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Comparative Analysis of Bias Index to Determine The Density of Pertalite and Pertamax Fuel Oil Using Snellius's Law

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Abstract
The refractive index value can be determined using various methods, one of which is the principle of Snell's law. . This research aims to compare the refractive index of Pertalite and Pertamax fuel oil and prove Snell's law. This research was conducted at the Optical Laboratory of the Tadris Physics Study Program, Syarif Hidayatullah State Islamic University, Jakarta. The main materials used are Pertamax and Pertalite as the fluid, then laser, ruler, glass container, pen, protractor, HVS paper. The results obtained from this experiment, namely the refractive index value for Pertalite, obtained an average value of 1.36 and for the refractive index for Pertamax, the average value was 1.653, so it can be concluded that the refractive rays in Pertamax are greater than the refractive raysin Pertalite. So, for its use, Pertamax is more efficient compared to Pertalite.
Keywords*: Refractive index, refraction, pertalite, and Pertamax*

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INTRODUCTION

The use of fuel oil in daily life continues to increase, due to the increase in the number of vehicles. The fuels that are often used by the public are Pertamax and Pertalite. However, Pertalite is more popular with the public than Pertamax users because the price of Pertalite is cheaper than Pertamax. The lack of public knowledge about the effectiveness of the fuel used causes people to be fooled by cheap prices.

Previously, research on cooking oil quality testing based on the refractive index of light using a simple refractometer was carried out by Dody, et al (2014). The results of this research state that cooking oil which has a large refractive index which is indicated to contain plastic, has poor quality and states that the refractive index of brand A cooking oil after being mixed with 1 gram and 11 gram plastic respectively has a refractive index of

1.351 and 1.443, whereas The refractive index value of brand B cooking oil after being mixed with 1 gram and 11 gram of plastic respectively has a refractive index of 1.297 and

1.492. From this research it can be concluded that, if the plastic content in cooking oil increases, the resulting refractive index will also become greater. So the role of the plastic particles is to inhibit the speed of light. The thicker the oil, the greater the refractive index. Changes in refraction using Pertamax and Pertalite fuel fluid by analyzing the refractive index, tests need to be carried out to determine the density of Pertamax and Pertalite using Snell's law.

Snell's Law explains that the refraction process occurs when a wave enters a medium that has a smaller refractive index, so the direction of wave propagation will be away from the normal line and vice versa (Abdullah, 2017: 610). The refractive index value of light in each liquid is different. The greater the optical density of the fluid, the greater the refractive index value. Light entering the fluid will be split into reflected light and transmitted light (refraction of light). (Akbar, 2021: 151)

The bending of light occurs in optical substances such as air, water and glass. The refraction that occurs in one substance will be different from other substances, depending on the density of the medium of the substance. Different densities of substances will produce different refractive indices. Refractive index is the ratio of the speed of light in a medium. (Giancoli, 2001)

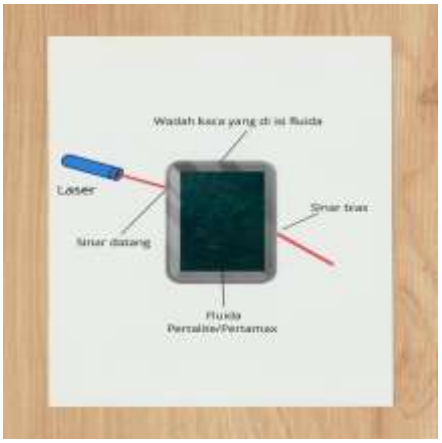
Refraction of light can occur when light propagates through a medium and then penetrates another medium with a different density. Refraction of light is a phenomenon of light bending until it

hits a boundary area between two media. The results of refraction are influenced by the density of the medium of a substance, this means that refraction that occurs in a substance will definitely produce different results from other substances. The density of the medium possessed by a substance will give different refractive index results.(Destriana, 2023)

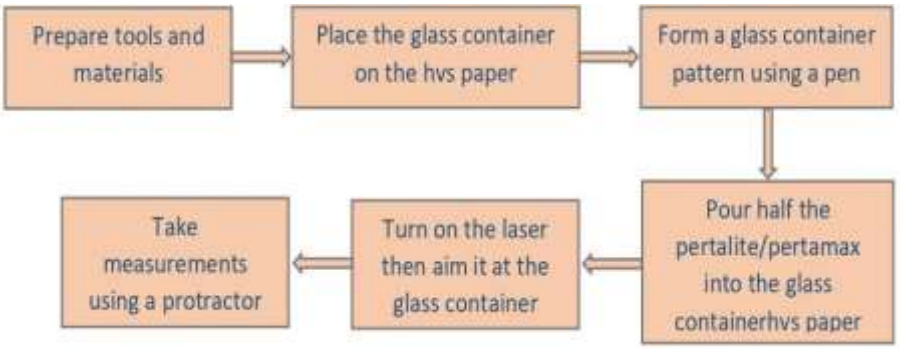
Based on the problems above and previous research on the refractive index of fuel oil, in this article we will discuss the comparison of the refractive index of Pertalite and Pertamax fuels and prove Snell's law.

METHODE

This type of research is experimental research, this research was carried out at the Optical Laboratory of the Tadris Physics Study Program, Syarif Hidayatullah State Islamic University, Jakarta. The tools and materials used to analyze the refractive index of several types of liquids are lasers, rulers, glass containers, pens, protractors, HVS paper, pertalite and Pertamax. The working principle of this experiment is based on Snellius' law. The sound of Snellius I's law is "the incident ray, the refracted ray, and the normal line are in the same flat plane" while the sound of Snellius II's law is "if the incident ray comes from a denser medium to a less dense medium (for example water to air) then the ray will be bent away from the normal line, but if the ray comes through a less dense medium into a denser medium (for example air to air) then the ray will be bent closer to the normal line.



In the first experiment, use pertalite, then place the glass container on HVS paper, after that form a pattern for the glass container. After the pattern is drawn, pour Pertalite into the glass container as much as half of the glass container. Then turn on the laser and aim it at the right/left side of the glass container. After that, make a mark using a pen on the HVS paper to indicate the incident and refracted rays that are formed when the laser is directed at a glass container that has been filled with Pertalite/Pertamax. Then measure the angle of the refracted rays using a protractor. In the second experiment, the same stages as the first experiment were carried out, but using a different fluid, namely Pertamax. After that, carry out data collection three times in each experiment.



RESULT AND DISCUSSION

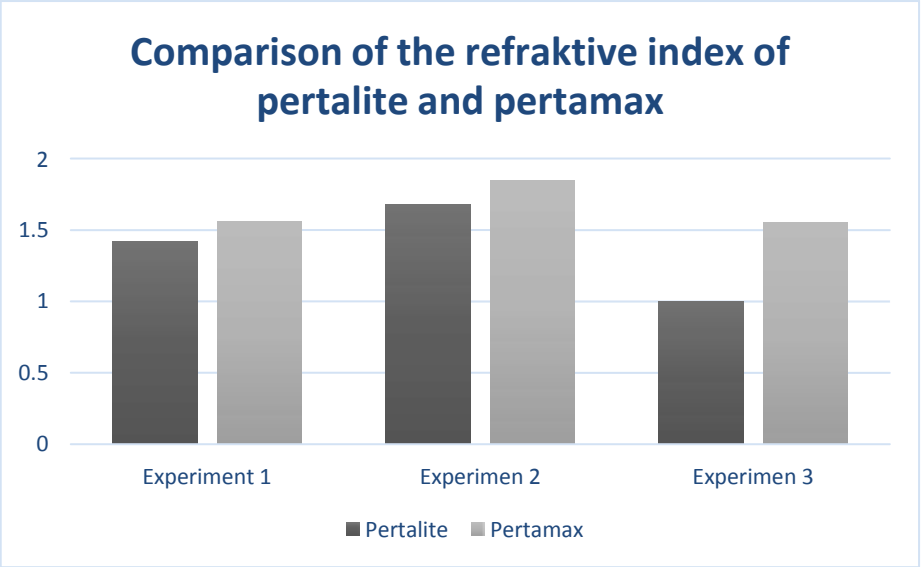
Based on the observations that have been made, the following results were obtained:

Table 1. Refraction experiment on pertalite

Repetition to	Light comes	Refracted light
1	32°	22°
2	25°	15°
3	20°	20°

Table 2. Refraction experiment on pertamax

Repetition to	Light comes	Refracted light
1	30°	19°
2	30°	16°
3	25°	16°



Picture 1. Chart Comparison of the refractive index of pertalite and pertamax

Based on the experiments above, it can be analyzed that the results of the comparison of refractive rays on Pertamax are smaller compared to Pertalite. According to Huygens (1629-1695), the refractive index is "the ratio of the speed of light in a vacuum to the speed of light in a substance. The absolute refractive index n for light moving from vacuum (air) into a certain medium is expressed by the following equation: (Faradhillah, 2019)

$$n = \frac{sin\theta_1}{sin\theta_2}$$

Experiment 1	Experiment 2	Experiment 3
$\boldsymbol{n = \frac{sin\theta_1}{sin\theta_2}}$	$n = \frac{sin\theta_1}{sin\theta_2}$	$n = \frac{sin\theta_1}{sin\theta_2}$
$\boldsymbol{n = \frac{sin32}{sin22}}$	$n = \frac{sin25}{sin15}$	$n = \frac{sin20}{sin20}$
$\boldsymbol{n = \frac{0,529}{0,37}}$	$n = \frac{0,422}{0,25}$	$n = \frac{0,34}{0,34} = 1$
$\boldsymbol{n = 1,42}$	$n = 1,68$	
Average=1,36		

In Experiment 1 :

In Experiment 2:

Experiment 1	Experiment 2	Experiment 3
$n = \frac{sin\theta_1}{sin\theta_2}$	$n = \frac{sin\theta_1}{sin\theta_2}$	$n = \frac{sin\theta_1}{sin\theta_2}$
$n = \frac{sin30}{sin19}$	$n = \frac{sin30}{sin16}$	$n = \frac{sin25}{sin16}$
$n = \frac{0,5}{0,32}$	$n = \frac{0,5}{0,27}$	$n = \frac{0,42}{0,27}$
$n = 1,56$	$n = 1,85$	$n = 1,55$
Average = 1,653		

Based on the measurement of the refractive index of each fluid, it can be seen that for the Pertamax fluid the refractive index is greater than that of Pertalite, so that in this study the results of the average value are not much different.

In the first experiment, the results of the incident rays were 32°, 25°, 20° and the refracted rays were 22°, 15°, 20°. Meanwhile, in the second experiment, the results for the incident rays were 30°, 30°, 25° respectively and for the refracted rays they were 19°, 16°, 16°. Meanwhile, for the refractive index for Pertalite, the average value was 1.36 and for Pertamax the average refractive index was 1.653. Based on these results, it can be concluded that the refractive rays and refractive index in Pertamax are greater than the refractive rays and refractive index in Pertalite. So, for its use, Pertamax is more efficient compared to Pertalite. This is in accordance with research conducted by Ariawan, et al (2016) which states that the octane value of Pertalite is smaller than Pertamax, namely Pertalite has an octane value of 90 and Pertamax has an octane value of 92, so that the level of resistance to the temperature of Pertamax fuel is higher. better used compared to pertalite fuel.

according to Wahyu, et al, (2022) the higher the octane value and the lower the process evaporative distillation of the fuel used will produce better torque and power. Properties/behavior of Pertamax fuel has a power performance increase of 0.4 hp at comparison every 500 rpm and increase in power performance of 0.3 hp at a ratio of every 1000 rpm. From this research it can be concluded that Pertamax is better to use comparedto Pertalite.

According to Miranda (2023), the factors that influence the refractive index are the viscosity of the liquid, the speed of propagation of light, temperature and wavelength. If the solution is thicker, the refractive index value will be greater and vice versa. As for the relationship between temperature, wavelength and speed of light with the refractive index, it is inversely proportional.

Based on research by Rosmalinda (2019), it is stated that the refractive index of oil depends on its density, the smaller the density, the easier it is for light to penetrate the oil and vice versa.

CONCLUSION

From the results of this research it can be concluded that The refractive rays in Pertamax are greater than the refractive rays in Pertalite. So, the use of Pertamax is more efficient compared to Pertalite. The refractive index value for Pertalite obtained an average value of 1.36 and for the Pertamax refractive index obtained an average value of 1.653.

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