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Comparative among the specific gravity of petroleum products (gasoline, kerosene, and gasoil, lubricating oils)

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Abstract

Density, specific gravity, and the American Petroleum Institute (API) grade of petroleum products are considered in identification tests to express the product's identity and determine subsequent laboratory tests. This research aims to differentiate the specific gravity (Sp.gr) and American Petroleum Institute gravity (API) of gasoline, kerosene, gas oil, and lubricating oils, and to identify what is different among them. This research dealt with four different oil products (gasoline, kerosene, gas oil, and lubricating oils). These samples were brought from Oil Products Distribution Company (OPDC), Salahuldeen Branch, Tikrit, Ministry of Oil, Iraq. Moreover, the results of the laboratory test showed that the specific gravity and American Petroleum Institute gravity of these samples were close to them. The results showed that the specific gravity of gasoline ranges between 0.700 and 0.750, the specific gravity of kerosene ranges from 0.750 to 0.800, while the specific gravity of gasoil ranges from 0.800 to 0.850, and lastly, the range of specific gravity of lubricating oils is from 0.850 to 0.900. In conclusion, this work will help the workers in the oil sector and engineering students who study in this field avoid mistakes in their work. will be presented and discussed as a road map for future research in the field.

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1. Introduction

Specific gravity (Sp.gr) is a key physical property used to distinguish petroleum products by measuring their density relative to water [1]. Since petroleum is a complex mixture of hydrocarbons, its specific gravity is directly related to the mixture's molecular weight and size, which generally increase as the product becomes heavier and has a higher boiling point during crude oil distillation [2] [3]. This property is an important factor in quality control, in determining transport and storage methods, and in converting volumes to mass in commercial transactions [4]. In the same vein as specific gravity and distinguishing petroleum products, the products mentioned are derived from different stages of crude oil refining, resulting in a clear trend in their approximate specific gravity ranges (at standard conditions) [5].

The key distinction is gasoline has the lowest specific gravity (it is the "lightest") because it contains the smallest,

most volatile molecules [6]. Specific gravity (Sp.gr) increases sequentially from gasoline to kerosene to gasoil as average molecular size and boiling point increase [7]. Lubricating oils have the highest specific gravity (the "heaviest") and are highly viscous because they contain the largest, least-volatile hydrocarbon molecules [8]. The Role of American Petroleum Institute (API) Gravity: in the petroleum industry, it is often used instead of specific gravity (Sp.gr) [9]. It is an inverse measure of Sp.gr [10]. A higher Sp. gr means a lower API gravity (heavier product) [11]. A lower me Sp. gr and a higher API gravity (lighter product) [12]. Therefore, the trend in API gravity for these products is the opposite of that for SP. gr trend; take, for instance, gasoline has the highest API gravity, and lubricating oils have the lowest API gravity [13].

The challenge in this study was the convergence of laboratory test results for specific gravity (Sp.gr). For example, the specific gravity of gasoline is between 0.700 and 0.750, while kerosene is between 0.750 and 0.800. This indicates that 0.750 is the maximum value for gasoline, while the same value is the minimum value for kerosene. On the other hand, 0.850 is the maximum value for kerosene products, the same as the minimum value for gas oil, and the same applies to lubricating oils and gas oil products. However, this research focused on the specific gravity (Sp. gr.) of gasoline, kerosene, gas oil, and lubricating oils, and on what differentiates them. Then to distinguish among these products via specific gravity.

2. Materials and methods

2.1Fuel samples

Eight samples of oil products, obtained from the Oil Products Distribution Company (OPDC), Salahuldeen Branch Laboratory, Tikrit, Ministry of Oil, were used in this study. These samples include two samples of gasoline, two of kerosene, two of gas oil, and two of lubricating oil, sent to the Al-Noor University College of Engineering, Department of Petroleum Engineering laboratory, for the porosity study. The tests of these samples were Sp. gr , temperature, and American Petroleum Institute (API) calculated as in equation 1 [14]. Figure 1 shows four types of fuel, which are (gasoline, kerosene, gas oil, and lubricating oil).

Figure 1: Four types of fuel: gasoline, kerosene, gas oil, and lubricating oil

2.2 Procedures

The specific gravity (Sp.gr) was determined according to ASTM D1298 [15], while the American Petroleum Institute (API) gravity was found according to ASTM D5002 [14], calculated using Equation 1 [16]. This study was conducted in the laboratories of the Petroleum Engineering Department, College of Engineering, Al-Noor University, Nineveh Governorate, Iraq. Figure 2 shows the specific gravity test and the apparatus.

$$API=141.5/(Sp.gr)-131.5 \quad (1)$$

Figure2: The Sp.gr test of gasoline, kerosene, gas oil, and lubricating oils

1. Results and discussions

3.1Specific gravity of gasoline fuel

Table 1 presents the results for specific gravity, API gravity, and temperature of gasoline samples, as shown in Figure 3. The results for specific gravity were 0.730 and 0.77 whereas the API gravity results were 62.33 and 52.27 for gasoline samples 1 and 2, respectively [17]. Compared with the standard tests, Sp.gr ranged from 0.700 to 0.750, while API gravity ranged from 57.2 to 75.6. The results showed that the temperature of the gasoline samples was the lowest compared to kerosene, gas oil, and lubricating oil, reaching 22 °C. These results are attributed to the presence of light volatile aromatic compounds that contribute to the composition of gasoline products [18]. Therefore, these results will strengthen the basic components of the final Table of this research [19]. The gasoline fuel was lightest (lowest boiling point). Contains the shortest hydrocarbon chains (C4 to C12), which are used as car gasoline fuel [20].

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Table 1: The results of specific gravity, API gravity, and temperature

Sample name	Sp. gr	API	Temperature °C
Gasoline-1	0.730	62.33	22
Gasoline-2	0.770	52.27	22

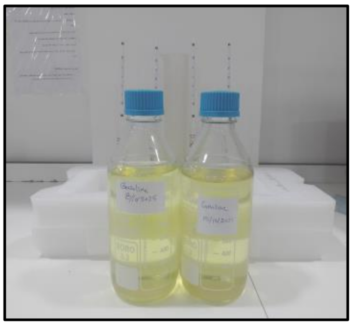

Figure 3: Gasoline fuel sample and samples and the specific gravity test

3.2. Specific gravity of kerosene fuel

Table 2 presents the data on the Sp. gr, API gravity, and temperature for gasoline samples as shown in Figure 4. The range of the specific gravity (Sp. gr.) was 0.765-0.780, and the API was 53.50 and 50.00 for kerosene samples 1 and 2, respectively [21]. Compared to the standard tests, the Sp.gr ranged from 0.750 to 0.800, while the API gravity ranged from 57.2 to 45.4. As a result, the Sp.gr were. The results showed that the kerosene product had an average temperature of 23 °C, compared to gasoline and gasoil. This is due to the mixture used to make kerosene. These findings are due to the existence of light volatile aromatic molecules, which contribute to the composition of gasoline products. Therefore, these data will help reinforce the outcomes that are the basic components of this research's final Table [22]. Intermediate weight, boiling point. Longer chains than gasoline (C10 to C16), which used as fuel for home heating [23].

Table 2: Sp.gr, API, and temperature results of kerosene fuel samples

Sample name	Sp. gr	API	Temperature °C
Kerosene-1	0.765	53.50	23
Kerosene-2	0.780	50.00	23

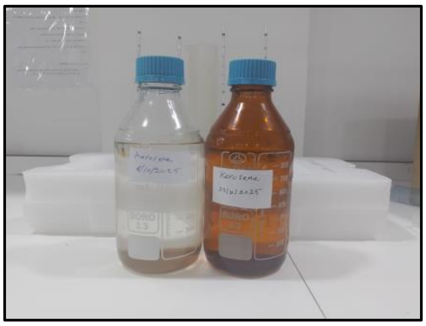

Figure 4: Kerosene fuel sample and specific gravity (Sp.gr) test

3.3. Specific gravity of gasoil fuel

Table 3 presents the results for specific gravity, API gravity, and temperature of the gasoline samples, as shown in Figure 5. The specific gravity was 0.765 and 0.780, and the API gravity was 53.50 and 50.00 for kerosene samples 1 and 2, respectively. The standard tests for specific gravity range from 0.750 to 0.800, while the API gravity range is from 57.2 to 45.4. The results showed that the temperatures of the gas oil product were reasonable compared to other products, which reached 24 °C [24]. This is attributed to the gas oil, which is a mixture of linear organic hydrocarbon compounds extending up to C30. These results are attributed to the presence of light, volatile aromatic compounds that contributed to the gasoline product's composition. Therefore, these results will help strengthen the results of the Sp.gr test [25]. Heavier than kerosene (higher boiling point) longer hydrocarbon chains (C10 to C28), which are used as a diesel fuel [26].

Table 3: The results of the specific gravity (Sp..), API gravity, and temperature of the gasoil samples of gasoil samples

Sample name	Sp. gr	API	Temperature °C
Gasoil-1	0.810	42.10	24
Gasoil-2	0.820	36.00	24

Figure 5: Gasoil fuel sample and Sp.gr test

3.4. Specific gravity of lubricating oil

Table 4 presents the specific gravity (Sp. gr.), API gravity, and temperature of the lubricating samples, as shown in Figure 6. The range of Sp. gr. ranged from 0.879 to 0.89, while the API gravity ranged from 35.00 to 25.70 for samples 1 and 2, respectively. For lubricating oil, the standard specific gravity range is 0.850 to 0.900, whereas the API gravity range is 35.00 to 25.700 [27]. The results showed that the lubricating oil products had higher temperatures than other products, reaching 26 °C [28]. These results are attributed to the presence of light volatile aromatic compounds that contribute to the composition of the gasoline product [29]. Therefore, these results will strengthen the basic components of the final Table of this research [30]. Heaviest (highest boiling point/viscosity). Compounds are composed of very long and complex hydrocarbon chains (C22 to C70), which are used as lubricating oil in a car engine [31].

Table 4: The specific gravity, temperature, and API gravity results

Sample name	Sp. gr	API	Temperature °C
Lubricating-1	0.879	29.50	26
Lubricating-2	0.890	27.50	26

Figure 6: Lubricating oil sample and specific gravity (Sp.gr) test

3.5. Comparative specific gravity

Table 5 presents data on the ranges of specific gravity (Sp.gr) and API gravity for fuels and oil products (standard tests). As a result, the results for gasoline, kerosene, gas oil, and lubricating oil detailed in Tables 1, 2, 3, and 4, respectively, agreed with the standard results [32]. This finding means the specific gravity (Sp.gr) and API gravity were found to be the same in the range of specific gravity (Sp.gr) and API gravity of fuel and oil samples [33]. The gasoline had the lowest specific gravity (Sp.gr.), ranging from 0.700 to 0.750 (lowest boiling point) [34]. Contains the shortest hydrocarbon chains (C4 to C12), which are used as a car's gasoline fuel [35]. While kerosene fuel is intermediate in weight, its boiling point and specific gravity range from 0.750 to 0.800, and it has longer chains than gasoline (C10 to C16), which is used as fuel for home heating. Although gasoil fuel was heavier than kerosene (higher boiling point), and has longer hydrocarbon chains (C10 to C28) are used as diesel fuel. Whereas regarding lubricating oil composed of very long and complex hydrocarbon chains (C22 to C70), which is used as lubricating oil in car engine [36].

Table 5: The standard tests of specific gravity and API gravity for the petroleum products (gasoline, kerosene, gasoil, and lubricating oil)

Sample	Sp.gr		API gravity	
	min	max	min	max
Gasoline	0.700	0.750	75.6	57.2
Kerosene	0.750	0.800	57.2	45.4
Gasoil	0.800	0.850	45.4	35.0
Lub. oil	0.850	0.900	35.0	25.7

4.Conclusions

This study successfully verified the specifications of petroleum products (gasoline, kerosene, diesel oil, and lubricating oils). The study showed that the density of gasoline is close to that of heavy naphtha. Therefore, it was necessary to verify the specifications of heavy naphtha to differentiate it from gasoline. The temperatures of gasoline, kerosene, gas oil, and lubricating oils were 22, 23, 24, and 26 °C, respectively. The results showed that the petroleum product specifications were similar, but they differed in specific gravity (Sp.gr). Furthermore, this study will provide sufficient information on fuel specifications and facilitate scientific research.

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التمييز بين الكثافة النوعية للمنتجات النفطية (الكازولين، والكيروسين، وزيت الغاز، وزيوت التزييت)

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الخلاصة
تعتبر الكثافة والوزن النوعي ودرجة معهد البترول الامريكي للمنتجات النفطية هي فحص تعريفي لتعبر عن هوية المنتوج وتحديد الفحوصات المختبرية اللاحقة. يهدف هذا البحث إلى تحديد الفرق بين الكثافة النوعية وكثافة معهد البترول الأمريكي للمنتجات النفطية التي هي للبنزين والكيروسين وزيت الغاز وزيوت التشحيم، وبيان الاختلاف بينهما من حيث الكثافة. علاوة على ذلك فقد تناول هذا البحث أربع منتجات نفطية مختلفة التي هي (الكازولين، والكيروسين، وزيت الغاز، وزيوت التشحيم) تم جلبها من مختبرات شركة توزيع المنتجات النفطية الهيئة الغربية فرع صلاح الدين. وأظهرت نتائج الفحوصات المختبرية تقاربًا في الكثافة النوعية لتلك المنتجات. وبالتالي فقد تراوحت الكثافة النوعية للكازولين بين 0.700 و0.750، وللكيروسين بين 0.750 و0.800، ولزيت الغاز بين 0.800 و0.850، أما زيوت التزييت فتراوحت بين 0.850 و0.900. ختاما فان هذا العمل سوف يُسهم في سهولة الوصول الى الكثافة من قبل العاملين في قطاع النفط والطلاب المتخصصين في هذا المجال وبذلك سوف يسهم في تجنب الأخطاء في العمل من خلال تمييز المنتجات النفطية في الكثافة.