Journal of Applied Science and Advanced Technology
Journal Homepage : https://jurnal.umj.ac.id/index.php/JASAT

The Effect of Oil Thickness in the Cylindrical Settling Tank on the Moisture and Impurities of Crude Palm Oil (CPO)

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ARTICLE INFO

JASAT use only:
Received date : 22 May 2020
Revised date : 23 June 2020
Accepted date : 27 July 2020

Keywords:
Cylindrical Settling Tank
Skimmer
Moisture Content
Dirt Content

ABSTRACT

Cylindrical Settling Tank (CST) is a unit of clarification station that functions as a process of placing and extracting / extracting palm oil using the under flow and upper flow processes of palm oil. A clarification station is a station in a palm oil mill which functions to separate oil, water, sludge and other objects involved in the refining process of palm oil. This process aims to obtain clean palm oil and avoid dirt and water levels during the extraction process. The higher / thicker the oil layer is taken, it will affect the quality of the palm oil obtained, so it is carried out by taking palm oil slowly (laminar flow). Taking the height / thickness of palm oil is carried out on a skimmer unit that can rise and fall from the surface of the palm oil using a screw system. The results of taking the height / height of palm oil from the level of 20 cm, 30 cm, and 40 cm with the average yield of water content and CST feed impurities are 29.125% and 38.931%, the average output of the Skimmer for moisture and moisture content. the impurities are 1.039% and 0.089%. The mean wet oil tank output was 0.956% and 0.037%, and the mean moisture content and dirt content of the vaccum drier were 0.196% and 0.021%.

INTRODUCTION

A clarification station is a station in a palm oil mill which functions to separate oil, water, sludge and other objects involved in the refining process of palm oil. Inside the clarification station, there are tools that have a role to produce good quality production oil. This quality is viewed from the quality standards set by the relevant agencies [1-3]. The palm oil quality standards set by the PMKS PT ABC are as shown in Table 1 below.

Table 1. PT ABC PMKS Palm Oil Quality Standards [2]

No	Quality Parameters	Presentage (%)
1	FFA	< 3,0
2	Water Content	< 0,15
3	Level of Dirt	< 0,015

The problem that often occurs in relation to the quality of palm oil is the failure to achieve the quality standards that have been set. These failures include high water content, high levels of impurities, or a high percentage of free fatty acids (FFA) [4]. The case that occurred at PT ABC's PMKS was the failure to achieve the level of dirt and moisture in the production oil. The high water content and impurities in the production oil will have an impact on decreasing the quality of oil and the result of this quality reduction often has an impact on the return of products that have been purchased by buyers [5]. Of course this will have an impact on the huge losses suffered by the industry concerned. The data on the high water content and oil impurities produced by PT ABC's PMKS can be seen in Figure 1. The data has been compiled for the last six months.

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DOI: https://dx.doi.org/10.24853/JASAT.3.1.21-28

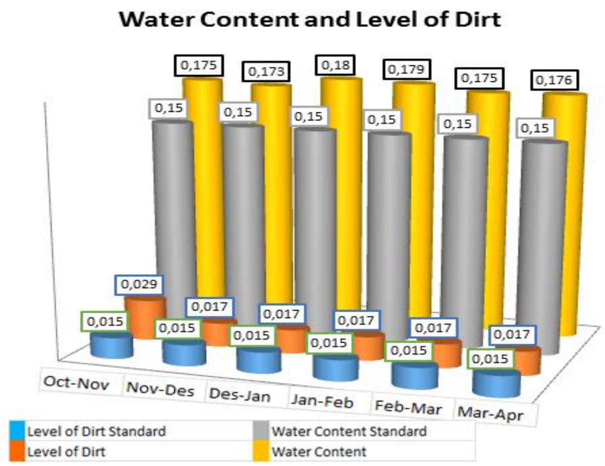

Fig 1. Moisture content and oil impurities produced by PT ABC PMKS [4]

In Fig 1, it can be seen that none of the obtained moisture content and dirt content during the last six months were according to the standard. The high water content and impurity content is possible due to the inability of the dirt and water separator tools to reduce the dirt and water content [6]. The inability is caused by a load that exceeds the maximum working capacity of the tool. Therefore, in order to reduce the high water content and oil impurity content, it should be necessary to reduce the burden that must be borne by these equipment. One method that can be used to reduce this load is to adjust the thickness of the oil in the cylindrical settling tanker before being picked up by Skimmer [7]. According to [8], the thinner the thickness of the oil when it is taken, the greater the moisture content and impurities. Therefore, a study on the effect of oil thickness in cylindrical settling tankers is very important to do in order to find out where the real problem lies.

Clarification Station

A clarification station is one of the many stations in a palm oil mill [9]. The clarification station is composed of several tool units such as: Sand trap tank, Vibrating screen, Crude oil tank, Cylindrical settling tanker, Oil tank, Float tank, Vaccum drier, and sludge processing unit consisting of Vibrating sludge, Sludge separator, Reclaim oil tank, and Sand cyclone [11]. As mentioned above, one of the compilers of the clarification station is the Cylindrical settling tanker. In this tool, there is separation between oil, emulsion, water and sludge [4]. Cylindrical settling tanker components are heating units consisting of Steam injection and Steam coil, Gerbox Stirrer and Skimmer and Thermostat. The function of cylindrical settling tankers is to separate pure oil and sludge with the principle of sedimentation [2]. The lighter oil will rise, while the heavier liquid sludge will fall. Some things that need to be considered in the operation of Cylindrical settling tankers are:

1. The temperature of the liquid when the Cylindrical settling tank operates is maintained at 90-95 °C by using a coil heater (spiral), this is so that the oil separation can be more perfect because it is in calmer conditions. The liquid temperature in the cylindrical settling tank is obtained from heating in the crude oil tank. The function of the steam coil when the cylindrical settling tanker operates is not to increase the temperature, but only to maintain heat.
2. The thickness of oil in the cylindrical settling tank at the time of quotation must be> 30 cm so that the levels of dirt and moisture in the oil produced by the cylindrical settling tank are smaller.

The oil thickness will not affect the oil retention time in CST. This is because according to [9] the retention time at Cylindrical settling of tankers is influenced by; tank volume, feed intake discharge, low drawn sludge, and sludge discharge.

The problem that requires immediate handling is the high percentage of water content and production oil impurities, so one solution that can be used to reduce the high percentage of water content and production oil impurities is to reduce the load that must be received by the Wet oil tank and Vacuum drier.

Skimmer is a tool used to quote oil in Cylindrical settling tankers [3]. The skimmer is composed of several components including the handle, screw iron, cone plate and pipe. The function of the handle is to control the height and low of the oil extractor cone. The description of the shape Skimmer is a tool that consists of a quotation funnel, thread and a handle to rotate the skimmer. The position of the skimmer is above the cylindrical settling tanker, and usually for every one unit of cylindrical settling a tanker consists of two skimmers. Skimmer work adjusts the thickness of the oil in the cylindrical settling tanker. If the quotation thickness is 40cm, the Skimmer will be set to quote the 40cm thick oil. In other words, it seems that the height of the Skimmer is equivalent to the thickness of the oil in the cylindrical settling of the tanker. For detailed images can be seen in Fig 2.

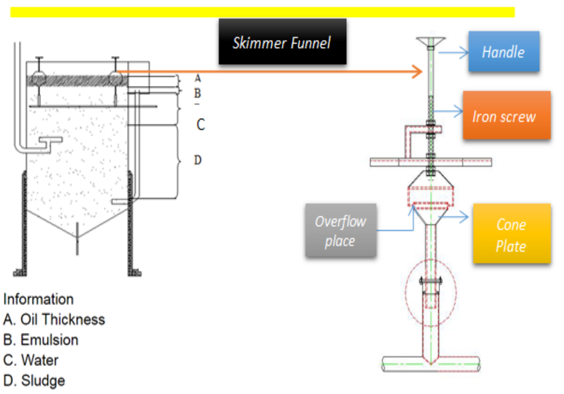

Fig. 2. Skimmer details

EXPERIMENTAL METHOD

Time and place

This critical study was conducted from 27 April - 27 May 2011 at PMKS PT. ABC

Tools and Materials

The tools needed to carry out this critical study are:

a. Measuring tool length (meter)
b. Oven
c. Analytical scales
d. Funnel
e. Erlenmeyer
f. Weighing glass

While the materials used for this critical study are hexane, ex-cylindrical settling tank oil and filter paper.

Method of Implementation

a. Identification of problems

The initial stage in this research is to identify the problems that exist in PMKS ABC. By knowing the existing problems, it can be determined methods or techniques that can be used to solve them. Based on interviews and seeing PT ABC's PMKS production report, it was found out that one of the problems that needed an immediate solution was the high moisture content and the level of production oil impurities. From the production report, it can be seen that the obtained moisture content and dirt content are still above the average of the standards set by PT ABC PMKS.

b. Literature Study

After knowing the problem, the next step is to find references related to the problem. This reference will later be used as a reference in solving the problem.

c. Data Mining

To find out the problems associated with the high water content and dirt content in the production oil, the water content and dirt content data were extracted at the following points:

- Cylindrical settling tanker bait
- Cylindrical settling tanker output
- Vacuum drier feed
- Vacuum drier output

The water content analysis procedure is as follows:

a. For the purposes of each analysis, the oil sample to be used must be preheated at 45-50 ° C so that it is melted and clear, and stirred evenly so that the sample is homogeneous.
b. Clean the petri dishes then dry (if necessary dry in the oven), then cool and weigh (W0).
c. The sample is weighed as much as 10 grams into a petri dish that has been determined by its empty weight, so that the combined weight of the empty petri dish and the sample will be obtained and it is considered as W1.
d. The weighed sample was then placed in an oven at 105 °C for 3.5 hours.
e. Data were taken every 30 minutes. With cooling time in the exactor for each data for 15 minutes and then weighed.

At each data collection, the sample is weighed carefully until it is known that the weight loss is not more than 0.05% every 30 minutes (W2) or visually the heating is considered complete when there are no water droplets sampled in the petri dish.

Calculation analysis

The water content is calculated according to the formula below and is expressed as 3 decimals

$$Water\ Content = \frac{W1 - W2}{W1 - W0}\ x\ 100\ \%$$

Where :
W0 = weight of empty petri dishes, grams
W1 = weight of petri dish and oil sample before oven, gram
W2 = weight of petri dishes and oil samples after oven, gram. While the procedure for analyzing the levels of dirt is as follows:

a. The oil sample to be used must be preheated at 45-50 ° C so that it is melted and clear, and stirred evenly so that the sample is homogeneous.
b. The filter paper was rinsed with n-hexane, then dried for 30 minutes at 100-105 ° C. After that, cool it in an exactor and weigh (W0).
c. The sample was weighed as much as 20 grams into a beaker glass (W1).
d. To the sample, 100 ml of solvent was added and stirred until the sample dissolved completely. Let stand for about 5 minutes so that the insoluble fraction can completely settle.
e. Samples were filtered with filter paper that was free of water and fat, filtering was carried out carefully and quantitatively.
f. Beaker glass and filter paper are washed until they are free of oil or grease. Use a new solvent to remove the remaining oil that is still left on the beaker glass or on filter paper. About 10ml of solvent is used for each rinse and this is done until it is completely clean.
g. The filter paper was dried in an oven at 105 ° C for 60 minutes.
h. The sample was cooled in an exicator for 15 minutes, and weighed until a constant weight (W2) was obtained.
i. Repeat drying, cooling and weighing until constant.
j. Perform the above steps 2 times for each solvent.

Engineering Overview

To determine the performance of the tools in the field, a comparison is needed to evaluate the work results of these tools. The most appropriate comparison is the normal working standard of the tools used. By knowing the standard, evaluation of the work results of the tool in question can be carried out. Therefore, the standard of tools at the clarification station must be clear to describe the problem of high water content and oil production levels at PT ABC PMKS.

RESULTS AND DISCUSSION

Based on the data on the quality of oil produced by PT ABC PMKS, it can be seen that the quality of the production oil in terms of the percentage of moisture content and dirt content is not in accordance with the predetermined standards. As stated in Table 1, the standard percentage of moisture content and dirt content of PT ABC PMKS are 0.15% and 0.015%, respectively. When compared with the standard water content and actual dirt content, the difference will be seen as shown in Fig 1.

From this graph, it can be seen that the average of water content and dirt content during the last six months is 0.176% and 0.019%. This Fig is clearly far above the standard that has been set. Considering that the problem of production oil lies in the high percentage of water content and dirt content, an assessment of tools that have the potential to increase or decrease the percentage of water content and dirt content.

Theoretically, the high water content and dirt content are allegedly influenced by the imperfect performance of the Cylindrical settling tanker, wet oil tank and vacuum drier. In more detail, the high water content in production oil is thought to be caused by the thin oil layer in the cylindrical settling tanker when quoted, the low oil temperature in the wet oil tank, and the imperfections of the vacuum drier. While the cause of the high level of impurities in the production oil is the thin layer of oil on the Cylindrical settling tanker when quoted, the low oil temperature in the Cylindrical settling tanker and too much solid in the tank. To find out where the problem lies with the high water content and the level of oil impurities in the production, it is necessary to analyze the components caused by the high water content and the dirt content.

Clarification Station Testing Data.
The data collected as material in analyzing the causes of high water content and dirt levels are as follows:

a. Cylindrical settling tanker feed data

Table 2. Cylindrical Settling Tanker (CST) Feed Data

Frequency	Feed Data	
	Water Content	Level of Dirt
1	28.74%	37.93%
2	30.49%	34.15%
3	30.488%	34.146%
4	28.736%	47.126%
5	27.174%	41.304%

From Table 2 it can be seen that the average feed water content that enters the Cylindrical settling tanker is 29.125%, while the average level of impurities is 38.93%.

b. Oil data ex Cylindrical settling tanker

Table 3. Oil data ex Cylindrical Settling Tank

Frequency	ex CST	
	Water Content	Level of Dirt
1	1.056%	0.087%
2	1.081%	0.091%
3	1.019%	0.086%
4	1.022%	0.097%
5	1.021%	0.084%

From table 3, it can be seen that the average moisture content and dirt content are 1.039% and 0.089%, respectively.

c. Wet oil tank output oil data

Table 4. Wet Oil Tank Output Data

Frequency	Wet Oil Tank Output	
	Water Content	Level of Dirt
1	0.973%	0.053%
2	0.970%	0.041%
3	0.909%	0.033%
4	0.939%	0.028%
5	0.991%	0.031%

From Table 4, it can be seen that the average yield of water content and impurities from the wet oil tank output are 0.956% and 0.037%, respectively.

d. Vacuum Drier output oil data

Table 5. Vaccum Drier Output Oil Data

Frequency	Vaccum Drier Output	
	Water Content	Level of Dirt
1	0.203	0.018
2	0.198	0.021
3	0.196	0.021
4	0.194	0.023
5	0.193	0.022

From Table 5 the average moisture content and dirt content of the vacuum drier output were 0.956% and 0.037%, respectively.

Oil thickness data for 20 cm

1. Water Content

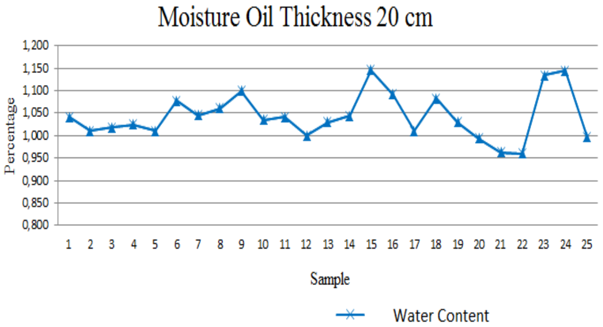

Fig. 3. Water content 20 cm thickness

Based on Fig 3 above, it is known that the average water content of the cylindrical settling tanker output is 1.044%.

2. Levels of Dirt

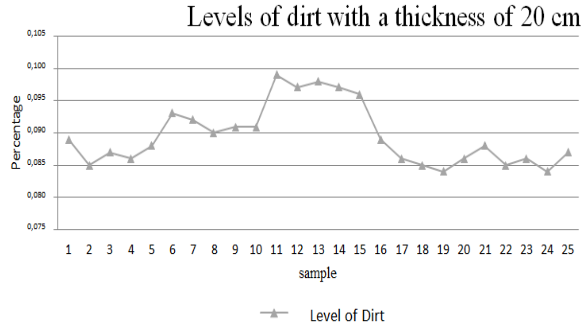

Fig. 4. Levels of dirt oil thickness of 20 cm

 ISSN : 2622-6553 (Online)

Based on Fig 4 above, it is known that the average level of impurities from the cylindrical settling output is 0.091%.

Oil thickness data for 30 cm

1. Water Content

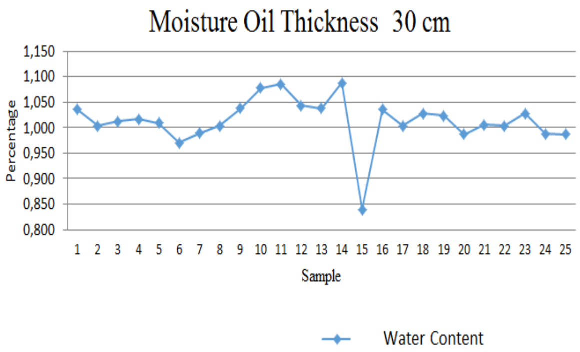

Fig. 5. Water content 30 cm thickness

Based on Fig 5 above, it is known that the average water content of the cylindrical settling output for 30cm oil thickness is 1.013%.

2. Levels of Dirt

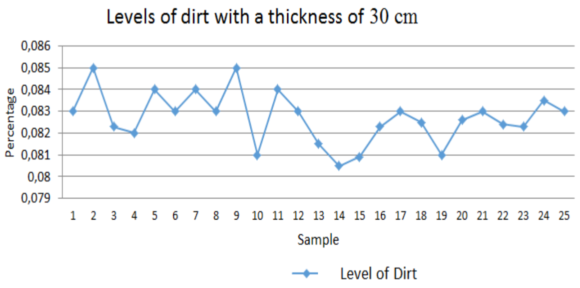

Fig. 6. Levels of dirt 30cm

Based on Fig 6 above, it is known that the average level of impurities from the output of the Cylindrical settling tank for 30cm oil thickness is 0.089%.

Oil thickness data for 40 cm

1. Water Content

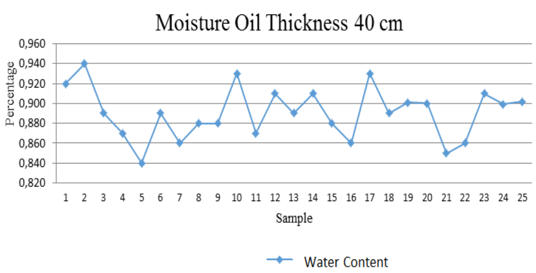

Fig. 7. Water content 40cm

Based on Fig 7 above, it is known that the average water content of the cylindrical settling output for the oil thickness of 40cm is 0.892%.

2. Levels of Dirt

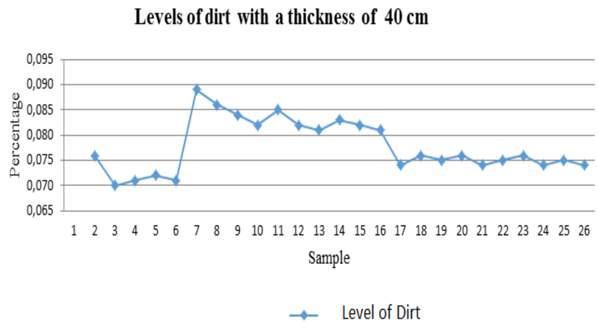

Fig. 8. Levels of dirt

Based on Fig 8 above, it is known that the average level of impurities produced by the cylindrical settling for the oil thickness of 40cm is 0.078%.

Technical Overview

To determine the standard as a working reference in determining the ex-cylindrical settling tanker oil exit standard, a calibration is carried out against the standards from the reference which are compared with the actual in the field. Standard data can be seen in Table 6. While actual data can be seen in Table 7.

Table 6. Standardization

Source	CST Feed		Ex. Skimmer		Oil Tank Output		Vaccum Drier Output	
	Water Content	Level of Dirt	Water Content	Level of Dirt	Water Content	Level of Dirt	Water Content	Level of Dirt
Standard Bakrie			0.6	0.15				
Standard Salim Group	42	8	0.75	0.25				
Standard dari Zairif			0.4 - 0.8	0.2 - 0.4				
Standard Naibaho					0.6 - 0.1	0.4 - 0.6		
Standard PT. SMART			0.8	0.2	0.4	0.02	0.12	0.015
Standard Adi Putra			0.4 - 0.8	0.02 - 0.04	0.3 - 0.4	0.02	0.15	0.01 - 0.017

Source : Bakrie Plantation, Salim Group, Naibaho (1998), PT SMART, Adi Putra (2003)

Table 7. Actual

Frequency	CST Feed		Ex. Skimmer		Oil Tank Output		Vaccum Drier Output	
	Water Content	Level of Dirt	Water Content	Level of Dirt	Water Content	Level of Dirt	Water Content	Level of Dirt
1	28.74	37.93	1.056	0.087	0.973	0.053	0.203	0.018
2	30.49	34.15	1.081	0.091	0.970	0.041	0.198	0.021
3	30.488	34.146	1.019	0.086	0.909	0.033	0.196	0.021
4	28.736	47.126	1.022	0.097	0.939	0.028	0.194	0.023
5	27.174	41.304	1.021	0.084	0.991	0.031	0.193	0.022

Source: Processed data 2011

Based on the data in the table, it is known that the average water content and impurities of the

CST feed were 29.125% and 38.931%, the average output of the Skimmer for moisture content and impurities was 1.039% and 0.089%. The mean Wet Oil Tank output was 0.956% and 0.037%, and the mean moisture content and dirt content of the vaccum drier were 0.196% and 0.021%. From the standards that have been obtained and from the actual data, it can be seen that:

a. Dirt Level

Based on the available data, it can be seen that CST has a bait with a higher level of dirt compared to the standard, which is 38.931% compared to 8%. With the large amount of feed impurities that enter the CST, the output of ex CST oil is still far below the predetermined standard of 0.089% compared with 0.2%. According to the results of a statistical review of the relationship between thickness and dirt content in CST, it was stated that the relationship between thickness and dirt content was 0.036%. So it can be said that in this case the oil thickness performance in CST does not have an effect on the acquisition of impurity levels. The factor that influences the level of dirt when viewed from the data that has been collected is the performance of the wet oil tank because it is not in accordance with existing standards. However, because this study only discusses the effect of oil thickness in CST on CST oil output, this paper does not discuss the effect of the wet oil tank in detail.

b. Water content

The obtained water content can be seen from the amount of feed that enters the CST. The standard feed into CST is 42% with an oil output of 0.8%. From the data collected, it was noted that the bait that entered the CST ranged from 29.126%. However, with the small amount of CST inlet when compared to the standard, this cannot provide an oil output with a water content that matches the standard. It is noted that the average feed that enters the oil output still contains a water content of 1.039%.

In CST, there are several factors which are alleged to affect the water content of CST output oil. These factors include the thickness of the oil. Oil thickness in CST has an influence on the quality of water content of CST output oil. The thinner the oil thickness, the greater the water content of the CST output oil. This is in line with a statistical review of the relationship between oil thickness and moisture content. Where through the calculation of KP obtained a correlation value of 68.794%. This shows that the relationship between thickness and moisture content is very large.

Analysis

From the previous explanation which explains the relationship between oil thickness with dirt and moisture content. Below is a graph of the 20cm, 30cm and 40cm oil level tests for dirt and moisture content.

1. The Relationship Between Oil Thickness And Dirt Levels

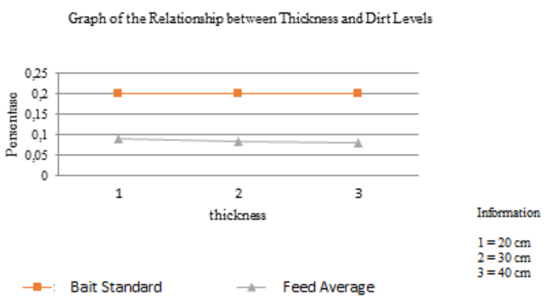

Fig. 9. Relationship between Oil Thickness and Dirt Levels

From Fig 9, it can be seen that the CST output oil has a dirt level below the predetermined standard, namely 0.2%. This shows that the work of CST is maximal in separating the levels of impurities in the oil. If in the end, the oil content in the production of impurities in the oil is not standard, then it is certain that there will be problems with the work of the tools behind the CST.

Although based on the statistical review, the value of the relationship between oil thickness and dirt content is only 0.036%, it can be seen from the data in Graph 10 that the thicker the oil, the lower the dirt content. This means that the thickness of the oil is positive for the contribution of impurities and does not affect the system behind the CST.

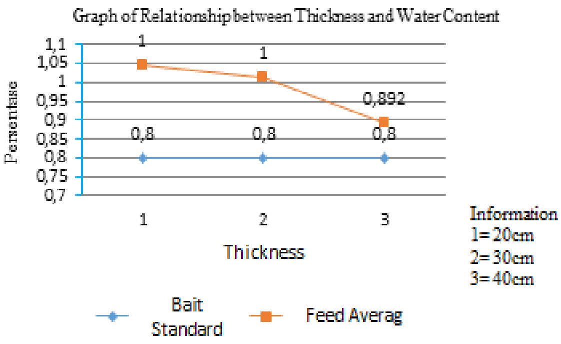

Fig. 10. Relationship between Oil Thickness and Water Content

From Fig 10 it can be seen that, by referring to the standard which is 0.8% for the standard CST output oil, the thickness of the oil that produces CST output oil that is close to the standard is 40cm thick. The graph also shows the relationship between the thickness of the oil and the percentage of the strong water content of the CST output oil. This is indicated by a striking difference between the thicknesses of 20cm, 30cm and 40cm. To find out at what level the water content of the CST output can be in accordance with the standard, namely 0.8%.

CONCLUSION

The conclusion that can be obtained from taking the height / thickness of palm oil is still: it is known that the average water content and the CST feed impurities are 29.125% and 38.931%, the average Skimmer output for moisture content and impurities levels is 1.039% and 0.089 %. The mean Wet Oil Tank output was 0.956% and 0.037%, and the mean moisture content and dirt content of the vacuum drier output were 0.196% and 0.021%.

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