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2 ND INTERNATIONAL SCIENCE, ENGINEERING AND TECHNOLOGY COLLOQUIUM



THE POWER OF SCIENTIFIC INNOVATION

INTELLIGENT SOLUTIONS FOR A SUSTAINABLE WORLD

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PREFACE

Welcome to the 2nd International Science, Engineering and Technology Colloquium 2025 (ISETC 2025)!

It is with great pleasure that we present this year's colloquium, a distinguished gathering of scholars, researchers, and professionals dedicated to the advancement of applied sciences. Held virtually on 9th July 2025, ISETC 2025 serves as a platform to highlight cutting-edge research, foster meaningful networking, encourage collaborations, and explore innovative solutions to global challenges.

This year's theme, "The Power of Scientific Innovation: Intelligent Solutions for a Sustainable World" highlights our shared goal to solve global challenges through applied science. It celebrates innovation as a key to building a more sustainable and resilient future. We're proud to feature keynote speakers and presenters who bring fresh insights, bold ideas, and breakthroughs shaping tomorrow's world.

We would like to extend our heartfelt appreciation to the Faculty of Applied Sciences, Universiti Teknologi MARA, Perak Branch, Tapah Campus, for their outstanding support and assistance throughout the planning and execution of the event. Their dedication has been instrumental to the success of this colloquium. We would like to sincerely thank all participants and researchers for their valuable contributions. We also appreciate the reviewers for their careful evaluations and helpful feedback. Your hard work and support mean a lot to us.

As editors, we are proud to present this collection of proceedings. It is an honour to bring together the interesting and meaningful work of our speakers and authors. We hope the ideas shared will lead to new discoveries, encourage more research, and help solve global challenges through science and innovation.

Warm regards,

Dr. Emi Norzehan Mohamad Mahbob
Dr. Saiyidah Nafisah Hashim
Ms. Lili Widarti Zainuddin
Ms. Nurul Nazwa Mohammad
Ms. Rozaina Saleh

ISETC 2025 Proceedings Editors

REFRACTION: THE PARAMETER-DRIVEN NATURE OF LIGHT

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Abstract: The refractive index of liquids is an important optical property that determines how light passes through different materials. This study utilized a laser beam to determine the refractive index of different liquids. The process involved measuring the angles of incidence and refraction with a protractor and ruler while the laser passed through the liquids. Using Snell's Law to find the refractive index showed that in thicker liquids, light bent more toward the normal, giving values that were close to their theoretical indices. The refractive indices ranged from around 1.33 for water to about 1.47 for sugar solutions. This study suggests that higher temperatures will lower the refractive index of water because the water will be less dense, but higher sugar concentrations will raise the refractive index because the sugar will be more optically dense. These results are relevant to several applications, such as evaluating food quality, monitoring chemical concentration, and calibrating optical sensors. The experiment met its purpose by confirming how light was expected to behave in different liquids. To improve accuracy and lower the chance of human mistake in future investigations, it is recommended to use digital angle measurement tools and automatic data recording.

Keywords: *Refractive index, temperature, concentration, optical density, glass*

INTRODUCTION

This study looks into how changing temps and sugar concentrations change the way light bends as it moves through different liquids. To learn how these things affect the refractive index, which is a key feature of materials for light, is the goal. The trouble is that there isn't enough basic information to compare how light behaves in different common liquids and environments. It is important to know this for both science reasons and everyday use. A laser pointer, a glass container, and a protractor were used to set the angle at which light bent as it went through each sample. At angles between 60° and 100°, we used Snell's Law to find the refractive indices of pure water, ethanol, oil, soap, and other liquids. To study the effect of temperature, pure water was heated from 30°C to 60°C. To study the effect of solute concentration, sugar-water solutions with concentrations between 10% and 50% were made. It was found that different liquids have different refractive indices. Oil and glycerin had the highest numbers. Also, the refractive index went down a little when the temperature went up, but it went up steadily when the sugar level went up. In areas like chemical analysis, optical sensing, and quality control, where it's important to know how to control and understand light well, these results are very important.

LITERATURE REVIEW

The refractive index of a material controls how light passes through it. The kind of liquid, its temperature, and how many solutes are in it all matter. For this reason, it is good for chemical analysis, food quality testing, optical tracking, and finding out what is wrong with your health. A new comprehensive model shows that the refractive index of dielectric materials changes with temperature, density, and wavelength. These changes have to do with how molecules act and how heat affects them (Tan, 2021). Tariq and Anwar (2023) say that the refractive index goes down with temperature because the molecule density goes lower. It also varies a lot with frequency in materials that are hygroscopic and have complicated molecular architectures. The refractive index goes up in a straight line as the amount of sugar in a solution goes up (Hilaris Publisher, 2018). A comprehensive analysis employing the Sellmeier equation revealed a robust linear correlation at sugar concentrations over 15%, with more intricate behavior at lower sugar levels (Misto et al., 2021). These studies provide a robust foundation for the present study, which expands the scope by examining more prevalent liquids and meticulously analyzing the impact of heating and sugar addition on light refraction.

MATERIALS AND METHODS

The experiment aimed to determine the refractive index of various liquids by employing Snell's Law, which correlates angles of incidence and refraction to the optical densities of two media. It was a glass box in the shape of a rectangle that you could look through. In every test, the laser beam hit the top of the liquid at an angle between 60° and 100°. To avoid parallax error, a protractor was placed at eye level to measure the bending angles (Siddiqui & Usmani, 2016). We utilized the angles we saw to find the refractive indices, and we verified them numerous times to be sure they were correct. They looked examined distilled water, ethanol, ethyl alcohol, glycerin, cooking oil, liquid detergent, liquid dish soap, and a 20% salt solution.

We heated up 250 mL of pure water on a hot plate in modest quantities to examine how temperature affected it. The temperatures were measured with a calibrated thermometer. We took measurements at 30°C, 40°C, 50°C, and 60°C, and we utilized the identical optical equipment to record the refraction angles at each temperature. This facilitated the examination of the impact of thermal expansion and reduced optical density on the refractive index (Prasad, Selvaraja, & Varma, 2017).

For the concentration-dependent study, sugar solutions with concentrations between 10% and 50% by weight were made by mixing certain amounts of sugar into 250 mL of distilled water. After thorough mixing, the solutions were assessed using the same optical setup. We wrote down the refraction angles at different angles of incidence and then calculated the refractive indices correctly. To avoid cross-contamination, the container was cleaned between trials. This method tried to find out how solute concentration and light refraction behavior are related. Light refraction behavior is known to get stronger when solute levels are higher because the optical density increases (Pedrotti et al., 2018).

RESULTS

Table 1 shows that the refractive indices of the liquids that were tested ranged from 1.44 to 1.49. The refractive indices of cooking oil and dish soap were the highest, while the refractive index of distilled water was the most different from what was expected. All of the percentage errors were less than 10%. For example, glycerine was just 0.68% off and distilled water was 8.27% off. This shows that the actual and theoretical values were mostly in line with each other, even though there were some small measurement errors.

Table 1. Refractive Index of Liquid and Percentage Error

Liquid	Average n_2 calculated	Error (%)
Distilled Water	1.44	8.27
Ethanol	1.45	6.62
2-Propanol (Isopropyl Alcohol)	1.47	6.52
20% Salt Solution	1.46	5.00
Glycerine	1.46	0.68
Cooking Oil (Palm Oil)	1.49	1.36
Detergent	1.48	3.50
Dish Soap	1.49	7.19

Figure 1 also shows how the refractive index of distilled water changes with temperature. The refractive index slowly dropped as the temperature rose from 30°C to 60°C, showing a little negative slope. This trend shows the expected drop in optical density because the liquid expands when it becomes hot.

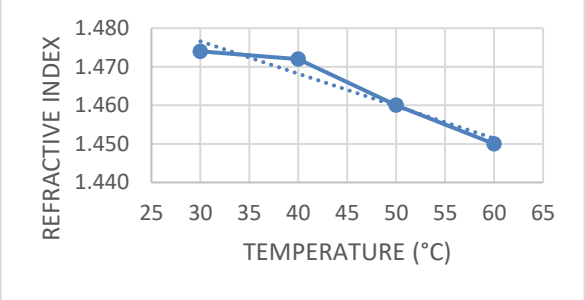


Figure 1. Graph of Refractive Index Against Temperature

Figure 2 shows that the refractive index of sugar solutions, on the other hand, went up in a straight line as the concentration went up. Values increased from about 1.46 at 10% to 1.49 at 50%, showing that there is a clear link between the amount of solute and the optical density.

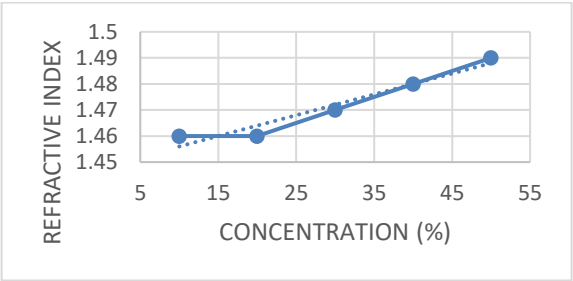


Figure 2. Graph of Refractive Index Against Concentration

DISCUSSION/ANALYSIS

The study's results show that the refractive index is strongly affected by the properties of the liquid itself, as well as physical factors like temperature and solute content outside the liquid. There were 1.49 times more molecules of cooking oil and dish soap than any other sample. This is probably because they are more complicated and have more light packed into them (Hecht, 2017). Distilled water, on the other hand, had the lowest number (1.44), as well as the largest error rate (8.27%). It's possible that this is because it's very sensitive to small changes in its surroundings and mistakes in size. The small differences between the other samples show that the method of experimentation based on Snell's Law works reliably and consistently. Measurements that were based on temperature also showed that as the temperature rose, the refractive index of pure water always went down. In this case, it dropped from 1.47 at 30°C to 1.45 at 60°C. The known negative thermo-optic coefficient fits with this finding (Novais et al., 2018; Silva et al., 2020). You can also think about this trend in terms of the idea that heat expansion lowers molecular density, which in turn lowers optical density and finally the refractive index. These data show how important it is to keep the temperature stable in optical research, since even small changes in temperature can have a big impact on the readings for the refractive index. The study of concentration also showed a clear straight relationship between the refractive index and the amount of sugar. As the quantity went from 10% to 50%, the refractive index went up from 1.46 to 1.49. Kamikawachi et al. (2016) say this shows that both the mass density and molecule interaction of the solution have gone up. The results of this study support the idea that measuring the refractive index is an easy and effective way to find out how much salt is in a solution. It can be used to study living things, make food, and check the grade.

CONCLUSIONS

The experiment validated Snell's Law by showing that the refractive index changes depending on the type of liquid, goes up with more sugar, and goes down a little with higher temperatures. Also, small mistakes like parallax, misalignment, and temperatures that weren't stable made it less accurate. The results also support real-world uses in

food science, optics, and chemical analysis. The findings indicated that cooking oil and dish soap exhibited the highest indices, with consistent patterns corroborating the notion.

REFERENCES

Hecht, E. (2017). Optics (5th ed.). Pearson Education. https://emineter.wordpress.com/wp-content/uploads/2020/04/hecht-optics-5ed.pdf.

Hilaris Publisher. (2018). Concentration, wavelength and temperature dependent refractive index of sugar solutions and methods of determination. *Journal of Lasers, Optics & Photonics, 5*(2). https://www.hilarispublisher.com/open-access/concentration-wavelength-and-temperature-dependent-refractive-indexof-sugar-solutions-and-methods-of-determination-contents-of-sug-2469-410X-1000187.pdf.

Kamikawachi, R. C., Abe, I., Paterno, A. S., Kalinowski, H. J., Müller, M., & Pinto, J. L. (2016). Determination of thermo-optic coefficient in liquids with fiber Bragg grating refractometer. *Optics Communications, 281*, 621-625. https://doi.org/10.1016/j.optcom.2007.10.023.

Misto, M., Purwandari, E., Supriyadi, S., Arkundato, A., Rohman, L., & Cahyono, B. E. (2021). Analyses of concentration and wavelength dependent refractive index of sugar solution using Sellmeier equation. *University of Jember Repository.* https://repository.unej.ac.id/handle/123456789/115993.

Novais, S., Ferreira, M. S., & Pinto, J. L. (2018). Optical fiber Fabry–Perot tip sensor for detection of water-glycerin mixtures. *Journal of Lightwave Technology, 36*(7), 1576–1582.

Pedrotti, F. L., Pedrotti, L. S., & Pedrotti, L. M. (2018). *Introduction to optics* (3rd ed.). Cambridge University Press.

Prasad, P. R., Selvaraja, S. K., & Varma, M. (2017). Thermo-optic coefficient measurement of liquids using silicon photonic microring resonators. *arXiv.* https://doi.org/10.48550/arXiv.1710.03605.

Siddiqui, M. A., & Usmani, M. A. (2016). Measurement of refractive index using laser beam and protractor method. *International Journal of Science and Research (IJSR), 5*(10), 953–956.

Silva, S., Pachon, E. G. P., Franco, M. A. R., Hayashi, J. G., Malcata, F. X., Frazão, O., & Cordeiro, C. M. B. (2020). Ultrahigh-sensitivity temperature fiber sensor based on multimode interference. *Applied Optics, 51*(14), 3236–3242.

Tan, C. Z. (2021). Dependence of the refractive index on density, temperature, and the wavelength of the incident light. *The European Physical Journal B, 94*(7). https://doi.org/10.1140/epjb/s10051-021-00147-2.

Tariq, N., & Anwar, S. (2023). Chromatic dispersion and thermal coefficients of hygroscopic liquids. *Optical Materials, 145,* 113328. https://doi.org/10.1016/j.optmat.2023.113328.

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Sekian, terima kasih.

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Setuju.

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