The Quality Control of Refinery Bleaching Deodorize Palm (RBDP) Olein with Variations of Phosphoric Acid (H_3PO_4) and Bleaching Earth (BE)

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Abstract. Crude palm oil (CPO) is the result of the production process of processing palm oil from fresh fruit bunches (FFB) of oil palm plantations. CPO is referred to as crude palm oil which is refined to become frying oil for public consumption. The process of refining CPO to become frying oil is carried out by the Refinery Bleaching Deodorize Palm (RBDP) Olein process. The Refinery is a process for separating gum or mucus, protein, residue, hydrates and resins using Phosphoric acid (H_3PO_4), Bleaching is a color bleaching process using bleaching earth chemicals, Deodorize is a process for removing FFA, odors and oxidizing materials. Researchers carried out variations of added ingredients (H_3PO_4 : 0.05%; 0.1%; 1.5% & BE : 0.5%; 1%; 1.5%) in the RBDP Olein process to find out the quality results adjusted to SNI 01-0018-2006. The tests carried out were free fatty acids (FFA), water content (moisture), dirt content (dirt). The results of testing the variation of additives in the RBDP Olein process obtained the highest FFA values at H_3PO_4: 1.5% & BE: 1%, the highest water content at H_3PO_4: 0.05% & BE: 0.5%, the highest dirt/impurities content at H_3PO_4 : 0.1% & BE : 1.5%. Based on SNI 01-0018-2006 the tests carried out are still below the standard required.

Keywords: Crude Palm Oil, Control Quality, Free Fatty Acids, Moisture, Dirt

1 Introduction

Palm oil is the processing of fresh fruit bunches (FFB) harvested in oil palm plantations. The State of Indonesia has an area of oil palm plantations reaching 16.38 million hectares [1]. Palm oil plantation products are processed at palm oil companies into crude palm oil (CPO), kernel/ kernel oil (PKO), and palm oil waste in the form of liquid and solid [3-5]. Palm oil companies that carry out the CPO processing process carry out the process of boiling, peeling, pressing, and refining the oil to become CPO [6-9]. The photos of FFB and CPO processed by palm oil mills can be seen in Fig. 1.

M. Setiyo et al. (eds.), *Proceedings of the 4th Borobudur International Symposium on Science and Technology 2022 (BIS-STE 2022)*, Advances in Engineering Research 225,
https://doi.org/10.2991/978-94-6463-284-2_45

(a) (b)

Fig. 1. Palm Oil Mill Materials (a) oil palm fresh fruit bunches (FFB), (b) crude palm oil (CPO)

CPO that has been produced by palm oil factories to be used as cooking oil needs to go through the refining stage, because there are still many dissolved substances in CPO, such as palm sap, metal materials, and dirt/flakes etc. which are still included in the CPO yield [10] -11]. The purification method carried out using Refined, Bleached, Deodorized Palm (RBDP) is a process used to obtain cooking oil raw materials in the form of liquid called olein and those in solid form called strain [12-15]. The CPO refining process using the RBDP Olein method requires the addition of chemicals, such as: phosphoric acid (H3 PO4) and bleaching earth (BE) to produce pure oil. The refining treatment of CPO with RBDP Olein requires quite a long time and an appropriate process, so as to produce good and safe pure oil [16-18]. The use of chemicals in the purification process is necessary to obtain fast and maximum results compared to natural processes. In the process of degumming use 0.5%; 1% phosphoric acid and BE 0.5%; 1%; 1.5% produces an FFA of 2.01% & 3.49%; 2.53% & 2.98% ; 3.33% & 3.59%[19]. The RBDP Olein process refers to the SNI-01-2901-2006 standard [2][19-21]. In this case the authors conducted an experiment with variations of phosphoric acid (0.05%, 0.1%, 1.5%) and BE (0.5%, 1%, 1.5%).

2 Method

2.1 Preparation

In the process of preparing for this experiment, the authors prepared 9 samples of 100 ml of CPO material which would first measure the FFA, Moisture, and dirt content. The test was carried out 2 times for each sample.

2.2 Degumming

The degumming process is the separation of gum or mucus, protein, residue, carbohydrates, water, and resin using the chemical phosphoric acid (H3 PO4) [22],[23]. This process was carried out using a magnetic stirrer with phosphoric acid mixing, temperature 80 º C, for ± 2 hours.

2.3 Bleaching

The bleaching process is the process of bleaching the color of CPO material using bleaching earth chemicals [23]. This process was carried out using a magnetic stirrer with phosphoric acid mixing, temperature 80 º C, for ± 1 hour.

2.4 Deodorizing

The deodorizing process is the process of removing FFA, odors such as peroxide and other compounds resulting from the oxidation of fats contained in the CPO material [23],[24]. This process uses an autoclave at a temperature above 125 º C, a pressure of 1.5 Bar, for ± 1 hour.

2.5 Grades of oil quality (FFA, Dirt, Moisture)

The quality of palm oil is determined from several standardized parameters. In this case SNI 01-0018-2006 is the quality standard for crude palm oil, and can be seen in table 1.

Table 1. Quality Requirements for RBDP Palm Oil [2]

No	Testing Criteria	Units	Quality Requirements
1	Colour		Reddish orange
2	Moisture & Dirt	% fraction mass	0.1 max
3	Free Fatty Acid (FFA)	% fraction mass	0.1 max
4	Iodine Number	g Iodine/100 g	50-55

3 Result and Discussion

The CPO raw material that will be refined through the olein RBDP process is first subjected to an initial testing process in the form of FFA, moisture, and dirt. The sample is placed in a glass beaker as much as 100 ml, then tested as an initial test of the material to determine the initial conditions. To show the initial testing of CPO raw materials can be seen in Table 2.

Fig. 2 shows the percentage of FFA, moisture, and dirt still under SNI 01-0018-2006 standard conditions. According to Hambali (2020) states that the standard FFA allowed is <3.5%. In this case, FFA is also influenced by the presence of lipase enzymes that

develop from raw materials. So to reduce the CPO raw material from FFA, it is necessary to maintain the temperature between 45ºC-55ºC.

Table 2. FFA, Moisture, Dirt initial test data

No	RBDPOlein Chemical Concentration		Preliminary Testing Data		
	H_3PO_4 (%)	BE (%)	FFA (%)	Moisture (%)	Dirt (%)
1	0.05	0.5	3.2057	0.1107	0.0553
2			3.7886	0.0909	0.0144
3		1	3.2057	0.1107	0.0553
4			3.7886	0.0909	0.0144
5		1.5	3.2057	0.1107	0.0553
6			3.7886	0.0909	0.0144
7	0.1	0.5	3.2057	0.1107	0.0553
8			3.7886	0.0909	0.0144
9		1	3.2057	0.1107	0.0553
10			3.7886	0.0909	0.0144
11		1.5	3.2057	0.1107	0.0553
12			3.7886	0.0909	0.0144
13	1.5	0.5	3.2057	0.1107	0.0553
14			3.7886	0.0909	0.0144
15		1	3.2057	0.1107	0.0553
16			3.7886	0.0909	0.0144
17		1.5	3.2057	0.1107	0.0553
18			3.7886	0.0909	0.0144

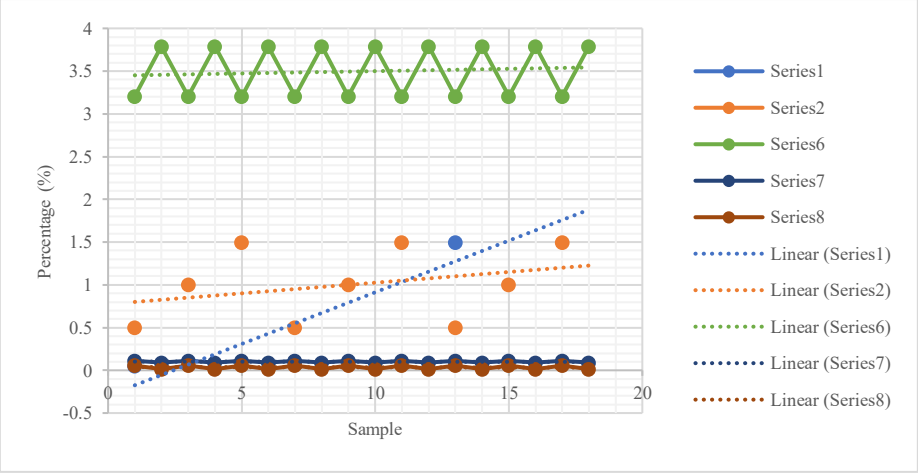

Fig. 2. Graph of FFA, Moisture, Dirt Test Results

3.1 Degumming Process

The degumming process is a chemical process of adding phosphoric acid with a magnetic stirrer for ± 2 hours at a temperature of 80ºC. Degumming samples consisted of 9 samples with 100 ml of each sample being added with 0.05% phosphoric acid; 0.1%; and 1.5%. After the degumming process was carried out, then the separation was carried out quickly using a centrifuge machine at ± 6,000 rpm for 15 minutes. The results of the degumming centrifuge can be seen in table 3.

Table 3. Results of the Degumming Centrifuge Process

No	Sample (gr)	RBDP Olein Chemical Concentration		CPO result centrifuge degumming (gr)
		H_3PO_4 (%)	BE (%)	
1	102.12	0.05	0.5	98.23
2	100.05	0.05	1	96.39
3	100.27	0.05	1.5	99.22
4	100.54	0.1	0.5	94.83
5	100.05	0.1	1	94.39
6	100.78	0.1	1.5	95.63
7	100.70	1.5	0.5	93.09
8	100.29	1.5	1	97.57
9	101.68	1.5	1.5	99.78

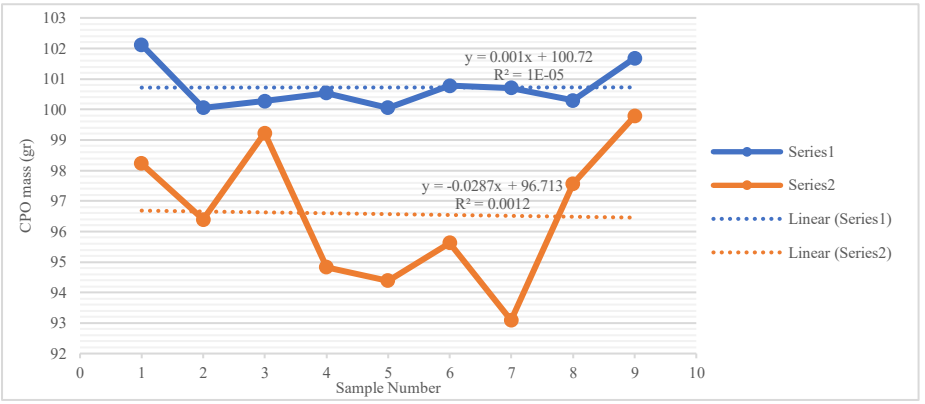

Fig. 3. Graph Degumming Centrifuge Results

Fig. 3 shows the results of the degumming centrifuge, where there is a reduction of ± 5%. This raw material reduction is in the form of palm sap, metal materials, carbon dioxide, impurities and others which are still involved in the oxidation process.

3.2 Free Fatty Acid (FFA)

CPO raw materials that have been processed using the RBDP method will undergo FFA testing. The FFA test is carried out to determine the value of free fatty acids contained in the oil, the higher the FFA value indicates the level of oil damage due to hydrolysis

that occurs, the lower the FFA value the better, and conversely the higher the FFA value indicates the quality of the oil is not good. FFA test results data can be seen in table 4.

Table 4. FFA Test Data

No	RBDPOlein Chemical Concentration		FFA testing	
	H_3PO_4 (%)	BE (%)	Before (%)	After (%)
1	0.05	0.5	3.2057	3.7446
2	0.05	0.5	3.7886	3.7129
3	0.05	1.0	3.2057	3.6521
4	0.05	1.0	3.7886	3.6256
5	0.05	1.5	3.2057	3.4727
6	0.05	1.5	3.7886	3.5743
7	0.1	0.5	3.2057	4.2186
8	0.1	0.5	3.7886	3.8633
9	0.1	1.0	3.2057	3.9897
10	0.1	1.0	3.7886	4.1159
11	0.1	1.5	3.2057	3.4830
12	0.1	1.5	3.7886	2.9798
13	1.5	0.5	3.2057	3.5174
14	1.5	0.5	3.7886	3.5230
15	1.5	1.0	3.2057	5.4774
16	1.5	1.0	3.7886	5.6370
17	1.5	1.5	3.2057	4.8427
18	1.5	1.5	3.7886	4.7876

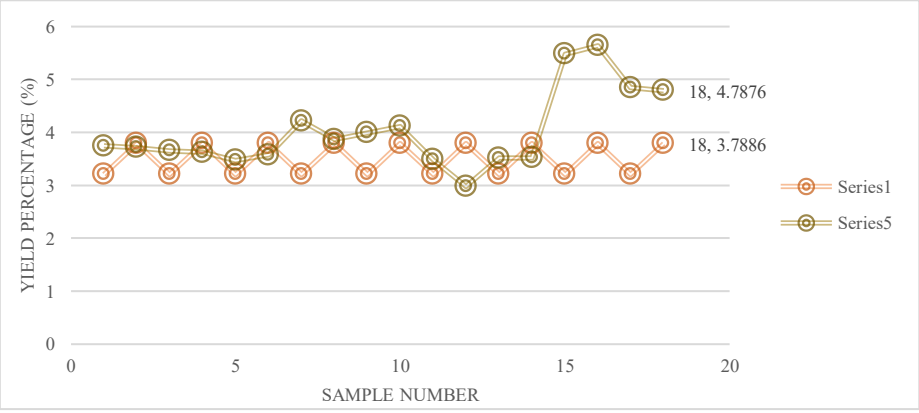

Fig. 4. Graph of FFA Test Results

In Fig. 4, it shows that after the RBDP process was carried out on the CPO material, it gave a value that was quite an increase of ± 1.19% from before the RBDP process was carried out. In this case there is still oil and water content which reacts, resulting in a hydrolysis process. With raw materials that have been processed by the RBDP, the temperature must be maintained and airtight, so that the FFA in the oil does not increase.

3.3 Moisture

The water content contained in the oil needs to be considered and maintained. Moiture testing on raw materials that have been carried out by the RBDP process aims to remove the water content in them. To remove the water content in the CPO from the RBDP, it is heated to ± 105 ºC-125ºC for 2 hours with the aim of evaporating the water in it. The results of the moisture test can be seen in table 5.

Table 5. Moisture Test Data

No	RBDPOlein Chemical Concentration		Moisture Testing	
	H_3PO_4 (%)	BE (%)	Before (%)	After (%)
1	0.05	0.5	0.1107	0.04510192
2	0.05	0.5	0.0909	0.01061774
3	0.05	1.0	0.1107	0.00111173
4	0.05	1.0	0.0909	0.00383224
5	0.05	1.5	0.1107	0.00210202
6	0.05	1.5	0.0909	0.00213051
7	0.1	0.5	0.1107	0.0004014
8	0.1	0.5	0.0909	0.00049118
9	0.1	1.0	0.1107	0.00066258
10	0.1	1.0	0.0909	0.00033304
11	0.1	1.5	0.1107	0.00039625
12	0.1	1.5	0.0909	0.0001176
13	1.5	0.5	0.1107	0.00187535
14	1.5	0.5	0.0909	0.00086425
15	1.5	1.0	0.1107	5.7405E-05
16	1.5	1.0	0.0909	0.00033837
17	1.5	1.5	0.1107	0.00011258
18	1.5	1.5	0.0909	0.00045619

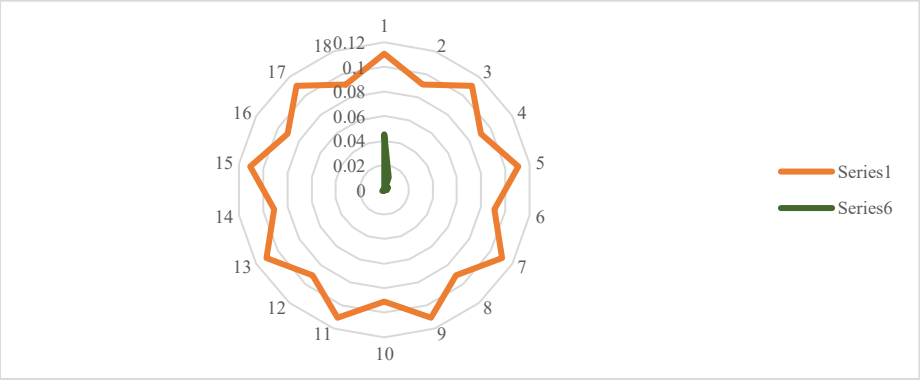

Fig. 5. Graph Moisture Testing

Fig. 5 provides an explanation of the results of the moisture test from the RBDP results, where these results are below the SNI 01-0018-2006 standard which is below 0.1%. The addition of phosphoric acid and BE resulted in significant moisture testing

values at 1.5% phosphoric acid and 1% BE. Whereas in the tests carried out by Rossani & Amri, 2021, the results of the moisture test were greatest at 1% phosphoric acid and 1.5% BE.

3.4 Dirt

The contents of impurities in the form of dust, fiber, metal materials and so on which are still included in the refining process must be purified as best as possible. The RBDP process that has been carried out is tested for dirt according to the SNI 01-0018-2006 standard. The allowable dirt content is 0.1%. The dirt test data can be seen in table 6.

Table 6. Dirt Testing Data

No	RBDPOlein Chemical Concentration		Dirt Testing	
	H_3PO_4 (%)	BE (%)	Before (%)	After (%)
1	0.05	0.5	0.0553	0.003545
2	0.05	0.5	0.0144	0.010519
3	0.05	1.0	0.0553	0.018998
4	0.05	1.0	0.0144	0.01011
5	0.05	1.5	0.0553	0.003812
6	0.05	1.5	0.0144	0.012033
7	0.1	0.5	0.0553	0.01684
8	0.1	0.5	0.0144	0.010983
9	0.1	1.0	0.0553	0.03043
10	0.1	1.0	0.0144	0.02926
11	0.1	1.5	0.0553	0.035217
12	0.1	1.5	0.0144	0.017316
13	1.5	0.5	0.0553	0.003151
14	1.5	0.5	0.0144	0.001204
15	1.5	1.0	0.0553	0.002775
16	1.5	1.0	0.0144	0.009414
17	1.5	1.5	0.0553	0.011211
18	1.5	1.5	0.0144	0.015296

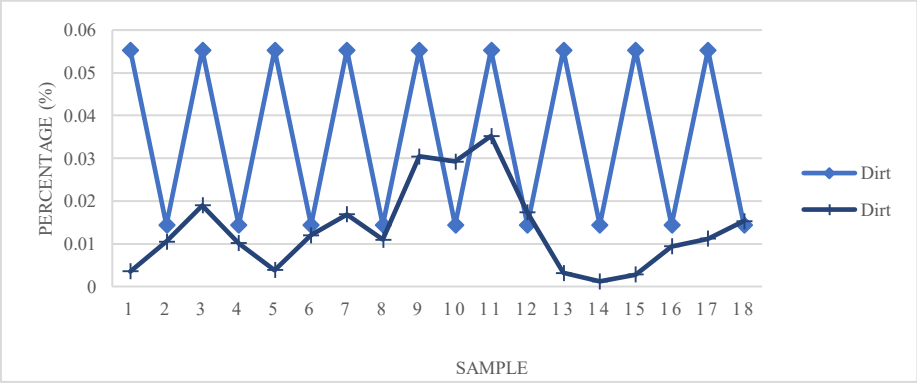

Fig. 6. Graph Dirt Testing Results

Fig. 6 shows the results of the dirt test on average, there was a decrease from before and after the RBDP process of ± 25%, in general the dirt content in the oil was below the SNI 01-0018-2006 standard limit of 0.1%. Thus, the testing process for FFA, moisture, and dirt that has been carried out in the purification of olein RBDP on CPO is under the SNI 01-0018-2006 standard.

4 Conclusion

In this study it can be concluded that the refining of CPO material with the RBDP process using phosphoric acid chemicals and bleaching ear produces oil of good quality and in accordance with SNI 01-0018-2006. By adding more phosphoric acid and bleaching ear, it will improve the quality of the oil with the appropriate temperature and time.

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

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