Al-Noor Journal for Oil and Gas Studies, Vol. 1, No. 1, 2025 (46-54)
ISSN: 3078-8706 Doi: https://doi.org/10.69 513/jnog.v1.i1.ar6:

Al-Noor Journal for Oil and Gas study

https://jnog.alnoor.edu.iq/

Significantly Effect of Temperatures on some Physiochemical Parameters during the Extraction of Diesel Oil from Free Water

A A Idress*, **R H Rajab**, **A M A Sedeeq**

Department of Mechanical Engineer, College of Agriculture, University of Mosul, Iraq ,

Article information

Article history:
Received
Revised
Accepted

Keywords:
Oil purification,
engine operation,
Volumetric percentage
Viscosity index
Ash content of oil.

Correspondence:
ahmed.21agp28@student.uomosul.edu.iq

Abstract

The experiment was conducted in the North Oil Company - Kirkuk site, which belongs to the Iraqi Ministry of Oil, which is located in the Arafa area, west of Kirkuk Governorate. The experiment started from August 3, 2022, to September 17, 2022, to study the effect of three factors. The first factor is the oil purification time in three levels, 30, 60 and 90 minutes. The second factor is the oil purification temperature in two levels, 50 and 60 C°. As for the third factor, it included the number of engine operating hours in three levels: 0, 50, and 100 working hours, and its effect on the characteristics of homemade oil, SAE-40 cycle type, such as sediment volume ratio, viscosity index, ash content. The data were analysed statistically according to the randomized complete block design (RCBD). Among the results, the best volumetric percentage of sediment for oil upon purification amounted to 0.0100 (%) and was achieved at a temperature of 60 C° and a time of oil purification of 90 minutes, respectively, which matched the international oil specifications. The best non-significant reading for the viscosity index of the oil at purification was 160.01 at a temperature of 50 C° and the time of oil purification was 60 minutes. The closest reading of the international oil specifications was 79.24.As for the ash content of the oil at purification, it recorded the best significant reading of 0.1107% at a temperature of 60 C° and the time of oil purification 90 minutes The closest reading of the international oil specifications was 0.1033% .

DOI: https://doi.org/10.69513/jnog.v1.i1.ar6 , ©Authors, 2025, College of Engineering, Al-Noor University.

Introduction

The main source of oils is crude oil, which is extracted from the ground, where it undergoes several processes called refining. Some elements are added to the oil to increase its properties such as antioxidants, anti-corrosion, viscosity improvers and anti-friction [1]. The mission of oils is not limited mainly to lubricating the moving parts and reducing friction between them only, but also plays an important role in using it as a sealant, as it contributes to bridging the gap between the walls of the cylinder and the piston, as well as its contribution to the process of preventing leakage of charge from inside the combustion chambers to the oil sump. In addition, the oil acts as a cleaner as a result of carrying dirt and impurities, and then filtering through the oil filter. And let's not forget its important role in the process of cooling engine parts, whether fixed or moving. [2]. As a exposure to several factors during work periods and conditions, there will be an accumulation of impurities that result from dust, dirt, and combustion products. Its highest level is 0.45%. After operation, the oil needs a system to purify it from impurities and dirt. Impurities, especially condensation water, lead to a deterioration of the oil in the lubrication system. The heavy components of gasoline, especially in a cold engine, thin the lubricant film on the cylinder wall. Looking at diesel engines, the lubricating oil is also contaminated with soot. Contaminated liquid poses a risk to the device in terms of increased corrosion. [3]. Used car oils are a serious environmental problem that many people don't know. These oils are mainly composed of complex petroleum hydrocarbon compounds (80-90%). In addition to these compounds, various chemical compounds are mainly added to improve the physical and chemical properties of these oils by (10-20%) such as anti-oxidation compounds, anti-corrosion compounds and other materials. In addition, oil pollution is one of the main causes that lead to engine consumption as a result of the oil losing its multiple properties. And the presence of water in the oil is a major reason for this to happen. Oil contamination with water affects its physical and chemical properties, which affects the life of the machine, which will all be reflected in The research was conducted in the Arafa region / Kirkuk governorate in the North Oil Company, which belongs to the Iraqi Ministry of Oil. The data were analyzed for the studied traits were tested using Duncan's multi-range method under the level of probability of 5% (Daoud and Abdel Elias, 1990). Note that the values of the studied traits were determined for global and local oils. mentioned and as

The Mechanism of Purifying the Oil from the Water Content

The oils were purified from the water content by a special device as shown in Figure (1). This device works by heating the oil inside a tank with a capacity of 150 litres, with pressure relief by means of a pneumatic pump equipped with a digital meter set at 0.5 bar to reduce the boiling point, with a mechanism for condensing the water extracted from the oil. The temperature of the device was also fixed at the levels of the second factor of the studied oil purification temperature at 50 °C and 60 C°, respectively. Different timings for the purification time were set: 30, 60 and 90 minutes. Oil samples to be tested were taken from the device after repeating the above operations three times

The Calculations Made in the Experiment

Volumetric Percentage of Sediment (%)

The volumetric ratio of the sediment was calculated using a centrifuge according to the method (D-1796) according to

result of the presence of oil in large quantities in the engine, as well as its multiple functions that characterize it, and its performance and increase the risk of breakdown. Therefore, it is necessary to preserve the oil by following proper purification and filtration processes [4]. Other studies have shown that no less than 75% of all engines are consumed due to the deterioration of the characteristics of the oils in them, for many reasons such as increased internal leakage, which reduces the efficiency of the engines as well as causing oil pollution within the lubrication system because the pollutants can be in the form of liquids such as water, which is the most common, or as particles. A solid that forms and accumulates within the lubrication system as a result of chemical reactions of the liquid over time [5]. There are criteria based on which oils are selected. Viscosity comes at the forefront of these scales because it represents the value used to express the oil's fluidity, density, and ease of flow throughout the engine. Temperature also represents another essential element when determining the appropriate viscosity scale, as low temperatures require a lower viscosity for the oil to move appropriately, while high viscosity is suitable for high temperatures [6].

Materials and Methods

statistically according to the randomized complete block design (RCBD) with three replications. Differences between the average levels of factors

shown in Table (1) and comparing them with what was obtained from the values of the local oil characteristics before and after the heating process.

ASTM standards (9) by calculating the percentage between the weight of the sediment to the total weight of the sample.

Viscosity Index (V.I.)

The SAE20 hydraulic oil viscosity index was calculated using the (D-2270) method according to ASTEM standards (9), which is the ability of the oil to maintain its viscosity during temperature changes, which is an integer number greater than a hundred or more. It is calculated from knowledge of the kinematic viscosity at 32 - 64 C°. Using special tables, the value of the viscosity coefficient is extracted.

$$V.I = [(L-U)/D] \times 100 \quad ....(1)$$

Where, L: viscosity at 100 CO and extracted from the ASTM schedule, U: viscosity at 40 CO, D: A constant derived from the ASTM schedule based on viscosity at 100 CO

Al-Noor Journal for Oil and Gas Studies, Vol. 1, No. 1, 2025 (46-54)
ISSN: 3078-8706 Doi: https://doi.org/10.69 513/jnog.v1.i1.ar6:

Table 1. Specifications of the oils used in the experiment.

Oil type	Volumetric percentage of sediment %	Viscosity guide	Ash content of oil %
German Universal Oil (Unrefined) POND OIL/API:CF-4 (15W40) SAE	0.0033	179.24	0.1033
Domestic motor oil (before purification) (S1 – Diesel Oil) SAE- 40	0.0100	146.74	0.3333
Oil specifications approved according to the Marketing Specifications Manual for Iraqi Oil Products 2013	0.0025		

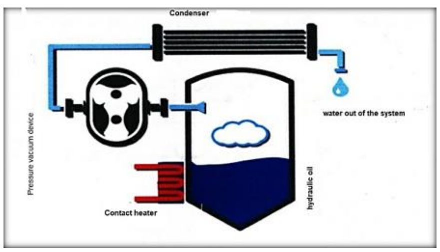

Figure 1: Parts and working principle of the oil purification

Fi Fig 2: Device from the water content sediment

Results and Discussion

Oil Viscosity Index

Table (2) shows that there are no significant differences for the averages of this characteristic with the engine operating hours factor. It was noted from the results obtained from the table that the oil viscosity index begins to decrease significantly with increasing engine operating hours. The highest value was recorded at 0 hours of engine operation, 152.52 ($mm^2.s^{-1}$). However, the lowest value in the viscosity index in oil was recorded at 100 working hours of engine operation, which was 150.45 (mm 2 Tha^{-1}). It was found that by increasing the temperature with the length of working hours, the oil gradually begins to lose one of its properties represented by this characteristic, which in turn will lead to a decrease in the engine performance efficiency over the value of this characteristic. This agrees with [10]. The results of Table (2) showed that there were no significant differences for the mean characteristics of the oil viscosity index with the temperature factor during the purification process. The increase in temperature showed that there was a noticeable decrease in the value of the viscosity index, which recorded the highest reading for this characteristic at a temperature of (50 C°), which is 153.95 (mm^2. Tha^{-1}), while the temperature (60 C°) recorded the lowest value, which is 153. .95 (mm^2. Tha^{-1}). Table (2) showed that there were no significant differences for the average value of the viscosity index with the purifier operating time factor. The increase in the operating time of the purifier showed a higher value of the viscosity index. The time of 90 minutes recorded the highest value for the viscosity index 154.02 ($mm^2.th^{-1}$), while the time of 30 minutes recorded the lowest value for the viscosity index 149.14 (mm2.th-1). They attribute this to the increase in the time of the purification process with the rise in temperature, through which the largest percentage of the amount of free water in the oil is withdrawn. This is consistent with what was indicated by [15]. Table (2) showed that there were no significant differences for the averages of this trait with this overlap. However, the viscosity index of the oil decreased with the increase of working hours, while the highest value was recorded at 0 working hours and 50 C° at a purification temperature of 156.03 (mm^2. Tha^{-1}). The lowest value was at 100 working hours and a purification temperature of 60 C°, which is 148.17 ($mm^2.Tha^{-1}$) with the temperature factor during the purification process. This is attributed to high temperatures, especially when working for long working hours, which causes a high rate of friction and corrosion between engine parts. This is consistent with what was indicated by [8], as well as the fact that the high temperatures during the purification process have a somewhat positive effect on this property. This is consistent with what was pointed out by [9]. Table (2) shows that there are no significant differences for the average of this

characteristic with this overlap and the factor of the number of operating hours of the engine and the operating time of the purifier. It was noted from the results in the table that the viscosity index of the oil begins to decrease significantly. As the highest value was recorded at 100 working hours of engine operation and at 90 minutes the highest value of the index of wife, which is 155.40 (mm^2. Tha^{-1}). The lowest value of the viscosity index of the oil was recorded at 0 hours of engine operation and 30 minutes of purifier operation, which is 150.45 ($mm^2.tha^{-1}$). They attribute this to the increase in the time of the purification process with the rise in temperature, through which the largest percentage of the amount of free water in the oil will be withdrawn. This is consistent with what was indicated by [15]. And with the increase in temperature with the length of working hours, the oil gradually begins to lose one of its properties represented in this capacity, which in turn will lead to a decrease in the efficiency of the engine's performance. This agrees with (Zebo Bakhtiyor 2022)[12].

The results of Table (2) indicate that there are no significant differences for the averages of this characteristic with this overlap with the temperature factor during the purification process and the operating time of the purifier. The increase in temperature showed that there is a noticeable increase in the viscosity index value. The highest reading for this characteristic was recorded at a temperature of (50 C°) and the operating time of the purifier was 90 minutes, which is 157.24 ($mm^2.th^{-1}$), while the lowest value was recorded at (60 C°) and the operating time of the purifier was 60 minutes, which is 147.26 ($mm^2.th^{-1}$). This is due to the high temperatures during the purification process, the effect of which has a somewhat positive result on this property. This is consistent with what was pointed out by [9]. Table (2) shows that there are no significant differences for the averages of this characteristic with the interaction of the factor of the number of hours of operation of the motor and the temperature and operating time of the purifier. It was noted from the results in the table that with high temperatures and a long period of purification, there is a rise in the value of the viscosity index of the oil. The highest value in the viscosity index of the oil was recorded at 0 hours of engine work, 50 C° temperature during filtration, and a purification time of 60 minutes. It amounted to 160.01 (g.cm-3), while the lowest value was recorded at 100 working hours of engine operation and at (50 C°) and filtration time of 30 minutes, which is 149.00 ($g.cm^{-3}$), in addition to the increase in the number of working hours in the engine That is 100 working hours. This is attributed to the increase in the number of operating hours, as the engine is exposed to excessive stresses such as high temperature, high friction and wear due to the engine working for long hours. These changes lead to a change in the chemical properties of the oil and then the viscosity property is lost. This is consistent with what was reported by (Imomov S. et al, 2020) (7).

The Influence of the Studied Factors on the Volumetric Percentage of Oil Deposits

Table (3) showed that there are significant differences for the averages of this characteristic with the engine operating hours factor. It was noted from the results in the table that the volumetric percentage of sediment in the oil indicates an increase in the percentage of sediment with the increase in working hours. The lowest value was recorded at 0 hours of engine operation, which is 0.0115%, while the highest value of the volumetric percentage of sediment in the oil at 100 hours of engine operation was 0.0606%. This is attributed to the number of hours the engine has been running for long periods and the internal friction between the parts. This friction with high temperatures will lead to the formation of deposits in addition to the occurrence of oil oxidation processes. This is consistent with what was mentioned by [11]. Table (3) shows that there are significant differences in the averages of this characteristic of the volumetric ratio of sediment in the oil with the temperature factor during the purification process. The high temperature led to a significant increase in the value of the volumetric sediment in the oil. The lowest reading for this characteristic was recorded at a temperature of (50 C°), which is 0.0271%. While the temperature (60 C°) recorded the highest value, which is 0.0313%. This is due to the high temperatures during the purification process, as well as the presence of external factors represented by dust and gases in the air. As a result, the oil will undergo an oxidation process. The oxidation process that occurs in the volume of the oil and on the surface of the metal is one of the main reasons that lead to the formation of deposits as well as to a large rise in temperatures, which negatively affects the reliability, efficiency, and durability of the engine. This is consistent with what was pointed out by [13]. Table (3) shows that there are significant differences for the average values of the sediment volume ratio with the purifier operating time factor. The increase in the operating time of the purifier with the increase in temperature showed a decrease in the value of the volumetric percentage of sediment. The time of 90 minutes recorded the lowest value, which is 0.0164%, while the time of 30 minutes recorded the highest value, which is 0.0388%. This is due to the presence of external factors in the air, represented by existing gases, the length of the purification process and the high temperatures, which have a direct negative impact on this property despite the usefulness of the purification process. This is consistent with what was reported by [14]. Table (3) shows that there are significant differences in the averages of this characteristic, with the overlap with the number of engine operating hours and the temperature during the purification process. It has been observed from process, which is 0.656%. This is due to the presence of external factors represented by dust and gases in the air, the number of hours the engine has been running for long periods, and the presence of internal friction with high temperatures that plays a role in the formation of deposits. This will lead to the formation of deposits in addition to the occurrence of oxidation of the oil. This is consistent with what was mentioned by [11]. Table (2) shows that there are significant differences for the averages of this characteristic with the overlap of the factor of the number of operating hours of the engine and the operating time of the purifier. It was noted from the results in the table that the volumetric percentage of sediment in the oil and at high temperatures with the length of the work period begins to rise. The lowest value was recorded at 0 working hours of engine operation and a time of 90 minutes, which is 0.100%, while the highest value was recorded for the volumetric percentage of sediment in the oil at 100 hours of engine operation and a time of 30 minutes, which amounted to 0.850%. This is due to the long period of the purification process and the high temperatures during the purification process, as well as the increase in the number of hours of engine operation. This will lead to the formation of friction between the parts of the engine, which has a role in the formation of mineral deposits, in addition to the occurrence of oil oxidation processes. This is consistent with what was mentioned by [11].

It can be seen from Table (3) that there are significant differences for the averages of this characteristic, with the interaction of the temperature factor during the purification process and the factor of the operating time of the purifier. The high temperature led to a significant increase in the value of the volumetric sediment in the oil. The lowest reading for this characteristic was recorded at a temperature the results obtained from the table that the volumetric percentage of sediment at high temperatures increases with long working hours. The lowest value was recorded at 0 hours of engine operation and 50 degrees Celsius during the purification process, which is 0.113%, while the highest value of the volumetric sediment was recorded at 100 hours of engine operation and 60 C° during the purification

(50 C°) and a time of 90 minutes, which is 0.162%, while the temperature (60 C°) and a time of 30 minutes recorded the highest value, which amounted to 0.410%. This is due to the high temperatures during the purification process. As a result of the high temperature, the oil will be exposed to an oxidation process, and the oxidation process that occurs in the volume of the oil and on the surface of the metal is one of the main reasons that lead to the formation of deposits, as well as to a significant rise in temperatures, which negatively affects the reliability, efficiency and durability of the engine. This is consistent with what was pointed out by [13]. Table (3) shows that there are significant differences for the averages of this characteristic with the combinations of the number of hours of engine operation and the temperature and operating time of the purifier. It was noted from the results in the table that with the high temperatures and the length of the purification period, there was a noticeable decrease in the value of the volumetric ratio of the sediment. The lowest value was recorded at 0 working hours of engine operation, 50 C° and 90 minutes of purification time, which is 0.100%, in addition to a rise with increasing engine operating hours. However, the highest value was recorded in 100 working hours of engine operation at 60 C° and 90 minutes of filtering time, which is 0.900%. The reason for this is the presence of water in the oil as a pollutant and its ability to form solids upon combustion, which increased this percentage. One of the most important oxidative processes that play a key role in the formation of these deposits. This is consistent with what was reported by [10].

Al-Noor Journal for Oil and Gas Studies, Vol. 1, No. 1, 2025 (46-54)
ISSN: 3078-8706 Doi: https://doi.org/10.69 513/jnog.v1.i1.ar6:

Table 2. Effect of oil purification time, temperature and number of engine operating hours on the viscosity index.

A Engine running hours	B The oil purification temperature is 0 °C	C Oil purification time (min) 30	 60	 90	A*B	A
0	50	154.86 a	160.01 a	153.22 a	156.03 a	152.52 a
	60	146.03 a	150.68 a	150.30 a	149.00 a	
50	50	144.79 a	155.82 a	158.60 a	153.07 a	151.34 a
	60	148.17 a	149.46 a	151.22 a	149.62 a	
100	50	149.00 a	149.29 a	159.92 a	152.74 a	150.45 a
	60	151.99 a	141.65 a	150.88 a	148.17 a	
A*C	0	150.45 a	155.35 a	151.76 a		
	50	146.48 a	152.64 a	154.91 a		
	100	150.50 a	145.47 a	155.40 a	B	
B*C	50	149.55 a	155.04 a	157.24 a	153.95a	
	60	148.73 a	147.26 a	150.80 a	148.93 a	
C		149.14 a	151.15 a	154.02 a		

Similar letters, there are no significant differences between them.

Table 3. Effect of oil purification time, temperature, and number of engine operating hours on the volumetric percentage of sediment (%).percentage of sediment (%).

A Engine running hours	B Celsius oil purification temperature	C Oil purification time (min) 30	 60	 90	A*B	A
0	50	0.0130 e	0.0110 e	0.0100 e	0.0113 c	0.0115 c
	60	0.0130 e	0.0120 e	0.0100 e	0.0117 c	
50	50	0.0167 e	0.0145 e	0.0120 e	0.0144 c	0.0155 b
	60	0.0200 d e	0.0167 e	0.0133 e	0.0167 c	
100	50	0.0800 b	0.0600 c	0.0267 d	0.0556 b	0.0606 a
	60	0.0900 a	0.0800 b	0.0267 d	0.0656 a	
A*C	0	0.0130 d e	0.0115 d e	0.0100 a		
	50	0.0183 d	0.0156 d e	0.0127 d,e		
	100	0.0850 a	0.0700 b	0.0267 c	B	
B*C	50	0.0366 a	0.0285 b	0.0162 c	0.0271 b	

	60	0.0410 a	0.0362 a	0.0167 c	0.0313 a
C		0.0388 a	0.0324 b	0.0164 c	

The Effect of the Studied Factors on the Percentage of Solids (Ash Content) of the Oil

It appears from Table (4) that there are significant differences for the averages of this characteristic with the factor of the number of engine operating hours. It has been noted from the results in the table that the proportion of solids (ash content) of the oil increases with increasing working hours. The lowest value of the percentage of solids (ash content) was recorded at 0 hours of engine operation, 0.1529%, while the highest value of the percentage of solids (ash content) was recorded for oil at 100 hours of engine operation, 0.7938%. This is due to the effect of combustion during the long working period of the oil and as a result of the presence of friction between the moving parts and the high temperatures to which the oil is exposed, which are among the main reasons for the formation of ash, which is considered a widespread and complex waste. This is consistent with what [15]. Table (4) indicates that there are significant differences for the averages of this characteristic, the ratio of solids (ash content) oil with the temperature factor during the purification process. The increase in temperature showed a significant decrease in the value of solids (ash content) in the oil. The highest reading for this characteristic was recorded at (50 C°) 0.5265%, while the lowest value was recorded at (60 C°) 0.3933%. This is due to the high temperatures during the purification process. As the purpose of the purification process is to withdraw the water content formed in the oil. However, it is not possible to protect the oil from the changes that occur in its properties, the most important of which is the oxidation process, which plays an essential role in the formation of these deposits. This is consistent with what was reported by [10]. Table (4) shows that there are significant differences in the average values of the percentage of solids (ash content) with the factor of operating time of the purifier. The increase in the operating time of the purifier with the increase in temperature showed a significant decrease in the percentage of solids (ash content). The time of 30 minutes recorded the highest value in the percentage of solids (ash content) 0.5422%, while the time of 90 minutes recorded the lowest value in the percentage of solids (ash content) 0.3994%. This is due to the effect of high temperatures and the long period of the purification process, as there is a high percentage of this characteristic. This is consistent with what was reported by [16]. Table (4) shows that there are significant differences in the averages of this characteristic with the interaction of the number of engine operating hours and the temperature during the purification process. It was noted from the results in the table that the percentage of solids (ash content) in the oil increased at high temperatures and long working hours. The lowest value of the percentage of solids (ash content) was recorded at 0 hours of engine operation and 50 degrees of temperature, 0.1728%, while the highest value of the percentage of solids (ash content) was recorded in the oil at 100 hours of engine operation and 50 degrees of temperature, where it reached 0. 8998%. This is due to the effect of internal combustion that results from the processes that take place inside the engine and as a result of the presence of friction between the moving parts. The high temperatures to which the oil is exposed is one of the main reasons for the formation of ash, which is a complex and widespread waste. This is consistent with what was reported by [17]. Table (4) shows that there are significant differences for the averages of this characteristic with the interaction of the number of hours of operation of the engine and the factor of operating time of the purifier. It was noted from the results in the table that with the increase in temperature, the value of the percentage of solids (ash content) increased. The lowest value of the percentage of solids (ash content) was recorded at 0 hours of engine operation and 90 minutes of operation of the purifier at 0.1230%, while the highest value of the percentage of solids (ash content) of oil was recorded at 100 hours of engine operation 30 minutes of purifier operation time 0.8403%. This is due to the effect of oil burning during the long working period and as a result of the presence of friction between the moving parts. The high temperatures to which the oil is exposed is one of the main reasons for the formation of ash, the effect of high temperatures and the long period of the purification process, as there is a high percentage of this characteristic. This is consistent with what was reported by [15]. It can be seen from Table (4) that there are significant differences for the averages of this characteristic with the temperature factor during the purification process and the purifier operating time factor. The increase in temperature with the increase in the operating time of the purifier showed a significant decrease in the value of the percentage of solids (ash content) in the oil. The highest reading for this characteristic was recorded at a temperature of (50 C°) and a time of 30 minutes 0.6270%, while the temperature (60 C°) and a time of 90 minutes recorded the lowest value of 0.3368%. This is due to the external factors represented by gases in the air, high temperatures during the purification process, and the long period of operation of the purifier. The purpose of the purification process is to withdraw the water content formed in the oil, but it is not possible to protect the oil from the changes that occur in its properties, the most important of which is the oxidation process, which plays a key role in the formation of these sediments. This is consistent with what was reported by [10]. Table (4) shows that there are significant differences for the averages of this characteristic with the overlap of the number of hours of engine operation and the temperature and operating time of the purifier. It was noted from the results in the table that with the high temperatures and the length of the purification period, a noticeable decrease in the percentage of solids (ash content) occurred. The lowest value was recorded at 0 working hours of engine operation and 60 C° temperature during purification time of 90 minutes by 0.1107%, in addition to a rise with the increase of working hours of engine operation, while the highest value was recorded at 100 hours of engine operation at 50 C° and 30 minutes of filtering time by 0.9572%. The reason for this is due to the presence of water in the oil as a pollutant, and its ability to form solids upon combustion increased this percentage, the most important of which is the oxidation process, which plays a key role in the formation of these sediments. This is consistent with what was reported by [10].

Table 4. Effect of oil purification time, temperature and number of engine operating hours on ash content (%).

A **Engine running hours**	**B** **Oil purification temperature**	**C** **Oil purification time (min)**			**A*B**	**A**
		30	**60**	**90**		
0	50	0.2159 fg	0.1672 fg	0.1353 f g	0.1728 e-	0.1529 c
	60	0.1767 fg	0.1114 g	0.1107 g	0.1329 e	
50	50	0.7080 b	0.4205 c d	0.3924 c d	0.5070 c	0.4331 b
	60	0.4720 c	0.3440 d e	0.2616 ef	0.3592 d	
100	50	0.9572 a	0.8842 a	0.8580 a	0.8998 a	0.7938 a
	60	0.7234 b	0.7020 b	0.6382 b	0.6879 b	
A*C	0	0.1963 e-	0.1393 e	0.1230 e		
	50	0.5900 c	0.3823 d	0.3270 d		
	100	0.8403 a	0.7931 a b	0.7481 b	B	
B*C	50	0.6270 a	0.4906 b	0.4619 b	0.5265 a	
	60	0.4574 b	0.3858 b	0.3368 c	0.3933 b	
C		0.5422 a	0.4382 b	0.3994 b		

Conclusion

we conclude that locally manufactured oils contain a high percentage of free water, up to more than 40 times the international oils. The results also showed the effectiveness of the purification device in extracting oils from suspended particles from the water content by up to 95%, improving the cleanliness of the oil from the water content, and extending its operational life. And the device is capable of producing 150 liters / hour of filtered oil free of water pollutants. The results also showed that increasing the factor of the number of engine operating hours from 0 to 100 engine operating hours led to an increase in the volumetric percentage of sediment in the oil due to the high engine temperatures at work, which leads to a significant decrease in the value of the viscosity index from the normal value, which is reflected negatively on Engine efficiency and performance. In addition, it was found that long working hours and high temperatures also contributed to an increase in the ash content in the oil. As a result of this increase, the spill point was greatly affected, which led to its decrease. The long working hours and the high temperatures of the engine caused oxidation processes that led to the formation of sediment, as well as an increase in the percentage of solids (ash content). Therefore, the study recommends using the purification device at a combination with a temperature of 60 C° and a purification time of 90 minutes, which would have achieved the best results in the desired physiochemical characteristics and the possibility of operating the engines with local oils resulting from this combination for more than 100 hours of work capacity and urged the concerned local government agencies in the Ministry of Oil Which produces oils by taking the initial recommendations of the current research to come out with the best desirable qualities because of their closeness to the approved and international specifications.

Acknowledgment

The authors would like to thanks University of Mosul for supporting this research

References

[1] Boreham C J, Blevin J E, Radlinski A P, & Trigg, K R. Coal as a source of oil and gas: a case study from the Bass Basin, Australia. APPEA J. 2003;43(1):117-148. DOI:10.1071/AJ02006oi:

[2] Kikuhara K, Koeser PS & Tian T. Effects of a Cylinder Liner Microstructure on Lubrication Condition of a Twin-Land Oil Control Ring and a Piston Skirt of an Internal Combustion Engine. Tribology Letters, . 2022;70(1), 1-15. DOI:10.1007/s11249-021-01546-3.

[3] Lou W, Zhang W, Wang H, Jin T, & Liu X. Influence of hydraulic oil on degradation behaviour of nitrile rubber O-rings at elevated temperature. Engineering Failure Analysis, 2018;92, 1-11. https://doi.org/10.1016/j.engfailanal.2018.05.006.

[4] Tormos B, Novella R, Gomez-Soriano J, García-Barberá A, Tsuji N, Uehara I, & Alonso M. Study of the influence of emission control strategies on the soot content and fuel dilution in engine oil. Tribology International. 2019;136:285-298. Doi:10.1016/j.triboint.2019.03.066

[5] Alie A, & Darwito P A. Improve of engine oil lifetime by using additional filter A case study at PT Vale Indonesia TBK. In AIP Conference Proceedings. 2019; Vol. 2088, No. 1, p. 020004). AIP Publishing LLC. https://doi.org/10.1063/1.5095252

[6] Ryniewicz AM, Bojko Ł, & Madej T. Assessment of motor oil viscosity with the use of rotary viscometer, Scientific bulletins of Silesian University of Technology. Transport. 2014;83:1904.

[7] Imomov S, Kholikova N, Alimova Z, Nuritov I, & Temirkulova, N. Oil purification devices used in internal combustion engines. Архив научных исследований 2020;(30). https://ejournal.tsue.uz/index .php/archive /article/ view/3128

[8] Hamawand I, Yusaf T, & Rafat S. Recycling of waste engine oils using a new washing agent. Energies. 2013; 6(2), 1023-1049. DOI:10.3390/en6021023

[9] Omwoyo J B, Kimilu R K, & Onyari J M. Effects of temperature and catalytic reduction of sulfur content on kinematic viscosity and specific gravity of tire pyrolysis oil. Chem Engin Commun. 2021;1-8 DOI:10.1080/ 00986445.2021.2015339.

[10] IHSSAN G. Etude géologique et géotechnique d'avant projet de l'autoroute reliant El Jadida à Safi (Maroc). 2016.

[11] Alimova Z. Research Of Changes In The Motor Oils Quality When Operating An Engine And Improving Their. Industrial Technology and Engineering.2020;3(36):11-16.https://www.researchgate.net/ Publication/

[12] Zebo A, & Bakhtiyor S. Oxidation of motor oils during operation engines in military equipment. Web of Scientist: Interna Scie Res J. 2022;3(8):97-103.

[13] Widodo S, Khoiruddin K, Ariono D, Subagjo S, & Wenten I G. Re-refining of waste engine oil using ultrafiltration membrane. J Environ Chem Engin. 2020;8(3):103789. DOI:10.1016/j.jece.2020.103789

[14] Tesfa B, Mishra R, Gu F, & Powles N. Prediction models for density and viscosity of biodiesel and their effects on fuel supply system in CI engines. Renewable Energy. 2010;35(12):2752-2760. DOI:10.1016/ j.renene.2010.04.026.

[15] Ahmad S, Ahmad M I, Naeem K, Humayun M& Faheem F. Oxidative desulfurization of tire pyrolysis oil. Chem Indu Chem Engin Quart.2016; 22(3):249-254. DOI:10.2298/CICEQ150609038A

[16] Korchak B, Grynyshyn O, Chervinskyy T, Shapoval P & Nagurskyy A. Thermooxidative regeneration of used mineral motor oils. Chem Chem Tech.2020;14(1):129-134. https://doi.org/ 10.23939/ chcht14.01.129

[17] Tripathi AK & Vinu, R. Characterization of thermal stability of synthetic and semi-synthetic engine oils. Lubricants. 2015;3(1):54-79.

[18] Daoud K Mand Zaki A E. Statistical Methods for Agricultural Research, Dar Al-Kutub for Printing and Publishing, University of Mosul, Ministry of Higher Education and Scientific Research. 1990.

[19] Tormos B, Novella R, Gomez-Soriano J. García-Barberá A, Tsuji N, Uehara I & Alonso M. Study of the influence of emission control strategies on the soot content and fuel dilution in engine oil. Tribol Intern. 2019; 136: 285-29. DOI:10.4271/2007-01-4036.

الخلاصة

أُجريت التجربة في موقع شركة نفط الشمال – كركوك، التابع لوزارة النفط العراقية، والواقع في منطقة عرفة غرب محافظة كركوك. بدأت التجربة في 3 أغسطس 2022، واستمرت حتى 17 سبتمبر 2022، لدراسة تأثير ثلاثة عوامل. العامل الأول هو زمن تنقية الزيت في ثلاثة مستويات، 30 و60 و90 دقيقة. العامل الثاني هو درجة حرارة تنقية الزيت في مستويين، 50 و60 درجة مئوية. أما العامل الثالث، فقد شمل عدد ساعات تشغيل المحرك في ثلاثة مستويات: 0 و50 و100 ساعة عمل، وتأثيرها على خصائص الزيت محلي الصنع، ونوع دورة SAE-40، مثل نسبة حجم الرواسب، ومؤشر اللزوجة، ومحتوى الرماد. تم تحليل البيانات إحصائيًا وفقًا لتصميم القطاعات الكاملة العشوائية (RCBD). ومن بين النتائج، بلغت أفضل نسبة حجمية للرواسب للزيت عند التنقية 0.0100 (%) وتم تحقيقها عند درجة حرارة 60 درجة مئوية ووقت تنقية الزيت 90 دقيقة على التوالي، والتي تطابقت مع المواصفات الدولية للزيت. وكانت أفضل قراءة غير معنوية لمؤشر اللزوجة للزيت عند التنقية 160.01 عند درجة حرارة 50 درجة مئوية ووقت تنقية الزيت 60 دقيقة. وكانت أقرب قراءة للمواصفات الدولية للزيت 79.24.أما بالنسبة لمحتوى الرماد للزيت عند التنقية، فقد سجل أفضل قراءة معنوية بلغت 0.1107٪ عند درجة حرارة 60 درجة مئوية ووقت تنقية الزيت 90 دقيقة وكانت أقرب قراءة للمواصفات الدولية للزيت 0.1033٪.