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Preface: Climate Change and Sustainability Engineering in ASEAN 2019

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Preface: Climate Change and Sustainability Engineering in ASEAN 2019

We are delighted to present the Proceedings of the International Conference on Climate Change and Sustainability in ASEAN 2019 (CCSE-ASEAN 2019).

CCSE-ASEAN 2019 was held at the University of Jember, Indonesia, on 13 November 2019. This conference was hosted jointly by the Faculty of Engineering, University of Jember (Indonesia) and the School of Engineering, University of San Carlos (Philippines). The conference will be held annually on alternate cities of Jember (Indonesia) and Cebu (Philippines).

CCSE-ASEAN is an attempt to formulate the best response to climate change that poses increasingly significant threats to sustainable development in Southeast Asia. This conference aims at encouraging rich discussions and continuous collaborations among researchers, engineers, leaders in regional government and industries, and students on enhancing the role of the engineering field with its major innovations in ASEAN countries to mitigate climate change impacts.

CCSE-ASEAN 2019 received 171 submissions of abstracts and full papers. On the basis of a single-blind review process, in which two or three independent reviewers were assigned for each submission, 100 full-papers were accepted for oral presentation. The presenters at CCSE-ASEAN 2019 came from several countries including Indonesia, Philippines, Japan, China, and Iraq. The authors presented original scientific reports on varied topics but highly relevant to climate change and sustainability studies, including new models in disaster management, advances in biomaterials, novel analyses in renewable energy technologies, and uses of artificial intelligence and Internet of Things in farming. Based on further assessment on the overall quality of the presented papers, the CCSE-ASEAN Committee has selected 50 outstanding papers for submission to AIP Conference Proceedings.

Our sincere appreciation goes to all authors who have submitted their abstracts and papers to CCSE-ASEAN 2019 especially to the authors who presented their papers in the parallel session. Our deep gratitude goes to the reviewers for their dedicated work. We sincerely thank Prof. Evelyn Taboada (University of San Carlos, Philippines), Prof. Siti Rozaimah SA (Universiti Kebangsaan Malaysia, Malaysia), Prof. How- wei Chen (National Central University, Taiwan), Dr. Timotius Pasang (Auckland University of Technology, New Zealand), and Dr. Hermann van Radecke (Flensburg University of Applied Science, Germany) for having presented their insightful lectures in the plenary session. We would also thank all committee members of CCSE-ASEAN 2019 for their continuous hard work and cooperation, and we thank our sponsors for their support.

We do hope that all the participants of CCSE-ASEAN 2019 would gain meaningful inspiration and fruitful collaboration from the conference. We also wish them a joyful experience from their stay at Jember during CCSE-ASEAN 2019. We are looking forward to seeing you again in CCSE-ASEAN 2020.

Chair of CCSE-ASEAN 2019
Dr. Eng. Triwahju Hardianto

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Using Multisample Refractometer to Determine The Sugar Content of Sugarcane Juice in Sugar Factory Besuki

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Abstract. The queue for transporting sugar cane from rice fields in sugar mills is very long and requires a long time. This creates a shortage of funds and time because workers must be in the queue. The need for rapid measurement in sugar cane at the sugar factory is expected to provide a solution to the problem. In this study we introduced a measurement system using multisample that can be measured simultaneously. The measurement system consists of three glass prisms, three photodiode array sensors, a multiplexer and ADC, and a computer. The measurement system in this study was used to measure the concentration of sugar from concentrations of 0, 5%, 10%, 15%, 20%, 25% and 30%. The results showed that the measurements went well, because all the results of the measurement measurements on the monitor screen. The measurement system can manage each measurement directly using three samples at a time. In this way the measurement takes place faster

INTRODUCTION

The milling season of sugar factories in Indonesia usually starts in June to December each year. Sugar cane to be milled is carried by trucks from rice fields to factories in long queues. The sugar cane transport truck that has arrived at the factory must wait for the queue to go to the mill [1]. Usually this queue is quite long, because it has to go through the weighing process and test the sugar level measurement [2, 3]. If the measurement results in the range of 16 to 17 percent can only enter the grinding process. The length of the queue is caused by the process of measuring sugar levels which are still manual.

The process of measuring sugar levels in sugar mills is usually done manually with brix meter. Each sugar cane in the truck is sampled, the sugar cane juice is taken through the grinding process and the sugar content is measured. The process of measuring sugar cane sugar levels is known by farmers who own sugar cane and factory representatives. On the basis of the results of this measurement the sugar distribution will be done after the mill is finished [3].

To increase the capacity to measure sugar levels at the factory is to replace a better measuring instrument. One of them is using a refractometer by connecting a computer and using many sample inputs. By using many sample inputs, the measurement can be faster and shorten the length of the queue.

Measurements using a refractometer to observe one important parameter in sugarcane liquid, namely the concentration of sugar and the refractive index. The concentration of sugar cane liquid not only determines whether the liquid is heavy or light, but also an input parameter for determining the crystal sugar to be produced. It has been established that concentration and refractive index are strongly correlated [4, 5].

Oti [6] has used the polarization method to determine sucrose content through refractive index measurement and built a simple regression model between sucrose content. Nawi et al. [7, 8] used a spectroscopic method combined with PLS models to determine the quality of sugarcane (brix and polarization) from clear and raw sugarcane juice.

Futhermore, for multi-sample measurements from initial samples and final samples of sugarcane juice, Labview (2013) has provided a method of choice because the programs in measuring the instrumentation system, which

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provide the possibility of processing data until the measurement display [9]. In addition, for measuring samples many offer sample rotations in the accepted. However, for the measurement of samples many forms of display are needed simultaneously that can be observed. Therefore, multi-sample measurements are very desirable for long-term measurement studies.

In this work, we have experimentally determined the liquid concentration and refractive index of sugarcane liquid using a refractometer. To improve measuring capabilities, we use the selector program to observe the concentration of sugar cane liquid. Data measured directly is then used to calculate the concentration and refractive index for many samples. Our results imply that the use of a multiplexer can accelerate the measurement of many sugarcane liquid samples.

MATERIAL AND METHOD

Sample preparation

Before use, calibration of the measuring instrument is carried out. Three prism-shaped sample containers were prepared for a mixture of sucrose and water. The sample of this mixture was measured at 29 ° C, conditioned by varying the mixture from 0 to 40% mass for sucrose solution. Mixture with 0% sucrose content is distilled water. A mixture of 5% sucrose is a solution made of 5 mg of sucrose and 95 mg of water. And so on for a solution with 10% sucrose, 15%, and so on to 40%. Furthermore, data measurement and analysis is carried out. The results of this analysis are used as a reference when the sample is replaced with sugar cane juice. Sugar cane juice is obtained by sampling sugar cane which is still in the truck queue.

Sensor System Preparation

The sensor system used consists of a photodiode array (PDA) TCD1304 type CCD image sensor made by Toshiba. Photodiode array (PDA) is a linear array of discrete photodiodes on an integrated circuit chip (IC). In this refractometer it is placed in the image area of the refractometer to allow the wavelength used to be detected. A photodiode is a semiconductor device that converts light into an electric current. Flow is generated when photons are absorbed in the photodiode. The photodiode array used in this experiment has 3648 phototube photos, for each wavelength difference. Figure 1 is the spectrum response of the photodiode. Laser that have wavelength 4500 nm - 6500 nm may be used in this application. The laser beam passing through the sample is then refracted to form refracted angle. . The refractive angle experienced by a laser beam depends on the concentration of the solution in the sample. Using a photodiode array allows refraction angles to be measured carefully. The TCD 1304 is wll suited for work within visible spectrum or

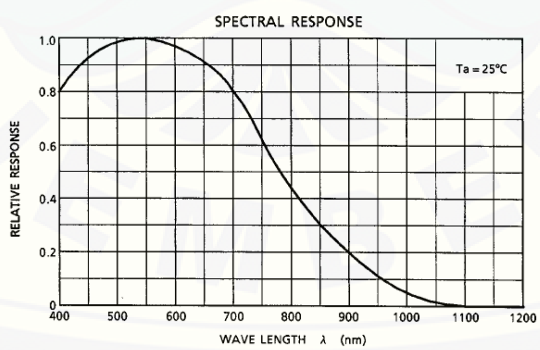

FIGURE 1. Spectrum response of TCD1304

In the research the sample container provided consisted of three pieces. The laser beam and photo diode array provided are also three pieces. The expectation of the number of sample containers and their detection system consists of three pieces to get a fast measurement. Output from the detector photo array is forwarded to signal processing systems and computers. Signal processing systems consist of amplifiers, filters, and analog to digital converters (ADC). The selector as the sample measurement selector is inside the computer using the program

PROGRAM FOR MEASUREMENT SYSTEM

The program on software that manages to be able to read distance (y) in APD, while (y) is the distance from the laser refraction beam that passes through the media such as at point reference, with length (x) made of 6 cm then it can be determined the value of the deviation angle, using equation of the relationship between refraction index and minimum deviation angel. Then the refractive index is converted to concentration (in %). After the deviation angle is obtained, the software arranges to display a graph of the relationship of the angle of deviation with the angle of incidence, and calculates the index of refraction value of each composition. Refraction of light (laser) after passing through the media will be seen on the screen which is considered as (y). When a ray can appear on the screen, the image analysis camera captures the light then stored in the form of an image. This image is used to use software for a biased and biased viewpoint of each concentration. The software used is the LabVIEW 2012 software.

The program initialization process stage by opening the LabVIEW software, then opening the diagram block to prepare the request in Figure 3. The following block diagram is where writing requests and functions, containing the source code in the form of symbols, vertices and lines as the data stream to execute the program. Where Figure 3, breaks the block of the arrangement diagram for the deviation point of view and displays a graph of the relationship of the angle of deviation with the angle of incidence to determine the minimum angle deviation.

After the program is finished, then open the front panel to measure the distance of the refractive ray as shown in Figure 3. The results obtained can be seen in figure 3, in the form of the value of the angle deviation and graph of determining the minimum angle of deviation from the relationship of the angle of deviation with the angle of incidence of each concentration.

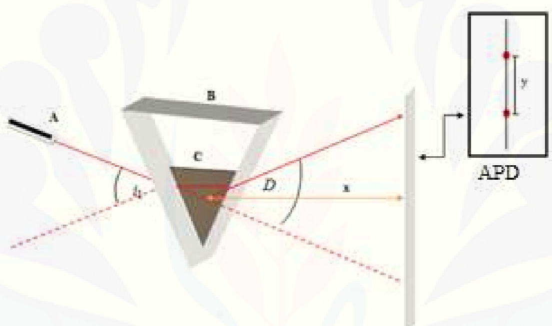

FIGURE 2. Deviation angle measurement

A description of each part in figure 2;

A. Laser source with the wavelength of 670 nm, 632,8 nm and 532 nm
B. Prism with length of the prism side 8 cm
C. Sample sugar
D. Deviation angle, with APD (array photodiode)

The measurement of the refractive index of the sample begins by passing the laser beam through the sample in a prism container. Then the light coming out of the sample is measured at an angle through the measurement of y (figure 2) using APD. If the distance between the point of discharge in the sample to the APD is x then the deviation angle *D* can be determined through the relationship

$$tan\left(\frac{D}{2}\right) = \frac{y}{x} \quad (1)$$

$$\text{or } D = 2tan^{-1}\left(\frac{y}{x}\right) \quad (2)$$

Then by arranging for the angle of incidence and refraction angle to be symmetrical so that the minimum angle *D* (D_m) is obtained, the refractive index can be determined by the equation

$$n = \frac{sin[(P+D_m)/2]}{sin\left(\frac{P}{2}\right)} \quad (3)$$

With : P = apex angle of prism (^{0})
D_m = minimum deviation angle (^{0})
In this paper the apex angle of prism is 60^0 and x = 6 cm, by the measuring of y so the computer can display the magnitude of the refractive index.

Measurement Design

Measurement of this sample was carried out at 29 °C, using a 670 nm, 632.8 nm, and 532 nm each laser source. From begining with the preparation of sample materials, pure water (distilled water) and sucrose and other ingredients (syrup) for the next measurement material.

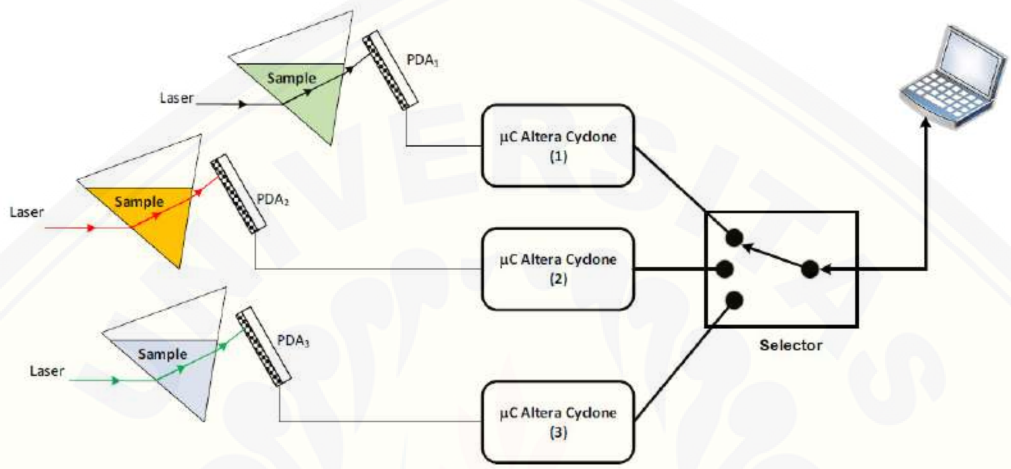

FIGURE 3. Design Measurement

After completing the spectrometer planning, the next step is calibration. This step is needed so that the measurement price of the glucose concentration sample and read out the detector value every time, then show out the relationship between sensor readings and glucose concentration. Using aquades and sucrose for calibration, we can prepare the concentration needed for the calibration process. The planned glucose concentration is: 0%, 5%, 10%, ... 40%, the measurement container is placed between the Laser source and the detector (photodetector array) by adding the sample container holder device. Detection by the photodiode array is adjusted by varying the laser light until the detector reads, which is adjusted for the light transmitted at zero glucose concentration. This value will be a zero process calibration number. To get the results of detection of readings at the next concentration, the sample in the container was replaced with a sample with a higher concentration and then read.

RESULTS AND DISCUSSION

Calibration

The calibration of the prism container is carried out using a transparent prism as the solution container to determine the refractive index value, where the solution used is aquades. Aquades were placed in the same prism as the sugar solution container at the time of the study. The data obtained is the deviation angle which is then used to calculate the refractive index value of the sugar solution. Determination of the deviation angle of the solution is done by observing the refraction of the laser beam when it passes through a prism that contains the solution so that the deviation angle shown in the Front panel in LabVIEW software is known. The calibration results are obtained by calculating the difference in values obtained between the observational data and the reference data. The difference in value is then used as a correction factor for the next measurement data.

In the calculation of sucrose 9 the concentration variation is done by measuring the minimum deviation angle to then determine the refractive index of each sample concentration. Minimum angle measurements are carried out using a laser directed at one side of the prism that has been filled with a sample angle of 20 angles - 60 ^{0} intervals of

5 ^{0}, laser light will increase refraction and light refracted at certain angular displays. The refracted laser beam will appear on the screen like the dot (E) in Figure 3.2, the beam will be captured by the camera then stored in the form of images. Analyze cameras that are approved with a computer that has LabVIEW software installed.

Measurement of Refractive Index in Sugar Solutions

The value of the refractive index is one of the important optical properties of a medium. There are three parameters that affect the value of the medium refractive index, namely the wavelength of the laser as a source of light and the concentration of the material measured by the refractive index.

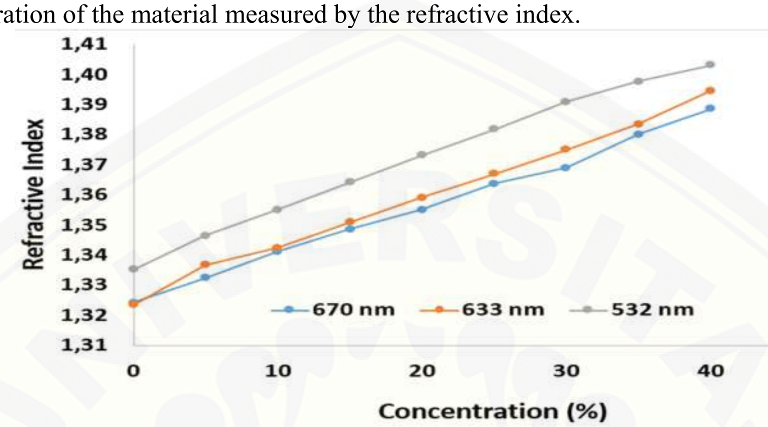

FIGURE 4. Refractive index vs sugar concentration

Figure 4, shows the refractive index values of sugar solutions varying in concentration for each wavelength. Based on the graph, it is known that the relationship between concentration and refractive index is directly proportional, where the greater the concentration of the refractive index value is also greater. It can be seen that the sugar solution produces the smallest refractive index at a concentration of 0% and produces the greatest refractive index at a concentration of 40%. According to Hidayanto et al. (2010) based on the physical properties explained that the greater the concentration of the solution, the greater the number of molecules and atoms that interact with light waves, so that the phase lag experienced by the incoming waves is greater. This means that the speed of light decreases with increasing concentration. In other words, the shorter the wavelength of light passing through a transparent medium, the greater the refractive index value of the measured medium.

Measurement of Sugar Content

The refractive index of a solution obtained from the experiment can be used as an indicator of a device can be used as an alternative measuring device. The refractive index value is converted back in the form of sugar levels (%) as in Table 1, Table 2 and Table 3, the table compares sugar levels (%) obtained from measurements using a prism and sugar levels (%) using a digital refractometer.

Table 1. Sugar Level Measurement Results in Old Red Laser source (670 nm)

Concentration (%)	Prism		Refractometer		D (%)
	n	Sugar content (%)	n	% Brix (%)	
0	1.3243	0.0000	1.333	0.0000	0.00
5	1.3325	5.1120	1.3432	5.2000	2.14
10	1.3412	9.5521	1.3492	9.8000	2.39
15	1.3487	14.8534	1.3557	14.4000	0.98
20	1.3552	20.9660	1.3645	19.9000	2.83
25	1.3638	24.7563	1.3718	24.6000	2.84
30	1.3690	29.7645	1.3805	29.8000	0.80
35	1.3801	35.1543	1.3892	34.5000	2.68
40	1.3887	39.9732	1.3989	38.6000	2.49

Table 1 shows the refractive index data of sugar solutions at various concentrations for wavelength (670 nm). Based on the table it can be seen the relationship between concentration and refractive index is directly proportional, where the greater the concentration of the refractive index value is also greater. The refractive index obtained is used to calculate the magnitude of the concentration of the sugar solution using a regression equation obtained from the relationship graph concentration (%) with the refractive index n shown in Figure 4. At a mathematical concentration of 0%, 5%, and 10% sugar content (%) from prism measurements obtained values of 0%, 5.1120%, and 9.5521%, measurements using a digital refractometer in the form of% Brix (%) respectively of 0%, 5.2000% and 9.8000%. The average value of discrepancy is 1.91%. so the accuracy value is 98.10%. The refractive index data of sugar solutions of various concentrations for wavelength (632.8 nm) are shown in Table 2.

Table 2. Sugar Level Measurement Results in Red Laser source (632,8 nm)

Concentration (%)	Prism		Refractometer		D (%)
	n	Sugar content (%)	n	% Brix (%)	
0	1.3235	0.0000	1.333	0.0000	0.00
5	1.3367	5.3025	1.3432	5.3000	3.42
10	1.3425	9.5625	1.3492	9.6000	4.37
15	1.3510	14.6562	1.3557	14.4000	2.29
20	1.3592	20.9687	1.3645	18.9000	4.84
25	1.3670	23.6562	1.3718	24.6000	3.84
30	1.3751	29.5625	1.3805	29.8000	1.46
35	1.3835	36.3125	1.3892	34.2000	3.75
40	1.3947	39.5625	1.3989	38.8000	4.38

Table 2. shows the refractive index data of sugar solutions at various concentrations for wavelength (632.8 nm). Based on the table it can be seen the relationship between concentration and refractive index is directly proportional, where the greater the concentration of the refractive index value is also greater. At a mathematical concentration of 30%, 35%, and 40% sugar content (%) from prism measurements obtained values of 29.5625%, 36.3125%, and 39.5625%, measurements using a digital refractometer in the form of% Brix (%) respectively of 29.8000%, 34.2000% and 38.6000%. The average value of discrepancy was 3.15%, so that the accuracy value was 96.85%. The use of 5% max tolerance refers to Bennet (2005), which states that the uncertainty of the measurement standard of 5% is still within the acceptable limit.

Table 3. Sugar Level Measurement Results in Green Laser source (532 nm)

Concentration (%)	Prism		Refractometer		D (%)
	n	Sugar content (%)	n	% Brix (%)	
0	1.3352	0.0000	1.3330	0.0000	0.00
5	1.3465	5.2300	1.3432	5.3000	4.61
10	1.3551	10.4214	1.3492	9.6000	4.12
15	1.3642	14.8928	1.3557	14.4000	0.72
20	1.3732	20.2500	1.3645	18.9000	0.14
25	1.3818	25.0357	1.3718	24.6000	1.77
30	1.3910	30.1785	1.3805	29.8000	1.27
35	1.3977	36.0357	1.3892	34.2000	4.37
40	1.4832	41.5357	1.3989	38.6000	3.38

Table 3, shows the refractive index data of sugar solutions at various concentrations for wavelength (532 nm). Based on the table it can be seen the relationship between concentration and refractive index is directly proportional, where the greater the concentration of the refractive index value is also greater. At a mathematical concentration of 30%, 35%, and 40% sugar content (%) from prism measurements obtained values of 30.1785%, 36.0357%, and 41.5357%, measurements using a digital refractometer in the form of% Brix (%) respectively of 29.8000%, 34.2000% and 38.6000%. The average value of discrepancy was obtained at 2.64%, so the accuracy value was obtained at 97.36%. The use of 5% tolerance refers to Bennet (2005), which states that the uncertainty of the measurement standard of 5% is still within the acceptable limit.

The research that has been done shows that the change in concentration in the sugar solution can affect the refractive index value. Hidayanto and Tiffany (2015) have shown the value of the refractive index is proportional to its concentration. While the refractive index value is greater in measurements using a laser with a wavelength (532 nm) than a laser with a wavelength (632.8 nm) and (670 nm).

CONCLUSION

We have been able to design refractometers with many samples that are suitable for measuring liquid sugar content in sugar mills. The experimental results show that this refractometer can be used quickly to measure sugar cane liquid levels at concentrations in the range (0-40)%. Measuring speed is obtained by adding sample inputs and the multiplexer circuit becomes faster than a single sample input. The measurement results for sugar content are in accordance with the results obtained from other measurement methods.

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