

The Density Value of Mixing Water and Cooking Oil Using an Emulsifier (Tween 20)

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ARTICLE INFO

Article history:

Received May 29th 2024
Revised June 05th 2024
Accepted June 06th 2024
Available online June 10th 2024

E-ISSN: 2809-3410

How to cite:

Istianto Budhi Rahardja, Azhar Basyir Rantawi, Hendra Saputra, Dian Oktavia Pambudi, Raden Naufal Rangga Gumilang, Apriadi, Nur Afni Safitri, Mirza Mahadewa, Eka Meutia Tari, Anwar Ilmar Ramadhan, Edy Susanto. "The Density Value of Mixing Water and Cooking Oil Using an Emulsifier (Tween 20)". *Jurnal Dinamis (Scientific Journal of Mechanical Engineering)*, Vol. 12 No 1, 30-38, June. 2024.



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<http://doi.org/10.32734/dinamis.v12i1.16567>

ABSTRACT

Water and cooking oil are fluids that we often encounter in our daily lives and are often needed. Water is polar while cooking oil is non-polar, so in uniting the two fluids an emulsifier (Tween 20) is used to mix them. The aim of this research is to combine polar and non-polar fluids. Emulsifier (Tween 20) is used as a polysorbate surfactant (mixing agent) for the two fluids and can mix perfectly. The combined water and oil are mixed using a mixing stirrer with a speed of 100-200 rpm, a temperature of 70°C, within 1 hour. To obtain a fluid density value by providing heating from 30°C-90°C, then inserting it into a 25 mL volumetric flask and weighing it. After mixing, a white hybrid fluid will be produced, and it will separate again when the fluid is at room temperature.

Keyword: Fluid, Water, Cooking Oil, Emulsifier, Mixing

ABSTRAK

Air dan minyak goreng merupakan fluida yang sering ditemui oleh kita di kehidupan sehari-hari dan sering dibutuhkan. Air bersifat polar sedangkan minyak goreng bersifat nonpolar, sehingga dalam menyatukan kedua fluida tersebut menggunakan emulsifier (Tween 20) untuk mencampurkannya. Tujuan dari penelitian ini menggabungkan fluida polar dan nonpolar. Emulsifier (Tween 20) dipergunakan sebagai polysorbate Surfactant (bahan pencampur) kedua fluida tersebut dan dapat bercampur secara sempurna. Gabungan air dan minyak dicampurkan menggunakan mixing stirer dengan kecepatan 100-200 rpm, temperatur 70°C, dalam waktu 1 jam. Untuk memperoleh nilai densitas fluida dengan memberikan pemanasan dari 30°C-90°C, kemudian memasukan kedalam labu volumetrik 25 mL dan menimbanginya. Setelah dilakukan pencampuran akan dihasilkan hybrid fluida berwarna putih, dan akan menjadi terpisah kembali saat fluida tersebut pada suhu ruang.

Keyword: Fluida, Air, Minyak Goreng, Emulsifier, Pencampuran

1. Introduction

The State of Indonesia has agrarian commodities that produce several plant, mining and marine products. Agricultural products from plant agriculture starting from vegetables, fruit, vegetable oil and so on, contribute to the development and fulfillment of consumption in the country and abroad. One of the big and excellent agricultural products, namely: oil palm plantations[1-5]. The produce of oil palm plantations in the form of fresh fruit bunches (FFB) will be processed into crude palm oil (CPO) in which the FFB is boiled, shelled, pressed, filtered, and purified in the clarification process [6-8]. The results of CPO will be processed back into cooking oil with a series of refining processes, bleaching deodorizing palm olein (RBDPO) [9-13].

Water is the main ingredient for living things to carry out the process of digestion, growth, and maintaining the body [14]. Water is an inseparable need for living things, such as for drinking, cleaning, cooking and so on [15].

Cooking oil is currently a community need in the process of cooking and ripening food by heating [16-18]. The heating process uses a heat source (furnace, LPG gas, electric stove) as heat energy in the ripening process. Compounds formed due to the existence of electron bonds with each other in the binding elements [19]. These binding elements will join each other because the bonding elements have different electronegativity values. Compounds are divided into polar and non-polar [20-23]. Some characteristics of polar compounds, namely: can dissolve in water and other polar solvents, have positive (+) and negative (-) poles due to the uneven distribution of electrons [24]. Water and oil are materials needed by humans, but have different characteristics, where water is a polar material while cooking oil is a non-polar material [25-26]. The two fluids have different densities, so they can easily separate between the two [27]. In Figure 1.1 you can see the condition of the water and cooking oil being separated.

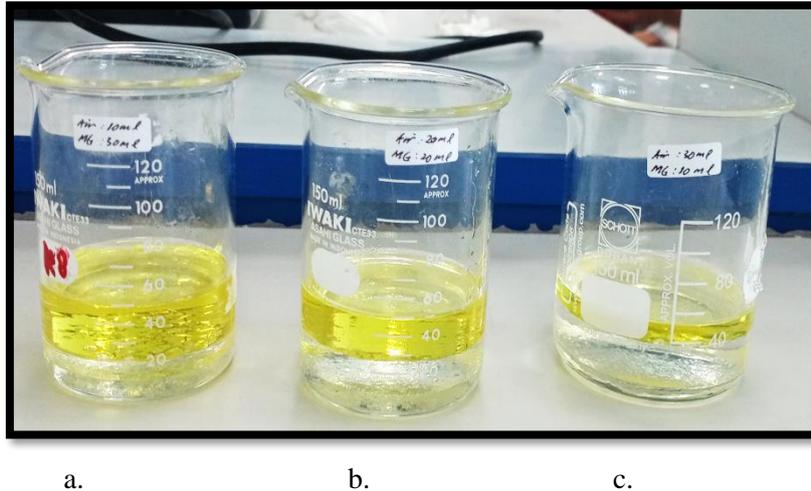


Figure 1.1. Water & Cooking Oil Fluid Conditions, a) 30 mL Cooking Oil & 10 mL Water, b) 20 mL Cooking Oil & 20 mL Water, c) 10 mL Cooking Oil & 30 mL Water.

In research, it is necessary to combine the added materials in the form of emulsion surfactants to combine the two.

2. Methodology

2.1 Preparation

In the process of this research was carried out using water and cooking oil with a composition of 10 mL & 30 mL; 20 mL & 20 mL; 30 mL & 10 mL, 3 times repetition. The addition of emulsion in each test is 10 mL of tween 20 [28-29]. The mixing process used a magnetic stirrer at 2000 rpm (2 Mot), 70°C, for 1 hour.

2.2 Density Testing

Density testing is carried out to determine the density of the fluid that has been mixed thoroughly from the two fluids (water & cooking oil) [30]. The fluid hybrid formed will be weighed using a 25 mL volumetric flask (picnometer). The mixed fluid is heated from 30°C - 90°C, put into a volumetric flask, and the total weight is weighed. The equation used to show density is [31] :

$$\rho = \frac{m}{V} \tag{1}$$

Where :

ρ = Fluid density [g/mL]

m = fluid mass [g]

V = Fluid volume [mL]

3. Discussion Result

3.1 Density

This test was carried out using 3 glass beakers with the composition of each glass beaker being 10:30:10; 20:20:10; and 30:10:10 (mL). The results of the density test carried out in mixing water, cooking oil, with this emulsifier can be seen in table 3.1.

Table 3.1. Sample Density Test Data 1

No Sample	Cooking Oil : Water : Emulsifier (mL)	Temperature (°C)	Sample Mass + picno (gr)	Picno Mass (g)	Sample Mass (g)	Picno Volume (mL)	Density (g/ mL)	
1	10:30:10	30	45.47	19.78	25.69	25	1.0276	
		40	45.2	19.78	25.42	25	1.0168	
		50	45.05	19.78	25.27	25	1.0108	
		60	44.73	19.78	24.95	25	0.998	
		70	44.39	19.78	24.61	25	0.9844	
		80	44.35	19.78	24.57	25	0.9828	
		90	44.54	19.78	24.76	25	0.9904	
		20:20:10	30	46.93	23.38	23.55	25	0.942
			40	46.98	23.38	23.6	25	0.944
	50		46.65	23.38	23.27	25	0.9308	
	60		46.55	23.38	23.17	25	0.9268	
	70		46.48	23.38	23.1	25	0.924	
	80		46.23	23.38	22.85	25	0.914	
	90		46.31	23.38	22.93	25	0.9172	
	30:10:10	30	44.54	21.55	22.99	25	0.9196	
		40	44.48	21.55	22.93	25	0.9172	
		50	44.32	21.55	22.77	25	0.9108	
		60	44.2	21.55	22.65	25	0.906	
		70	43.85	21.55	22.3	25	0.892	
		80	43.82	21.55	22.27	25	0.8908	
		90	43.67	21.55	22.12	25	0.8848	

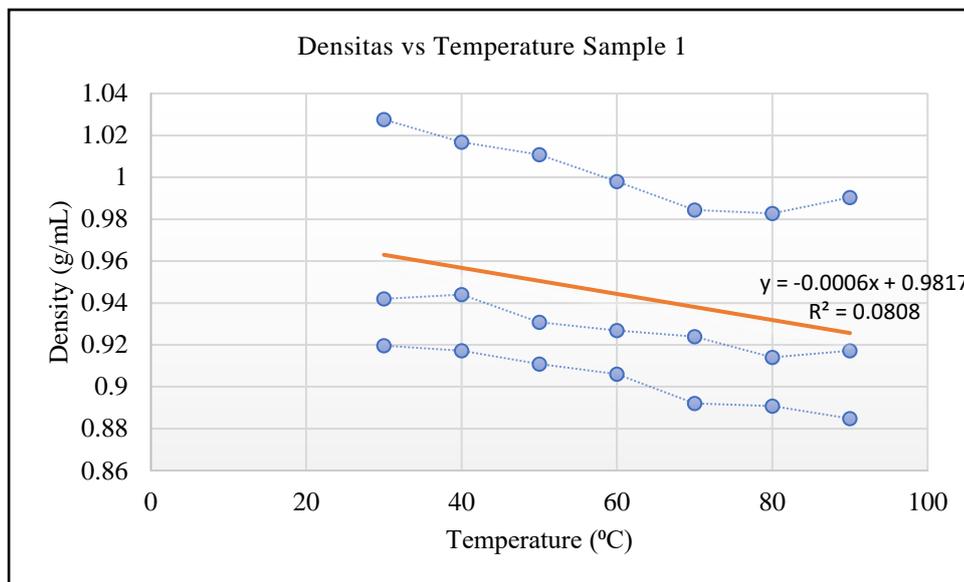


Figure 3.1 Graph of Density vs Temperature in Sample 1

Figure 3.1 shows that different compositions and different temperatures will give different values. At a composition of 10:30:10 mL (cooking oil : water : emulsifier) it can be seen that the density is still above 1 g/ mL at a temperature of 30°C-60°C. This shows that the mixture still contains a lot of water, where the density of water is 1 g/mL. After giving the addition of a temperature of 70°C-90°C the fluid mixture will be lower. At compositions 20:20:10 ml and 30:10:10 mL, there has been a decrease in density starting from 30°C-90°C

indicating that these compositions match the density of cooking oil. According to Sahasrabudhe et al 2017, the higher the temperature, the lower the fluid density value [32]. Then the researchers repeated the second sample with the same composition and the same treatment (using a magnetic stirrer for mixing, temperature 70°C for 1 hour). The results of mixing the fluid are then tested for density which can be seen in table 3.2.

Table 3.2. Sample Density Test Data 2

No Sample	Cooking Oil : Water : Emulsifier (ml)	Temperature (°C)	Sample Mass + picno (g)	Picno Mass (g)	Sample Mass (g)	Picno Volume (mL)	Density (g/mL)
2	10:30:10	30	43.58	19.72	23.86	25	0.9544
		40	43.21	19.72	23.49	25	0.9396
		50	43.15	19.72	23.43	25	0.9372
		60	42.69	19.72	22.97	25	0.9188
		70	42.35	19.72	22.63	25	0.9052
		80	42.25	19.72	22.53	25	0.9012
		90	42,38	19.72	22.66	25	0.9064
	20:20:10	30	46.76	21.55	25.21	25	1.0084
		40	46.67	21.55	25.12	25	1.0048
		50	46.36	21.55	24.81	25	0.9924
		60	46.02	21.55	24.47	25	0.9788
		70	45.97	21.55	24.42	25	0.9768
		80	45.81	21.55	24.26	25	0.9704
		90	45.67	21.55	24,12	25	0.9648
	30:10:10	30	45.03	19.786	25.244	25	1.00976
		40	44.62	19.786	24.834	25	0.99336
		50	44.22	19.786	24.434	25	0.97736
		60	44.2	19.786	24.414	25	0.97656
		70	44.02	19.786	24.234	25	0.96936
		80	43.5	19.786	23.714	25	0.94856
		90	43.48	19.786	23.694	25	0.94776

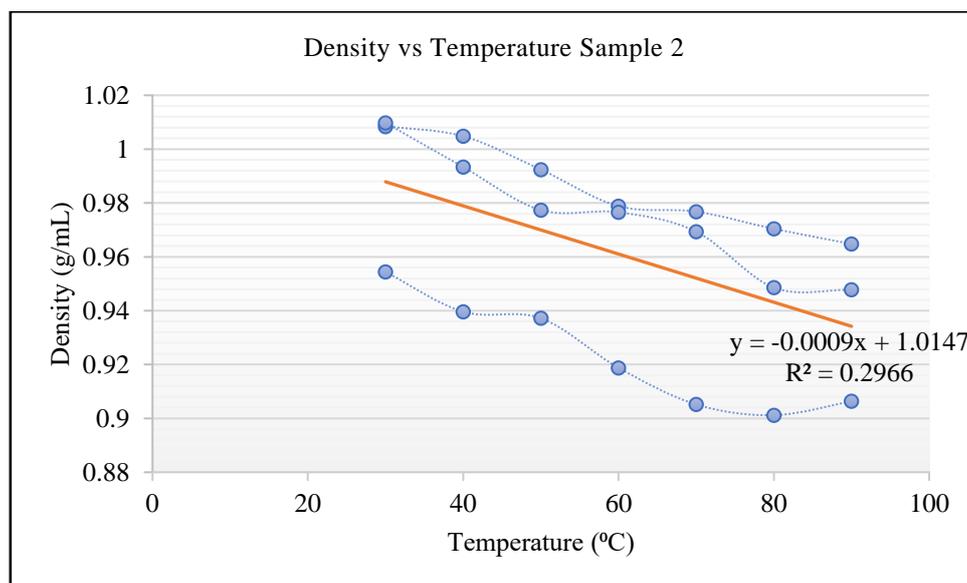


Figure 3.2 Graph of Density vs Temperature in Sample 2

Figure 3.2 shows that the graphs for compositions 10:30:10 mL, 20:20:10 mL and 30:10:10 mL are almost entirely below 1 g/mL, this shows that mixing is getting better and leading to mass. the type of cooking oil, which is below 1 g/mL. the statement that high temperatures will decrease the value of the fluid density in oil [32]. Then the mixing process was carried out on sample 3, where the mixing treatment, temperature and time used were the same. The results of the density test on sample 3 can be seen in table 3 below.

Table 3.2 Sample Density Test Data 3

No Sample	Cooking Oil : Water : Emulsifier (mL)	Temperature (°C)	Sample Mass + picno (g)	Picno Mass (g)	Sample Mass (g)	Picno Volume (mL)	Density (g/mL)
3	10:30:10	30	46.01	23.38	22.63	25	0.9052
		40	46.73	23.38	23.35	25	0.934
		50	46.49	23.38	23.11	25	0.9244
		60	45.61	23.38	22.23	25	0.8892
		70	45.56	23.38	22.18	25	0.8872
		80	45.21	23.38	21.83	25	0.8732
		90	45.17	23.38	21.79	25	0.8716
		20:20:10	30	44.28	19.8	24.48	25
	40		44.21	19.8	24.41	25	0.9764
	50		44.05	19.8	24.25	25	0.97
	60		43.64	19.8	23.84	25	0.9536
	70		43.45	19.8	23.65	25	0.946
	80		43.34	19.8	23.54	25	0.9416
	90		43.09	19.8	23.29	25	0.9316
	30:10:10		30	48.03	23.44	24.59	25
		40	47.91	23.44	24.47	25	0.9788
		50	47.77	23.44	24.33	25	0.9732
		60	47.32	23.44	23.88	25	0.9552
		70	47.27	23.44	23.83	25	0.9532
		80	47.16	23.44	23.72	25	0.9488
		90	47.08	23.44	23.64	25	0.9456

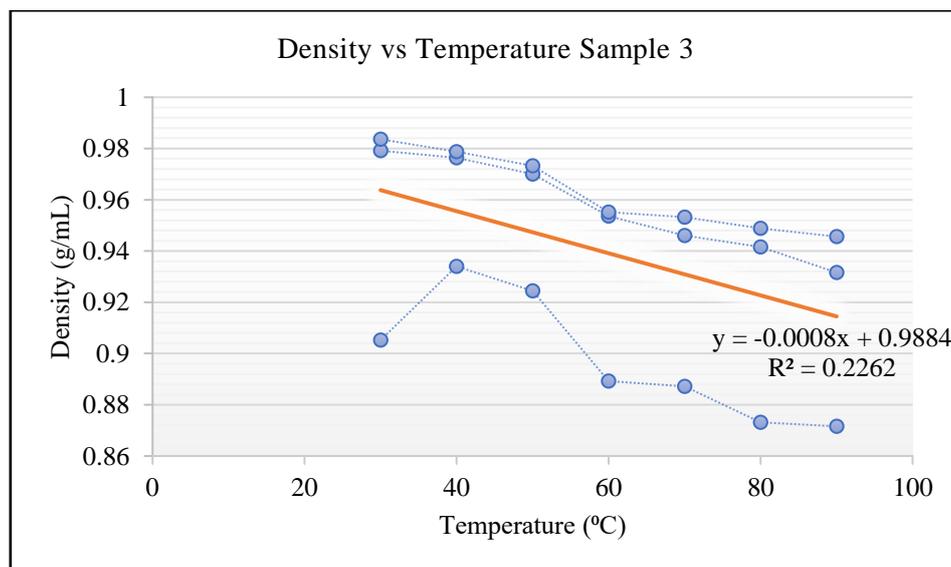


Figure 3.3 Graph of Density vs Temperature in Sample 3

Figure 3.3 shows that all of the mixed compositions of the three samples are below 1 gr/ml and are close to cooking oil fluids. This indicates that the composition will have almost the same properties and shape as

cooking oil [27]. In oils derived from canola, corn, olive, peanut, and soybeans will also experience a low density value when given heating [32].

3.2 Density Comparison

From the results of the density test that has been carried out, the researchers made a comparison of the same composition in the samples. Each composition of 10:30:10 mL will be compared to samples 1,2,3, this is done to find out how much influence and density values occur. In Figure 5, you can see a graph of the 10:30:10 composition in samples 1,2,3.

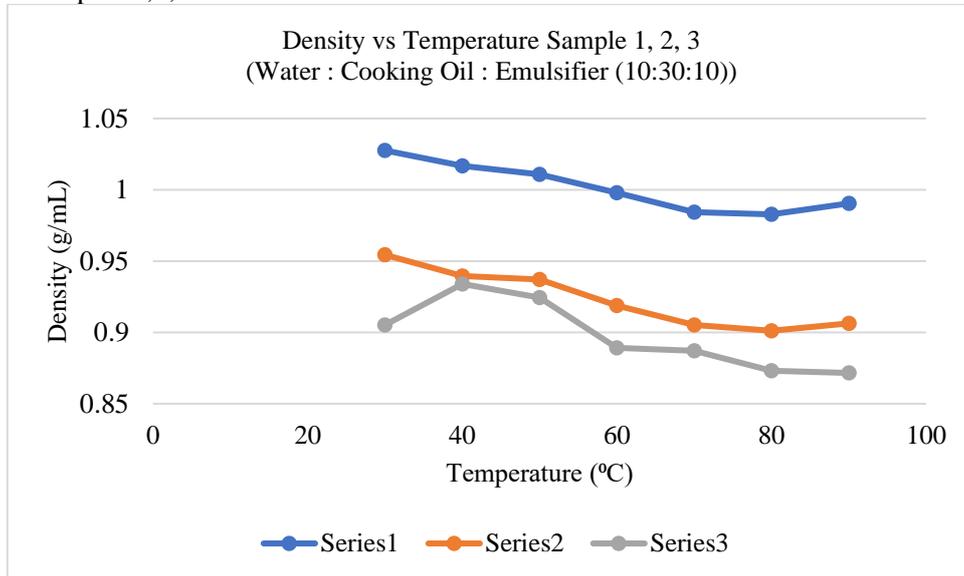


Figure 3.4 Graph of Density vs Temperature Composition 10:30:10 in Samples 1,2,3

In Figure 3.4, the sample 1 graph for this composition shows that the density value is still partially above 1 gr/ml. This shows that the content of this sample is close to the water fluid which is at 1 g/mL. Whereas in samples 2 & 3 it was below 1 g/mL, this indicates that this sample resembles a like cooking oil content.

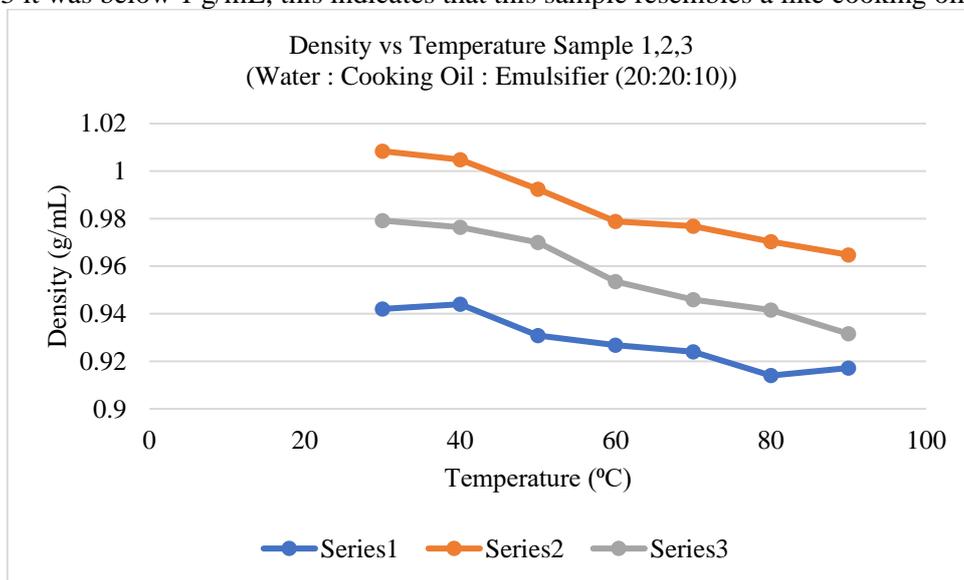


Figure 3.5. Graph of Density vs. Composition Temperature 20:20:10 in Samples 1,2,3

Figure 3.5 shows that sample 1 is still above 1 g/mL. For samples 2 & 3, all of them show a value below 1 g/mL, where this fluid is almost like a cooking oil.

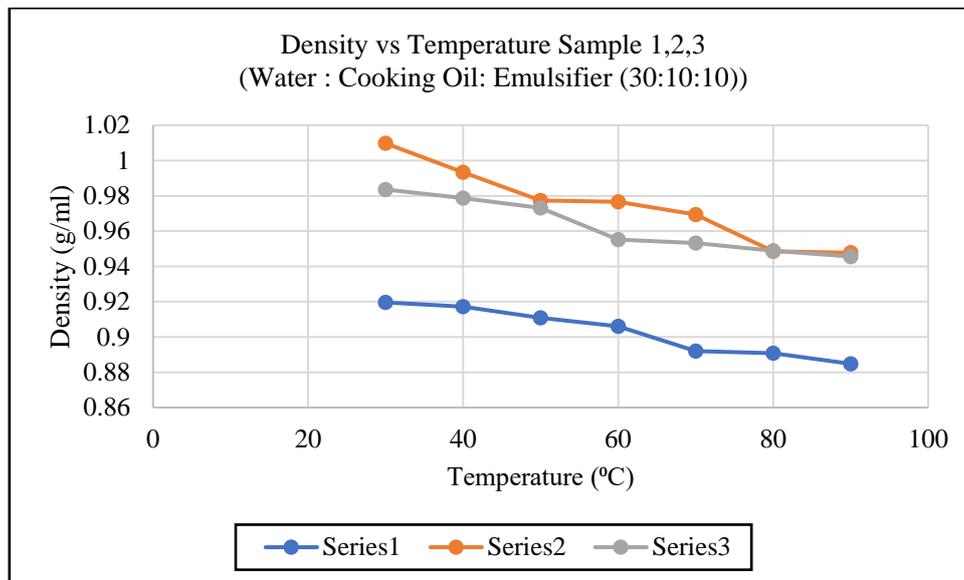


Figure 3.6. Graph of Density vs. Temperature Composition 30:10:10 in Samples 1,2,3

In Figure 3.6, almost all samples 1, 2, and 3 are below 1 g/mL, which almost resembles the condition of cooking oil in general. Where cooking oil in general has a density value in the condition of 1 g/mL [27].

4. Conclusion

Based on the research conducted, it can be concluded that the density value of mixing cooking oil, water, and emulsifier (Tween 20) is generally below 1 gr/ml, which shows almost similar conditions to cooking oil. Cooking oil has the ability to absorb and release heat faster and can be used in the cooling & heating industry.

5. Acknowledgments

Thank you for Grant Riset Sawit K22 from Badan Pengelola Dana Perkebunan Kelapa Sawit (BPDPKS) with Contract Number No: PRJ – 356/DPKS/2022.

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