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Variation of Agitator Blades in Continuous Settling Tank to Reduce Oil Losses in Oil Refining Process in Palm Factories

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ABSTRACT

Continuous Settling Tank (CST) is one of the units located at the clarification station where the CST works to separate oil and mud based on differences in specific gravity where the lighter density will go up, namely oil, while the heavy type will settle to the bottom, namely mud. The language here is how to make the construction of the agitator transmission in the Continuous Settling Tank (CST) unit and how the agitator blade influences the oil content contained in the sludge in the Continuous Settling Tank (CST) unit. The method is carried out with variations in the number of blades that open 2, 4 and 6 pieces. The specifications of the equipment data obtained are primary data resulting from the design of the Continuous Settling Tank (CST) tool. Based on the blade obtained two results the percentage of oil content of 10.85%. This shows that there is still oil content in the mud. Likewise, the blade that found four pieces was 8.678%. While on the blade that got six pieces, the average percentage of oil was 7.652%. This shows that the blades that have been opened six pieces have met the desired percentage of oil standards.

I. Introduction

Continuous Settling Tank (CST) is a type of continuous tank that can separate sludge while flow from one tank to another. Sludge separation went well, first tank the liquid was separated into two phases, namely the light phase and the heavy phase. The heavy phase flows from one tank to another through the bottom of the tank while the light phase flows from the top. More tubs that are connected, perfect the separation of oil and sludge, and the higher oil temperature will speed up the separation process. Temperature should be between 80 – 90^0 C. Heating is carried out using steam in closed pipes [1][2].

Oil that floats at the top is extracted through two overflow pipes (skimmers whose ends are in the shape of an inverted cone whose height can be adjusted). Sludge removed from the bottom of the tank slightly above the circular base of the tank cone through a vertical pipe whose end is open, the overflow lip is slightly higher than oil overflow cone lip [4], the height can also be adjusted. The tank is equipped with a stirrer with a vertical axis that rotates slowly, the stir leaf moves in a horizontal shear or cutout plane which apparently has the effect of reducing viscosity [10].

Function of CST is precipitate sludge that is still contained in the oil. Process of sludge deposition in oil in CST is accelerated by heating using steam and stirring. In this way, mud that has a greater specific gravity will settle quickly. The sludge that settles in the CST is channeled to the Sludge Tank (Underflow). Meanwhile, the oil flows to the Pure Oil Tank (Overflow) [5][6].

To determine CST performance is still good, the indicator used is that the oil content in the mud in the underflow must be around 10%. Thickness of the oil layer in the CST can influence the oil

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content in the mud in the underflow. It's recommended that the thickness of the oil layer in the CST be 40 – 60 cm before extracting the oil through a skimmer. Position of the oil skimmer is in the middle of the tank, height of which is usually raised and lowered according to the level of oil in the CST [7][4].

A typical mixer setup is a centrally mounted drive shaft with a thrust drive unit on top of impeller blades mounted on the shaft. A variety of blade designs are used and usually the blade covers about two-thirds of the reactor diameter. Where viscous products are handled, paddle-shaped anchors are often used which have tight clearance between the blade and the vessel wall. Most batch reactors also use baffles. It is a stationary blade that breaks up the flow caused by the rotating stirrer. These may be specified for the vessel cover or installed on the inside of the side walls [5]. An agitator is a tool used to stir a material in a tank so that it is homogeneous with a preset rotation. The term stirring is used for a variety of operations, where the degree of homogeneity of the material being stirred varies greatly [8][9].

Successful operation of a processing process often depends on the effective stirring of the liquid in the process. In this case, the terms stirring and mixing, which are often confused, are actually not synonymous with each other. Stirring (agitation) indicates that it usually depends on the purpose of the processing itself. many processing purposes vary depending on needs [10].

II. The Proposed Method

A. *Test Equipment Data*

Results of data collection on tool specifications on the influence of the number of agitator blades on the oil content in the sludge in the Continuous Settling Tank (CST) unit.

1. Electromotor

Type	: YC 90S-4	Voltage	: 5A
Frequency	: 50 Hz	Rotation	: 1400 rpm
Power	: 1 Hp	Cos Ø	: 0.8

2. Inverter

Type	: ZK800-1.5G1
Input	: AC 220 V – 240 V +/- 5% 50 – 60 Hz
Output	: 1.5 KW 5A 0 – 400 Hz

3. Gear Box

Brand	: WPA
Type	: 40-A
Input Shaft	
Shaft Diameter	: 12 mm
Shaft Length	: 30 mm
Output Shaft	
Shaft Diameter	: 14 mm
Shaft Length	: 44 mm
Colour	: Green
Ratio	: 50:1

4. Continuous Settling Tank

Tube Height	: 60 Cm
Inner Tube Diameter	: 30 Cm
Outer Tube Diameter	: 40 Cm
Inner Tube Volume	: ± 44 Liter
Outer Tube Volume	: ± 36 Liter

B. Materials Used

Materials and functions used in this research are as follows :

1. Plate, functions as a bearing for the electromotor.
2. Elbow, functions to make a motorbike mount.
3. Electromotor, convert electrical energy into mechanical energy.
4. Flange coupling, functions to connect the electromotor shaft to the gear box shaft.
5. Gear Box, functions to reduce rotation.
6. Inverter, to reduce the frequency of the electromotor.

Fig 1. Continuous Settling Tank (CST)

C. Agitator Transmission Construction

1. Agitator Transmission Construction Drawing

Construction drawing of the agitator transmission shown in figure 2 below.

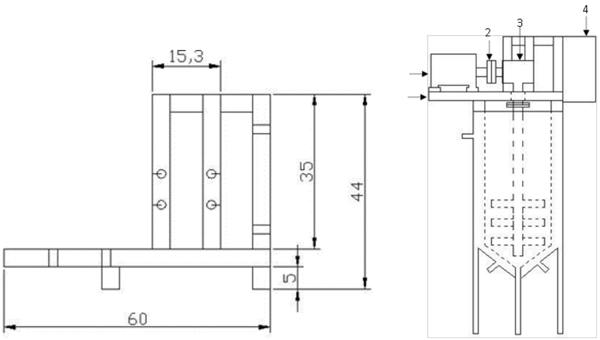

Fig 2. Agitator Transmission Construction

D. Procedure for Making Agitator Transmission Construction

Fig 3. Making the Agitator Transmission Construction

III. Large oil content in the continuous settling tank (CST) unit

Test the effect of the number of agitator blades on the oil and sludge separation process in the vertical continuous tank unit by changing the number of agitator blades. The inverter tool is set, then the stirring time is calculated using a stopwatch, and the temperature is determined using a heater within a predetermined limit. This test was carried out 3 (three) times and the results of this test were obtained.

After conducting experiments on a vertical continuous tank, sludge (mud) is taken as a sample to be tested using the tool FOSS NIRS DA 1650.

A. Sludge Sample Testing Procedure Using the FOSS NIRS DA 1650 Tool to Determine the Oil Content in Sludge

Procedures carried out for testing sludge samples using the FOSS NIRS DA 1650 tool to determine the oil content in the sludge are as follows:

1. Put the sludge sample into the cup. Figure 4. shows a picture of a sludge sample in a cup.
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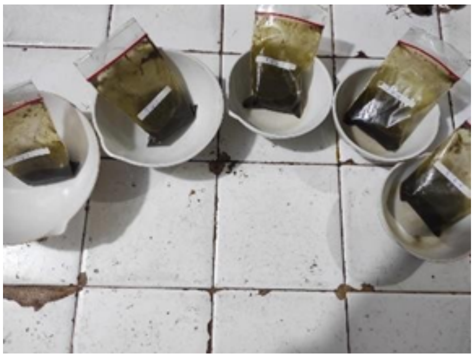

Fig 4**.** Until the sludge is in the cup

3. Put the sample in the oven for 5 minutes at 90°C. Then after 5 minutes, the sample was removed from the oven. Figure 4.9 shows a picture of the sample in the oven.

Fig 5. Sludge Sample in the Oven

4. Then place the sample cup into the FOSS NIRS tool and then add the sludge sample. Figure 4.10 shows a picture of a sludge sample being put into a sample cup.

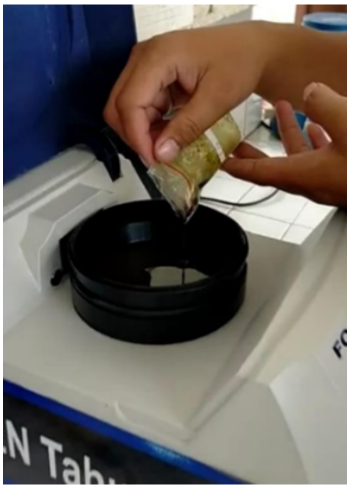

Fig 6. Sludge sample is put into the sample cup

5. Turn on the FOSS NIRS DA 1650 tool then set the tool to sample underflow VCT (sludge)

6. Wait until the results appear on the digital screen of the FOSS NIRS tool. Figure 7. Picture of the results of testing a sludge sample on the FOSS NIRS tool.

Fig 7. Sludge Sample Test Results on the FOSS NIRS Tool

8. After the results come out, record the results of the analysis in the table.

9. Carry out the same procedure by testing sludge samples on 4 and 6 blade tables starting from number 2 to 8.

B. Testing Using 2 Blades

The samples that were taken were tested using a FOSS NIRS DA 1650 tool to determine the oil content in the sludge. Table 4.1 shows the results of sample testing using the FOSS NIRS DA 1650 tool

Table 1. Sample Test Data Number of Blades 2

No	Date	Sample Sludge	Volume Sample (ml)	Temperature (^{0}C)	Oil/ WM (%)	VM (%)	NOS (%)
1	27 June 2024	J.2.1	20	90	11,28	81,51	7,21
2	27 June 2024	J.2.2	20	90	10,77	79,38	9,85
3	27 June 2024	J.2.3	20	90	11,78	82,17	6,05
4	27 June 2024	J.2.4	20	90	10,15	78,47	11,39
5	27 June 2024	J.2.5	20	90	10,27	79,67	10,06
		Average			10,85	80,24	8,912

In table 1, there is test data for two sludge samples on blades using the FOSS NIRS DA 1650 tool. There were five samples tested and the average results for oil/WM were 10.85%, VM was 80.24. % and NOS of 8.912%. From the data above we can conclude that the sludge sample, namely oil/WM, does not meet the oil percentage standard because there is still a lot of oil contained in the sludge. This is caused by uneven mixing.

C. Testing Using 4 Blades

The samples that were taken were tested using a FOSS NIRS DA 1650 tool to determine the oil content in the sludge. Table 2. results of sample testing using the FOSS NIRS DA 1650 tool.

Table 2. Sample Test Data Number of Blades 4

No	Date	Sample *Sludge*	Volume Sample (ml)	Temperature (^{0}C)	Oil/ WM (%)	VM (%)	NOS (%)
1	28 June 2024	J.4.1	20	90	8,80	80,70	10,50
2	28 June 2024	J.4.2	20	90	8,92	81,57	9,51
3	28 June 2024	J.4.3	20	90	8,45	80,61	10,95
4	28 June 2024	J.4.4	20	90	9,18	81,29	9,54
5	28 June 2024	J.4.5	20	90	8,04	79,60	12,36
Average					8,678	80,754	10,572

D. Testing Using 4 Blades

The samples that were taken were tested using a FOSS NIRS DA 1650 tool to determine the oil content in the sludge. Table 3. results of sample testing using the FOSS NIRS DA 1650 tool.

Table 3. Sample Test Data Number of Blades 6

No	Date	Sample *Sludge*	Volume Sample (ml)	Temperature (^{0}C)	Oil/ WM (%)	VM (%)	NOS (%)
1	29 June 2024	J.6.1	20	90	6,26	80,19	13,55
2	29 June 2024	J.6.2	20	90	7,55	79,70	12,75
3	29 June 2024	J.6.3	20	90	8,48	80,29	11,23
4	29 June 2024	J.6.4	20	90	7,23	78,99	13,78
5	29 June 2024	J.6.5	20	90	8,74	80,34	10,92
Average					7,652	79,942	12,446

E. Effect of the number of agitator blades on the oil content in the sludge

Graph of the oil content in the sludge in the Continuous Tank unit based on the difference in the number of agitator blades.

Table 4. Oil Level Data

Sample	Blade Agitator Number	Oil Level (%)
J.2	2	10,85
J.4	4	8,678
J.6	6	7,653

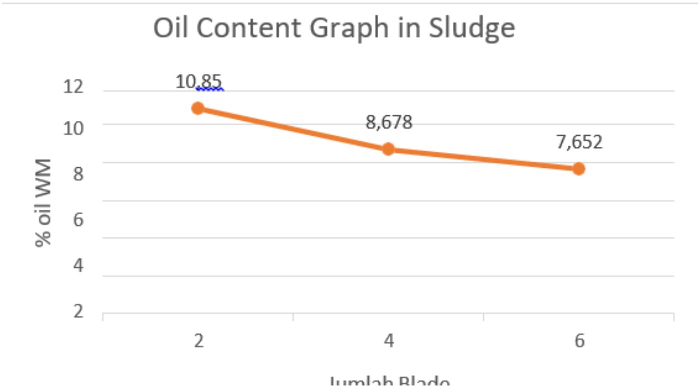

Fig 8. Graph of % Oil Content Effect of Number of Blades on Sludge

Overall results of calculating the oil content in the sludge are based on the difference in the number of agitator blades in the continuous tank unit. The oil content contained in the J.2 sludge sample with two agitator blades was found to be an average percentage of 10.85%. This shows that the two blades do not meet the oil percentage standard, because there is still a lot of oil contained in the sludge. This is also caused by uneven mixing.

In sample J.4 with four blades on the agitator, the average oil content percentage was 8.678%. This shows that the four blades are close to the standard oil percentage. Meanwhile, in sample J.6 with six blades on the agitator, the average oil content percentage was 7.652%. This shows that the six blades have met the desired oil percentage standards due to even mixing.

Based on Figure 8 graph of the average percentage of oil content in the sludge, it can be seen that the oil content in the sludge decreases with different blade numbers. This shows that the number of agitator blades greatly influences the results of extracting sludge in the Continuous Tank. The more blades on the agitator, the lower the oil content in the sludge in the Continuous Tank unit.

Apart from that, for sludge that still contains oil content in Continuous Tank unit, there are also several factors that influence the percentage of oil content in the CST unit, including processing capacity in the CST unit, rotation speed, heating temperature, agitator used and cleaning on continuous tank units.

IV. Results and Discussion

After testing the sample in the Continuous Tank unit on sample J.2 with two agitator blades, the oil percentage was 10.85%, where there was still a high oil content included in the sludge. And in sample J.4 with four agitator blades, the oil percentage was 8.678%, where there was still oil content included in the sludge. Meanwhile, in the J.6 sample with six agitator blades, the percentage obtained was 7.652%, where the oil content included in the sludge met the standard oil percentage. This shows that the greater the number of blades, the lower the oil content included in the sludge.

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