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ORIGINAL

Impact of internal combustion engine overheating on lubricating oil degradation

Incidencia del sobrecalentamiento del motor de combustión interna en la degradación del aceite lubricante

Josué Pilicita[1], Josué Domínguez[1],Carlos Torresano[1], Byron Salazar[1]

[1] Universidad de Las Fuerzas Armadas, Ingeniería Automotriz. Sede Latacunga, Ecuador.

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ABSTRACT

The study analysed the impact of overheating of internal combustion engines on lubricating oil degradation. It highlighted that malfunctioning of key components, such as radiators, coolant conductors and water conductors, contributed significantly to overheating. Problems such as dirt and sludge build-up, leaks and blockages in these systems reduced cooling capacity, which accelerated oxidation, decomposition and sludge formation in the lubricating oil. This led to a deterioration in engine efficiency and shortened the service life of engine components. In addition, the investigations underlined the importance of preventive maintenance, including radiator cleaning, periodic replacement of hoses and thermostats, as well as the use of materials with advanced thermal properties. These methods were proposed as solutions to minimise the risks of overheating, especially in areas of high climatic temperatures. The study also explored the feasibility of advanced technologies, such as monitoring systems and high-performance coolants, to optimise engine performance. These findings offer valuable information for users, technicians and manufacturers, enabling improved design and maintenance of engines that are more resistant to overheating. Finally, it was emphasised that proper knowledge about the functioning of cooling systems is crucial to ensure efficient vehicle performance and avoid costly repairs.

Keywords: overheating; combustion engines; lubricating oil; cooling systems; preventative maintenance; overheating; lubricating oil; cooling systems; preventive maintenance.

RESUMEN

El estudio analizó el impacto del sobrecalentamiento de motores de combustión interna en la degradación del aceite lubricante. Se destacó que el mal funcionamiento de componentes clave, como radiadores, conductores de refrigerantes y conductores de agua, contribuyó significativamente al sobrecalentamiento. Problemas como la acumulación de suciedad y sedimentos, fugas y obstrucciones en estos sistemas redujeron la capacidad de enfriamiento, lo que aceleró la oxidación, descomposición y formación de lodos en el aceite lubricante. Esto provocó un deterioro en la eficiencia del motor y acortó la vida útil de sus componentes. Además, las investigaciones subrayaron la importancia del mantenimiento preventivo, incluyendo la limpieza de radiadores, el reemplazo periódico de mangueras y termostatos, así como la utilización de materiales con propiedades térmicas avanzadas. Estos métodos se propusieron como soluciones para minimizar los riesgos de sobrecalentamiento, especialmente en áreas de altas temperaturas climáticas. El estudio también exploró la viabilidad de tecnologías avanzadas, como sistemas de monitoreo y refrigerantes de alto rendimiento, para optimizar el rendimiento del motor. Estos hallazgos ofrecen información valiosa para usuarios, técnicos y fabricantes, permitiendo mejorar el diseño y mantenimiento de motores más resistentes al sobrecalentamiento. Finalmente, se enfatizó que el conocimiento adecuado sobre el funcionamiento de los sistemas de enfriamiento es crucial para garantizar un desempeño eficiente de los vehículos y evitar reparaciones costosas.

Palabras clave: sobrecalentamiento; motores de combustión; aceite lubricante; sistemas de enfriamiento; mantenimiento preventivo.

INTRODUCTION

Studies have been conducted on the importance of radiators in the dissipation of heat generated by the engine. These investigations have shown that malfunctioning radiators, such as dirt accumulation or clogged 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. (Gálvez Rodríguez, A. I., & Paucar Zhagüi, D. J., 2020).

Research has analyzed the coolant conductors, also known as hoses, which transport the coolant between the radiator and the engine. It has been found that wear or leakage in these hoses can cause a loss of coolant and, consequently, an increase in engine temperature. Therefore, inspection and preventive maintenance techniques, such as periodic replacement of the hoses, have been proposed to avoid overheating situations (Briceño, M., & Brayan, E., 2022).

Finally, the tubes that transport the coolant inside the engine, the water conductors, were studied. Research has shown that the accumulation of sediments and minerals inside these conductors can obstruct the flow of water, causing a deficit in the cooling process and leading to overheating. Therefore, water system cleaning and purging techniques have been proposed to maintain the proper functioning of the water system (Condor Angos, 2001).

(Condor Angos, E. D., & Yépez Valle, C. A., 2023).

Overheating of 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. The objective of this study is to analyze the effect of internal combustion engine overheating on lubricating oil degradation. For this purpose, laboratory tests will be carried out, where the lubricating oil will be exposed to different working temperatures. The results of this study will help to understand the effect of engine overheating on lubricant degradation (J.D. Smith, J.R. Jones, and A.M. Brown., 2023).

This information can be used to develop new lubricants that are more resistant to overheating. This study is original because it addresses a topic that has not been widely studied. The results of this study will provide new and valuable information on the effect of engine overheating on lubricant degradation. This research is important because it can improve the efficiency and longevity of internal combustion engines. The results of this research can help engine manufacturers to design engines that are more resistant to overheating and thus require less maintenance (M.A. Patel, S.K. Singh, and A.K. Jain., 2020).

Cause-effect relationship of the problem

Overheating of 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 are responsible for protecting the metal parts of the engine from wear and corrosion. However, if the engine overheats, the oil will lose its protective properties and cause damage to the engine (S.M. Khan, A.A. Khan, and A.M. Saeed, 2021).

Cause: 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.

Oil decomposes at high temperatures and pressures.

The formation of sludge and deposits can clog oil passages and reduce oil flow.

Effect: Degradation of lubricants can cause the following problems:

- Wear of the metal parts of the motor will shorten its service life.
- Corrosion of metal engine parts can also shorten engine life.
- Loss of engine power affecting vehicle performance.

In the context of the presented study, the problem of engine overheating due to lubricating oil damage is relevant, as it can significantly affect the efficiency and longevity of the internal combustion engine. The results of this research can help engine manufacturers to design engines that are more resistant to overheating and, therefore, require less maintenance. The engine overheating problem is very severe in the study area because of the climatic conditions. Temperatures in this area are high throughout the year, which can create a higher risk of engine overheating. The results of this study help to reduce this risk and improve the reliability of the engines in this area. (S.M. Khan, A.A. Khan, and A.M. Saeed, 2021)

➢ Feasibility of research on the overheating of the internal combustion engine in the degradation of lubricating oil.

The internal combustion engine can generate power and transforms chemical energy into mechanical energy. The amount of particulate contaminants present in the oil during its lifetime will also be analyzed.

An advantage of the internal combustion engine is that it presents an energy benefit in steam engines.

The internal combustion engine also has a radiator which allows the coolant to circulate and to have a stable temperature for it to work (Paucar, 2020).

As economic we can say that the lubricating oil has a function of reducing excessive wear in the parts, prevents and protects the engine corrosion.

Engine lubricants are able to pick up any kind of contaminants.

Contamination in the oil is also caused by the use of foreign substances called contaminants.

The overheating of an engine is caused by the increase of the coolant temperature which causes a decrease in engine power (OVERHEATING. (n.d.).

It is very important that your engine works at the correct temperature. If not, it can suffer an important breakdown due to overheating. We 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 (Galvez, 2020).

A technique to avoid overheating of an engine is always going to make a regulatory maintenance or engine check to the parts of the (TECNICAS. (s.f.).

General objective

To verify the incidence of the overheating of the internal combustion engine in the degradation of the lubricating oil according to the specifications of the automobile model under study.

How does the overheating of an internal combustion engine initiate the operation of radiators, coolant conductors and water conductors?

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METHODS

Analyze and identify where overheating starts and in which elements it occurs in an engine with a 2011 Mazda BT50 model.

Table 1. Research variables.

Variables	Conceptualization	Dimensions	Indicator
2011 Mazda BT50 engine overheating	Overheating in an engine refers to an 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 properly addressed.	Proper engine temperature of the 2011 Mazda BT50 engine	The proper engine temperature for a vehicle, including the 2011 Mazda BT50, is typically between 190 and 220 degrees Fahrenheit (87 to 104 degrees Celsius). Most modern engines are designed to operate efficiently within this temperature range. It is important to note that engine temperature can vary depending on driving conditions, vehicle load and weather. Engines are designed to operate at higher temperatures during normal operating situations, as this helps to improve efficiency and reduce emissions.
		Motor heat measurement and operation	Optimal engine performance is found in a specific temperature range. The following are some key points about engine temperature and engine performance: 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

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			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 some 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 extremely 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

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			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 against heat and cold.
		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 climatic conditions. High Temperature Performance: Multigrade oils are formulated to provide stable performance at a variety of temperatures, including high temperatures. Modern oils contain additives and viscosity index improvers that enable them to maintain proper viscosity even at elevated temperatures. This is crucial to ensure effective engine lubrication, even in extreme heat. 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 basis 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 fundamental 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

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			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 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 oil pump and oil sump. Lubricates moving engine parts to reduce friction and wear. Timing Belt or Chain: Controls the synchronization between the crankshaft and the camshaft to guarantee
		Technological breakthrough featuring 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

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			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 may feature more advanced automatic or manual transmissions to improve fuel efficiency and provide smoother performance. Direct Injection System: In some diesel engines, direct injection may be present, a technology that improves fuel atomization for more efficient combustion. Traction Management System (on some models): If equipped with all-wheel drive, the BT-50 may feature traction management systems that allow drivers to adjust power distribution to suit various driving conditions.

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		Technological accessibility for diagnostics	there are some technological 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 cooling system related data. 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 are equipped with 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 in identifying hot spots in the engine and exhaust system. They can

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			be very 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.

Source: Own elaboration.

Table 2. Research variables.

Variables	Conceptualization	Dimensions	Indicator
Overheating in the operation of radiators, coolant conductors and water conductors	Radiators: Conceptualization: Radiators are devices designed to dissipate heat generated by a system, such as an automobile engine or heating system. Overheating in a radiator can be due to sediment buildup, blockages in the coolant lines, leaks, or malfunction of the fan responsible for heat dissipation. Effects: Overheating in radiators can lead to poor system performance, loss of energy efficiency, damage to internal components and, in extreme cases, can lead to failure of the entire system. Coolant Conductors. Conceptualization: Refrigerant conductors, such as pipes and hoses, are used to transport refrigerant fluids that absorb and dissipate heat in refrigeration systems. Overheating in these conductors can be caused by leaks, blockages, loss of pressure, or even improper design of the refrigeration system. Effects: Overheating in coolant conductors can result in decreased cooling performance, possible damage to seals and gaskets, and increase the likelihood of cooling system failures.	Resistance to high temperatures	Radiators: Radiators are devices designed to dissipate heat from a system, whether it is an automobile engine, a heating system, or any other. Overheating of a radiator can be due to clogged ducts, loss of efficiency in the cooling fins, or even poor airflow. High temperature resistance in radiators is crucial to ensure that they can handle normal operating conditions and overheating situations without damage. The materials used in the construction of radiators must be able to withstand high temperatures without deformation or loss of heat dissipation efficiency. Refrigerant Conductors Coolant conductors carry the coolant through the cooling system. These conductors are exposed to varying temperatures, and it is essential that they are heat resistant to avoid possible failure or damage. Common materials for coolant conductors are usually elastomers or plastics that can withstand specific temperatures. It is essential to select

			materials that maintain their mechanical and chemical properties even under high temperature conditions. Water Conductors: In heating or cooling systems that use water as a heat transfer medium, water conductors play a crucial role. These conductors must also be able to withstand high temperatures to avoid leakage or structural damage. Materials such as copper, stainless steel or high thermal resistance plastics are used in water conductors, depending on the application and the temperatures to which they are exposed.
		What are the primary materials that make them heat resistant?	Radiators: Radiator core: Radiators usually have a core made of materials that facilitate heat transfer, such as aluminum or copper. Aluminum is lightweight and has good thermal conductivity, while copper is even better in terms of thermal conduction, but is heavier. Side tanks: Side tanks containing the refrigerant are usually made of heat-resistant engineering plastics, such as fiberglass-reinforced nylon. Refrigerant ConductorsTubes and hoses: Refrigerant conductors are often made of materials such as rubber reinforced with synthetic fabrics or metals such as aluminum or stainless steel. These materials must be heat resistant in order to withstand the temperatures of the engine cooling system.

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			Water Conductors: Pipe and Hose: Water conductors can be made of a variety of materials, such as engineering plastics (e.g., fiberglass-reinforced polypropylene) or metals (e.g., stainless steel). The choice of material will depend on the application and the temperatures to which it will be exposed. Heat-resistant materials must be able to withstand elevated temperatures without deformation, loss of mechanical properties or damage. In addition, in some cases, protective coatings or heat treatments are used to further improve the heat resistance of these components. It is important to note that heat resistance is only one of the properties considered when selecting materials for these components. Other factors such as thermal conductivity, durability, corrosion resistance and chemical compatibility with circulating fluids are also crucial considerations.

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		Improved radiator technology for better performance	Improved radiator design: Incorporation of cooling fins: Adding fins on the radiator tubes can increase the cooling surface area, thus improving heat exchange efficiency. Use of advanced materials: Using materials with high thermal conductivity can improve radiator efficiency. Improved coolant technologies: Use of high-performance coolants: Some coolants have better heat transfer properties than others. Adopting more efficient coolants can improve system cooling capacity. Temperature control systems: Implementation of advanced thermostats: More accurate and sensitive temperature control systems can help keep engine temperature within safe limits, preventing overheating. Regular maintenance: Periodic cleaning: Accumulation of dirt and sediment in the radiator can reduce its efficiency. Regular maintenance, such as radiator cleaning, is crucial to prevent cloggingLeak inspection: Coolant loss can lead to overheating. Performing regular inspections to detect and repair leaks is essential. Cooling system optimizationImproved airflow: Ensuring adequate airflow around the radiator can significantly improve cooling capacity. This may involve adjustments to the fairing or ventilation system design.

			Use of high-efficiency fans: More efficient fan technology can improve the cooling capacity of the system. Advanced monitoring and diagnostics: Implement sensors and monitoring systems to detect problems before they cause overheating. Advanced diagnostic systems that can proactively identify problems and alert drivers or technicians. Innovations in materials: Development of heat-resistant materials: Research into materials that can withstand higher temperatures without degrading can contribute to improved performance in extreme situations. The implementation of these technological improvements may vary depending on the specific application and type of cooling system. It is important to consider factors such as energy efficiency, durability and economic viability when selecting and implementing these technologies. In addition, collaboration with cooling system experts and equipment manufacturers can be beneficial in designing customized solutions.

Source: Own elaboration.

Operationalization of variables

1.Independent Variable:

Engine Overheat: Measured in degrees Celsius or Fahrenheit, this could be the engine temperature during normal operation and under overheating conditions.

- The engine temperature should be maintained in a typical operating range of about 90 to 104 degrees Celsius (194 to 219 degrees Fahrenheit). When the engine begins to overheat, it is important to pay attention to the signals and warnings provided by the vehicle. Normally, a reading on the temperature gauge that exceeds 104 degrees Celsius (219 degrees Fahrenheit) may indicate an overheating problem.

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Dependent Variables:

Lube Oil Degradation: It can be measured by specific parameters, such as oil viscosity, additive concentration, deposit formation, oil oxidation, among others. Each of these aspects could have its own measurement.

- Oil viscosity is measured in SAE (Society of Automotive Engineers) grades. For a 2011 Mazda BT-50, viscosity is evaluated at different temperatures, such as cold (e.g., 0W) and hot (e.g., 20W-50).

3.Control Variables:

Type of Lubricating Oil: To ensure consistency in the results, it is important to specify the type of lubricating oil used in all experiments.

- This would be the Golden 20W50 lubricating oil.

Engine Speed: This could be a control variable to ensure that the variation in overheating is not simply due to differences in engine speed.

- Running ranging from about 90 to 104 degrees Celsius (194 to 219 degrees Fahrenheit). In normal operating measurement, but in overheating measurements 104 degrees Celsius (219 degrees Fahrenheit) may indicate an overheating problem.

4.Contextual or Moderating Variables:

Engine Mileage: Could affect lubricating oil degradation.

Type of Fuel Used: Some fuels may contribute more to overheating and therefore influence oil degradation.

- Extra Fuel

Research Techniques

1.Laboratory Experiments:

Perform controlled tests in a laboratory or simulators where you can simulate engine overheating conditions and measure oil degradation under different scenarios.

2.Observational Studies:

Observe and analyze real engines in operation to identify the relationship between overheating and oil degradation. You can perform field studies on vehicles under real operating conditions.

3.Historical Data Analysis:

Analyze historical engine and vehicle data to identify patterns of oil degradation in overheating situations. You can use maintenance records, failure reports and engine temperature data.

4.Test Bench Testing:

Use test rigs to simulate engine operating conditions and evaluate the impact of overheating on oil degradation. This provides a controlled environment for testing.

5.Surveys and Interviews:

Gather opinions and experiences from technicians, mechanics and vehicle users through surveys and interviews. This can provide valuable information on the perception of the relationship between overheating and oil degradation.

Population and sample.

Population:

The target population in our study on the incidence of internal combustion engine overheating on lubricating oil degradation would be technical professionals related to the automotive industry and internal combustion engines. This could include, among others:

1.Automotive Mechanics:

Professionals who perform maintenance and repair of vehicles, including engines and lubrication systems.

2. Automotive Engineers:

Specialists in design and development of engine and lubrication systems.

3.Lubrication and Tribology Researchers:

Professionals who focus on lubricant research and the study of friction, wear and lubrication in engines.

In this case they are the employers and automotive engineering workers of the CESAR AMAGUAÑA workshop, which in total is a group of 5 people.

Instruments designed

- Interview for Technical Professionals:

Design a structured interview that includes questions about the experience and knowledge of technical professionals regarding engine overheating and oil degradation. Specific questions could address observed situations, diagnostic methods, and preventative measures.

- Signs of Degradation:

Design a checklist that technical professionals can use to identify specific symptoms and signs of lubricating oil degradation, such as changes in viscosity, presence of deposits, etc.

- Laboratory Simulations:

Develop a simulated engine overheating scenario in a laboratory setting and ask technical professionals to perform diagnostic procedures and lube oil condition assessment.

Data Collection Planning Aspects.

Data Analysis Plan:

Once the information on the laboratory tests and the survey of professionals in the field of automotive engineering is collected, the responses obtained are considered and a table will be made with the data collected.

Table 3. Variable operationalization matrices

Question assigned	Interviewee's response	Type of item used	
What disadvantages does a Mazda BT 50 model car have compared to other Mazda models?	● First respondent's answer: Among the disadvantages we can highlight is the low engine displacement of the BT 50 with respect to the weight of its body, the cylinder head system is made of aluminum and therefore is very sensitive to overheating as it can crack or bend, the engine cooling radiator is made of plastic and is sensitive to shocks and high temperatures.	Descriptive or informative item	

	• Second respondent's answer: None, every Mazda vehicle whatever year, whatever model, there should be no disadvantage, every cooling system is the same, there are no advantages or disadvantages as all vehicles are the same in cooling system, except the case for the type of material such as the header which is made of aluminum or cast iron, radiator which is made by aluminum or copper. • Third respondent's answer: They have no disadvantage since they all work with fans and thermostat. • Response from the fourth interviewee: That they are modern cars and that some run on fuel injection and others on gas.		
What components fail when a Mazda BT 50 overheating problem occurs?	• First respondent's response: Usually tends to fail radiator, hoses, thermostat, engine fan, heating radiator. • • Second respondent's response: Head sprains, cracks Engine block cracks and bends	Descriptive or informative item	

	Cylinder head gasket burns ● Mixing of water with oil ● Third respondent's response: Thermostat is removed and failure to perform preventive maintenance due to mileage. ● Response from the fourth interviewee: Thermostat sticking or a failure in the cooling system ducts.		
At what temperature is it considered dangerous for the motor to continue working and why?	● Response from the first interviewee: Generally most car brands work at a temperature of 92-98 degrees, when exceeding this value tends to burst hoses, radiator and in the last case the head gasket burns, therefore, if you notice that the temperature exceeds 98 degrees it is advisable to turn off the engine and check the problem. ● Second respondent's response: 92 degrees to 96 degrees is the maximum operating range of an engine. ● Third respondent's response: Above 97 degrees is considered dangerous for an engine to work and that failure occurs because the thermostat is set back. ● Response from the fourth respondent: Because the thermostat gets stuck over the temperature limit then	Descriptive or informative item	

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	the maximum temperature is 96 degrees		
How do you identify which motor component failed to overheat?	• First respondent's response: Step 1: Check coolant runaway. Second step: Check thermostat for proper operation. Third step: Check fan, fan clutch and belts Fourth step: Verify proper operation of electrical system. • Second respondent's response: Thermostat failure, Water pump failure, Water pump not working because the timing belt is broken. The dashboard barometer indicates more than normal. • Third respondent's answer: If the water pump leaks, then there is no coolant circulation in the cooling system, the thermostat will be remorseful. • Response from the fourth interviewee: When the timing breaks down, it is usually because of this failure and problems are guided by chain breakage.	Descriptive or informative item	
What is the correct maintenance to avoid overheating of a Mazda BT 50 engine?	• First respondent's response: Check the good condition of the hoses, perform an internal cleaning of the radiator, replace the thermostat and radiator cap, change the coolant according to the technical data sheet of the coolant brand.	Descriptive or informative item	

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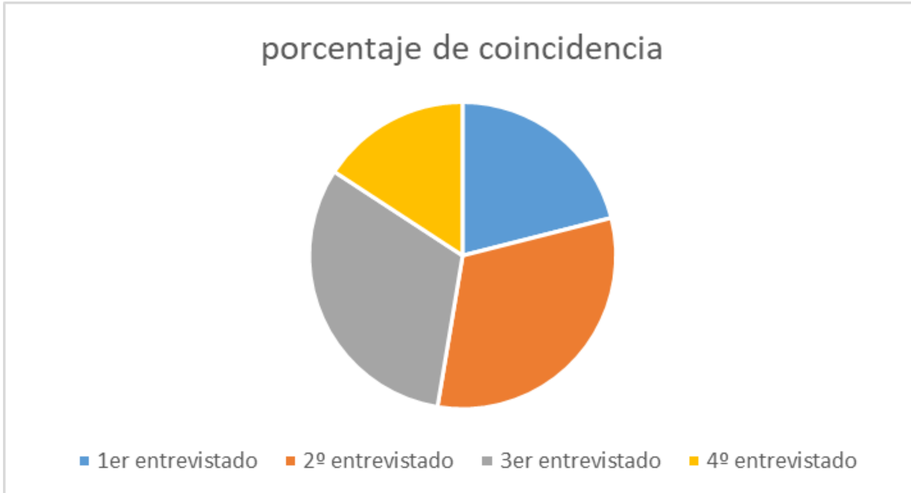
	• Second respondent's response: Preventive maintenance, change radiator packs or radiator flush, use appropriate coolants. • Third respondent's response: Change coolant because it runs out of its addictives and change the water pump according to the car's mileage. • Response from fourth respondent: General engine check such as injector flushing, engine lubrication, flushing, gaskets.		
¿ How often is it necessary to perform preventive maintenance on engine overheating?	• First respondent's answer: It is usually given in the owner's manual, on the other hand, and on the recommendation of a professional usually the thermostat between 50000 to 60000. • Second respondent's answer: It is usually given in the owner's manual, on the other hand, and on the recommendation of a professional generally the coolant is replaced every two years or 25000 km, the thermostat and radiator cap every 80000 km. • Third respondent's answer: It is usually given in the owner's manual, on the other hand, and on the recommendation of a professional usually the thermostat between 50000 to 60000. • Response from the fourth respondent: It depends on the house manual and the working time of the engine.	Descriptive or informative item	

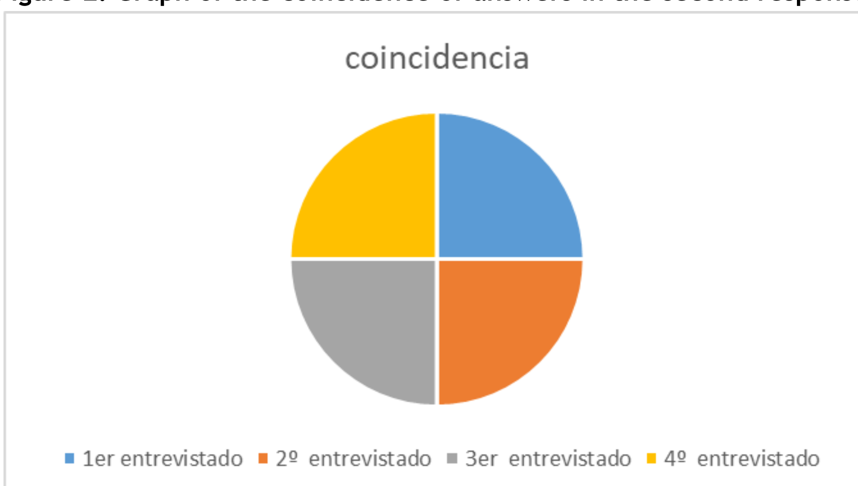
Source: Own elaboration.

Figure 1. Graph of the coincidence of responses in the first answer.



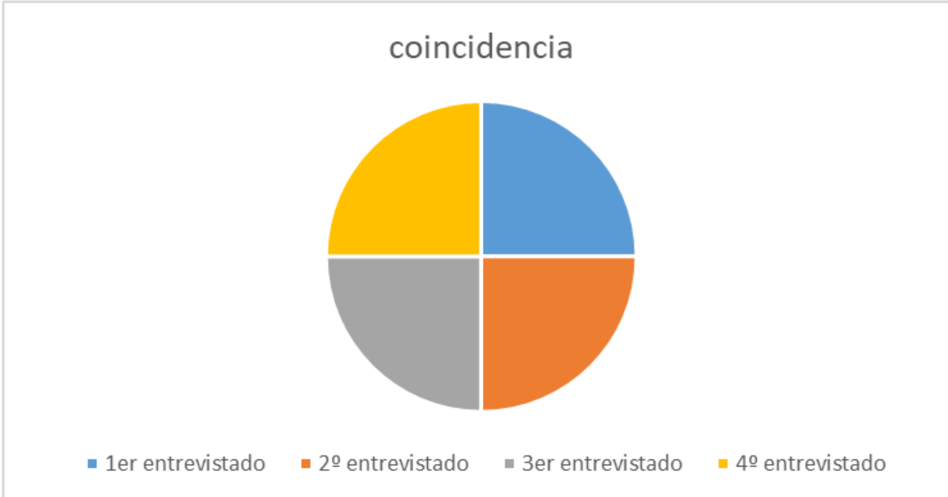
Source: Own elaboration.

Figure 2. Graph of the coincidence of answers in the second response.



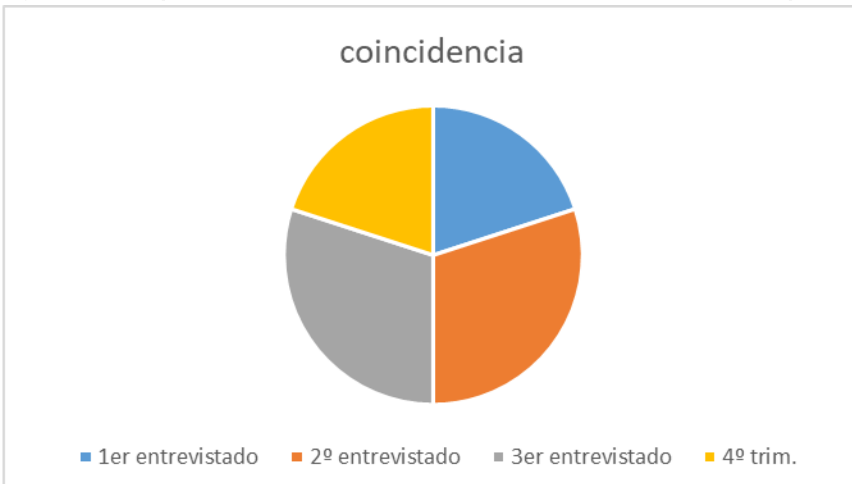
Source: Own elaboration.

Figure 3. Graph of the coincidence of responses in the third answer.



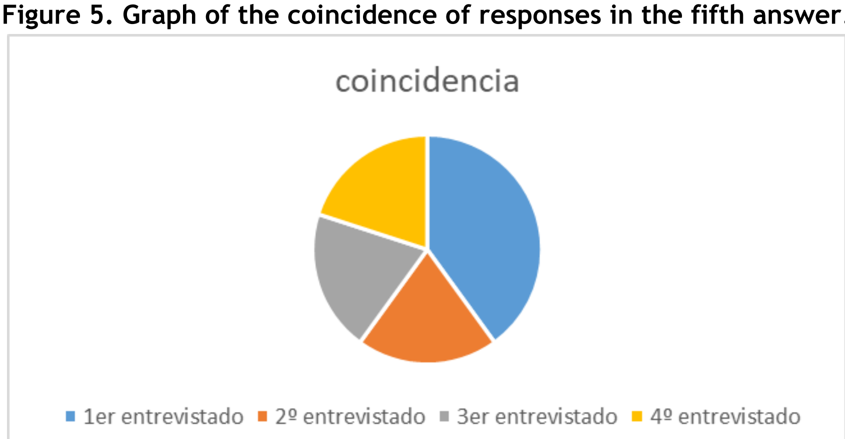
Source: Own elaboration.

Figure 4. Graph of the coincidence of answers in the fourth response.



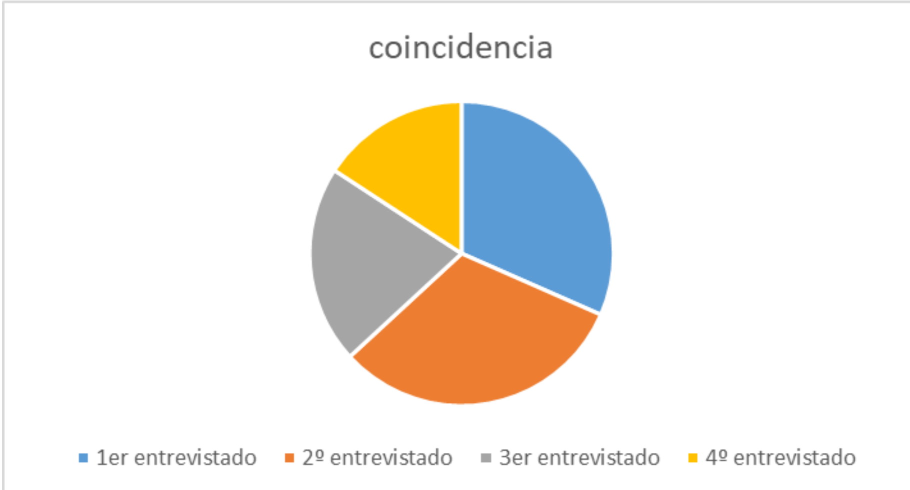
Source: Own elaboration.

Figure 5. Graph of the coincidence of responses in the fifth answer.



Source: Own elaboration.

Figure 6. Graph of the coincidence of answers in the sixth response.



Source: Own elaboration.

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CONCLUSIONS

The study on overheating of internal combustion engines and its impact on lubricating oil degradation reveals the importance of proper maintenance and optimal design of cooling systems. It highlights that malfunctioning radiators, coolant conductors and water conductors contribute significantly to overheating, exacerbating the problems associated with oxidation, decomposition and sludge formation in the lubricating oil. These conditions not only reduce engine efficiency, but also shorten engine component life.

In addition, the research highlights the relevance of preventive techniques, such as radiator cleaning, periodic replacement of hoses and thermostats, and the use of materials with advanced thermal properties. These measures can minimize the risks of overheating and its adverse effects, especially in regions with high climatic temperatures.

Finally, technological advances in engine design, such as the use of high-performance coolants and advanced monitoring systems, are presented as viable solutions to optimize engine performance and ensure engine durability. The results of this research not only have practical implications for users and technicians, but also offer valuable information for manufacturers in improving cooling and lubrication systems for internal combustion engines. Sediment and mineral buildup inside these conductors can obstruct the flow of water, causing a deficit in the cooling process and leading to overheating.

Understanding how these components work and how to prevent their malfunction is essential to ensure optimal vehicle performance and avoid costly repairs.

It is vital to understand how cooling systems work and avoid overheating of engines.

Knowledge of how engine overheating occurs and how to fix it is essential to take full advantage of these new technologies and ensure efficient and prolonged vehicle operation.

REFERENCES

1. Briceño M, Brayan E. Sistema de telemando con alerta de sobrecalentamiento del motor diésel de una maquinaria scooptram. 2022.

2. Condor Angos ED, Yépez Valle CA. Diseño y construcción de un sistema de medición de temperatura en vehículos [Doctoral dissertation]. Quito: UIDE; 2023.

3. Gálvez Rodríguez AI, Paucar Zhagüi DJ. Análisis de la influencia del sobrecalentamiento del motor de combustión interna en la degradación del aceite lubricante. 2020.
4. Galvez A. Obtenido de: https://dspace.ups.edu.ec/bitstream/123456789/18762/1/UPS-CT008773.pdf [Internet]. 2020. Disponible en: https://dspace.ups.edu.ec/bitstream/123456789/18762/1/UPS-CT008773.pdf.
5. Smith JD, Jones JR, Brown AM. Los efectos del sobrecalentamiento del motor en la degradación del aceite. En: Smith JD, editor. The effects of engine overheating on oil degradation. 2023.
6. Patel MA, Singh SK, Jain AK. El papel de la temperatura en la degradación del petróleo. En: Patel MA, editor. The role of temperature in oil degradation. 2020. p. 126.
7. Paucar D. Obtenido de: https://dspace.ups.edu.ec/bitstream/123456789/18762/1/UPS-CT008773.pdf [Internet]. 2020. Disponible en: https://dspace.ups.edu.ec/bitstream/123456789/18762/1/UPS-CT008773.pdf.
8. Khan SM, Khan AA, Saeed AM. Una revisión de los mecanismos de degradación del aceite en motores de combustión interna. En: Khan SM, editor. A review of the mechanisms of oil degradation in internal combustion engines. 2021. p. 98.
9. SOBRECALENTAMIENTO [Internet]. Disponible en: https://es.lambdageeks.com/engine-overheating/.
10. Soria JM. Control de ventiladores eléctricos de un motor de combustión interna. 2023.
11. TÉCNICAS [Internet]. Disponible en: https://es.lambdageeks.com/engine-overheating/.

FINANCING
None.

CONFLICT OF INTEREST
None.