system have been proposed to maintain its proper functioning.[5]

Overheating of the engine will cause several phenomena that damage the lubricating oil, such as:

- Oil oxidation occurs when the oil is exposed to high temperatures.
- The oil decomposes at high temperatures and pressures.
- The formation of sludge and deposits can clog the oil passages and reduce oil flow.

Degradation of lubricants can cause the following problems:

- Wear and tear of the engine's metal parts will shorten its useful life.
- Corrosion of the engine's metal parts can also shorten its useful life.
- Loss of engine power affecting the vehicle's performance.

The issue of overheating an internal combustion engine in the operation of radiators, coolant pipes, and water pipes is highly relevant for several reasons. Firstly, with the growing concern about climate change and the adoption of increasingly strict policies on greenhouse gas emissions, it is essential to understand how to prevent engine overheating. Overheating can increase polluting gas emissions and contribute to global warming, which has a considerable impact on the environment and human health, criteria that several authors agree on.[6,7,8,9,10] It is vital to understand how cooling systems work and to prevent engine overheating.

The problem of engine overheating due to damage to the lubricating oil is relevant, as it can significantly affect the efficiency and longevity of the internal combustion engine. The problem of engine overheating is severe in the study area due to the climatic conditions. Temperatures in this area are high throughout the year, which can increase the risk of engine overheating.[4]

The internal combustion engine can generate power and transform chemical energy into mechanical energy. The amount of polluting particles in the oil throughout its useful life will also be analyzed. An advantage of the internal combustion engine is its energy benefit over steam engines. The internal combustion engine also has a radiator, which allows the coolant to circulate and has a stable working temperature.[2]

Lubricating oil reduces excessive wear on parts and prevents and protects the engine from corrosion. Engine lubricants can collect any type of contaminant, and contamination in the oil also occurs due to the use of foreign substances called contaminants. An increase in the temperature of the coolant causes an engine to overheat, which decreases power.

The engine must work at the correct temperature. If not, it can suffer a major breakdown due to overheating. We will tell you the causes and how to avoid them as far as possible. Using the wrong oil Using an oil that does not correspond to the manufacturer's specifications can also lead to engine overheating.[2] One technique to avoid engine overheating is regular maintenance or checks on the engine.[4]

The overheating of internal combustion engines is very relevant to technological research and innovation. Studies on this topic can lead to improvements in engine cooling systems, the creation of new materials, and more efficient temperature control technologies. This research can contribute to the development of cleaner and more sustainable engines and to the advancement of the automotive industry in general.[11]

CONCLUSIONS

Overheating of the combustion engine significantly affects its operation, so proper maintenance and a proper cooling system are essential to avoid power loss and increased fuel consumption. In addition, overheating accelerates oil oxidation, loss of viscosity, deposit formation, and increased engine wear.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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