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EVALUATION MODEL FOR WWTP FEASIBILITY PALM INDUSTRY IN WEST SUMATERA
(Case of PT. Binapratama Sakatojaya South Solok)

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ABSTRACT: This research is motivated by the collapse of the WWTP pool PT. Binapratama Sakatojaya South Solok, namely pond Anaerobic pond 2 which occurs due to very high rainfall and lasts a long time, so that the embankment cannot hold the volume and discharge of wastewater at that time. The company is required to repair the broken embankment and conduct a feasibility study of the embankment conducted by the independent PPKLH UNP team. The purpose of this study is to analyze and provide recommendations on the feasibility of WWTP PT. Binapratama Sakatojaya South Solok. Primary data collection is done by surveying the location of the study, water sampling, testing the quality of wastewater, ground water and surface water and soil sampling. Secondary data used include maps (administrative maps, maps of plantation locations, and maps of PT. Binapratama Sakatojaya Selatan Solok and land applications). The research findings reveal: (1) There was no water pollution from the analyzed water samples either wastewater, ground water and surface water which were sampled on June 20, 2019. (2) Making wooden pile on the inside of the embankment that serves to hold the soil or restrain the entry of water into the dug hole. (3) The embankment used has met the strong requirements for shear and rolling both in conditions without earthquake loads and with earthquake loads.

Keywords: Feasibility of WWTP, Broken Down, Environmental Pollution

1. INTRODUCTION

PT. Bina Pratama Sakato Jaya South Solok is part of the Incasi Raya Group which is engaged in agribusiness in oil palm plantations and processing. Implementation of environmental management and monitoring of PT. Binapratama Sakatojaya South Solok which includes oil palm plantations and mill activities including Ambient Air Quality, Noise, Liquid Waste, Solid Waste, B3 Waste, Domestic Waste, Job Opportunities, Community Income, Occupational Safety and Health, and Forest and Land Fires.

Waste generated by the palm oil mill PT. Binapratama Sakatojaya South Solok from plantation activities such as oil palm fronds which are used to prevent erosion as well as mulch, while solid waste generated from palm oil mill activities in the form of shells, fibers, empty cages (Tankos), Abu Boiler and Solid. Solid waste in the form of a Shell is accommodated in a temporary shelter inside the factory to be used together with Fiber as boiler fuel, while Solid and Empty Fruit Bunches are reused for organic fertilizer (mulch) for plants.

On November 3, 2018 one of the IPAL pools of PT. Binapratama Sakatojaya South Solok collapsed, namely anaerobic pond 2. This happened because of very high rainfall and lasted a long time, so the embankment could not hold the volume and discharge of wastewater at that time. This is what underlies the authors to conduct this research. The purpose of this study is to analyze and provide recommendations on the feasibility of WWTP (wastewater treatment plant) PT. Binapratama Sakatojaya South Solok.

2. RESEARCH METHOD

Primary data collection is done by surveying the research location, water sampling, testing the quality of wastewater, ground water and surface water and soil sampling. Secondary data used include maps (administrative maps, plantation location maps, and PT. Binapratama Sakatojaya Selatan Solok South location and land application) and land application schedules application (streaming schedule). Water sampling will be carried out at 5 points, namely WWTP Inlet, WWTP Outlets, Well Monitored Residents Settlements, Sungai Pauh and Sungai Suir. Data analysis was performed by testing water samples. The results are in the form of water quality data that have been obtained from analyzes in the UPTD laboratory. West Sumatra Provincial Health Laboratory Center presented in the form of a table, comparing with environmental quality standards.

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3. RESULTS AND DISCUSSION

3.1. Wastewater Quality

Table 1. Location and Physical Properties of Palm Oil Waste Water Companies

No	Sampling Points	Coordinate point	Temperature	Information
1	Inlet WWTP (Sludge Pit)	S 1023'29.4612" E 101035'41.568"	48,2^{0}C	Very murky, brownish black, foul smelling, many deposits
2	Outlet WWTP (Buffer Pond)	S 1023'40.8192" E 101035'44.3724"	37,9^{0}C	Turbid, Smelled, There are deposits

Table 2. Palm Oil Company Wastewater (Inlet and Outlet WWTP)

No	Parameter	Value (Inlet WWTP)	Value (Outlet WWTP)	Quality Standards Permen LH RI No. 5 Year 2014	Quality Standards Kepmen LH No. 29 Year 2003	Unit
1	BOD5	14.219	143	100	Maks. 5000	mg/l
2	COD	48.172	681	350	-	mg/l
3	Oil and Fat	2.096	28	25	-	mg/l
4	Total Nitrogen (as N)	535	321	50	-	mg/l
5	DO	0,8	2	-	-	mg/l
6	TSS	10.800	210	250	-	mg/l
7	pH	4,33	7,77	6 – 9	6 – 9	-

From the above table it can be seen that the liquid waste of the palm oil industry of PT. Binapratama Sakatojaya South Solok contains very high organic matter, namely for BOD of 14,219 mg/l and COD of 48,172 mg/l, so the levels of contaminating material will be higher. In general, the impact by the palm oil industry wastewater, which is the contamination of receiving water bodies which are generally rivers, because almost every palm oil industry is located near the river. Palm oil industry wastewater if left unprocessed will form ammonia, this is because the organic material contained in the liquid waste decomposes and forms ammonia. Ammonia that is formed will affect the life of aquatic biota and can cause a foul odor [1] [2] [3].

BOD or Biochemical Oxygen Demand is a characteristic that shows the amount of dissolved oxygen needed by microorganisms (usually bacteria) to break down or decompose organic matter under aerobic conditions [4][5][6]. Reiterated again by [7] [8] [9].that organic material decomposed in BOD is organic material that is ready to decompose (readily decomposable organic matter).

COD or Chemical Oxygen Demand is the amount of oxygen needed to break down all organic matter contained in water [10][11][12]. This is because the organic material is intentionally decomposed chemically using a potent oxidizer of potassium bichromate under acidic and hot conditions with a silver sulfate catalyst [13][14][15]. so that all kinds of organic materials, both easily decomposed and those that are easily broken down complex and difficult to decompose, will oxidize. Thus, the difference in value between COD and BOD gives an idea of the amount of organic material that is difficult to decompose in the waters. It could be that the BOD value is the same as the COD, but the BOD cannot be greater than the COD. So COD illustrates the total amount of organic matter that exists.

It can be seen from the table above that the initial quality of waste (prior to management) has very high BOD, COD, Oil and Fat, Total Nitrogen (as N) and TSS values, and very low DO values. While the value of the Palm Oil WWTP outlets has greatly decreased, this proves that the WWTP from PT. Binapratama Sakatojaya is still going well. Referring to RI LH Candy No. 5 of 2014 for the value of BOD, COD, Oil and Fat and Total Nitrogen (as N) at the WWTP outlet of PT. Binapratama Sakatojaya exceeds value standard quality. However, the BOD value and pH have been categorized as safe to be applied to the land as determined in the Minister of Environment Decree No. 29 of 2003. The high BOD value is due to the processing in anaerobic ponds, namely the overhaul by microorganisms has not yet happened perfectly. This aims to maintain organic material in the waste to be applied to the land, and this is what influences so the DO value is low.

This high nitrogen content is maintained as an important nutrient for oil palm plant fertility. As for the pH value, it shows a value of 7.77 where this value falls within the normal pH range. Nopianto (2010) explains that anaerobic ponds occur pH neutralization by recirculating waste output from anaerobic ponds to the anaerobic pond's input trench so that the overhaul of organic acids by anaerobic bacteria occurs optimally. The normal pH value in the wastewater test results in the anaerobic pool shows that the waste treatment in the anaerobic pool (the last WWTP pond) has been going well so that this pH value does not directly affect the environment.

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The cause of the high concentration of pollutants in wastewater that is the object of treatment, so that excess mud immediately builds up in biologically stable ponds (anaerobic ponds-aerobic ponds) and as a result, the residence time needed at treatment is not met according to design values. In addition, as another factor, it was also raised the reason for the unstable burden of pollutants into this treatment system. Thus, it is necessary to periodically dispose of excess mud that has accumulated. In addition, compared to the initial design, if the production volume has increased, the volume of pollutant load will also increase, because it is necessary to revise work standards, for example increasing the frequency of disposal of excess sludge and floating oil and others.

3.2. Analysis of the Effect of Land Application on Groundwater Quality

This groundwater quality data is the quality of ground water on the application land which is used as a control to show groundwater quality in the area. Groundwater quality data can be seen in the following table:

Table 3. Location and Physical Characteristics of Groundwater (Monitor wells for Human Settlements)

No	Sampling Points	Coordinate point	Temperature	Information
1	Air Sumur Pantau Pemukiman Penduduk	S1^{0}23'53.9628" E01^{0}35'3.48"	26,5 ^{0}C	Clear, clear, no odor

Table 4. Groundwater Quality (Well Monitor Population Settlement)

No	Parameter	Value	Quality Standards Permenkes No.32 Year 2017	Quality Standards Permenkes No. 416 Year1990 Lamp. II	Unit
1	BOD_5	0,680	-	-	mg/l
2	COD	<9,91	-	-	mg/l
3	Oil and Fat	<0,100	-	-	mg/l
4	Ttl Nitrogen (as N)	9,15	-	-	mg/l
5	DO	8,5	-	-	mg/l
6	TSS	3,00	-	-	mg/l
7	pH	5,08	6 ,5- 8,5	6,5 – 9,0	-

The quality of the water body will affect the condition of the surrounding well water quality. According to the Republic of Indonesia Minister of Health Regulation No. 416/MENKES / PER/IX/1990 concerning Requirements and Supervision of Water Quality, which is meant by clean water is water that is clear, colorless, odorless, tasteless, and does not contain minerals / germs that are harmful to the body. Based on the Decree of the Minister of Health of the Republic of Indonesia No. 1405/MENKES/SK/XI/2002 concerning Health Requirements for Office and Industrial Work Environment, there is an understanding of clean water that is water used for daily needs and its quality meets the health requirements of clean water in accordance with applicable laws and regulations and can be drunk if cooked.

Based on Table 4. shows that the results of the examination of the quality of well water there is one parameter that is not in accordance with the Quality Standards in the parameters of the Minister of Health Regulation No.32 of 2017 and the Quality Standards of the Minister of Health No. 416 of 1990 Lamp. II Water Quality is the pH parameter.

The low pH value is due to the factor of fertilization that contributes to the entry of organic material into ground water.

3.3. Analysis of the Effect of Land Application on Surface Water Quality

Surface water quality is the quality of river water that lies between oil palm plantations and PT. Binapratama Sakatojaya taken from downstream and upstream to determine whether there is an influence of land application on surface water. Surface water quality can be seen in the following table:

Table 5. Location and Physical Properties of Surface Water Quality

No	Sampling Points	Coordinate point	Temperature	Information
1	Pauh River Water	S 1023'36" E101036'53"	27^{0}C	Clear, clear, no odor
2	Suir River Water	S 1023'14.56" E101039'12.84"	27,7^{0}C	Clear Yellowish, Somewhat Turbid, No Odor

Table 6. Surface Water Quality (Pauh River Water and Suir River Water)

No	Parameter	Value Pauh River Water (downstream)	Value Suir River Water (Upstream)	Quality Standards Pergub Sumbar No. 5 Tahun 2008	Quality Standards PPRI No. 82 Tahun 2001Kelas II	Unit
1	BOD5	0,680	1,35	3	3	mg/l
2	COD	<9,91	<9,91	25	25	mg/l
3	Oil and Fat	<0,100	<0,200	0,75	1	mg/l
4	Total Nitrogen (as N)	4,90	5,40	-	10	mg/l
5	DO	5,8	4,5	>4	4	mg/l
6	TSS	7,00	8,00	50	50	mg/l
7	Ph	7,78	5,42	6,0 – 9,0	6,0 – 9,0	-

The table shows that surface water in the area does not experience pollution which can be seen from the value of several parameters that do not exceed the threshold, such as BOD, COD, Oil and Fat, Total Nitrogen (as N), and TSS. This indicates that contamination from waste originating from the application land and from WWTP does not have a negative impact on surface water, because the river is the lowest part of the land, groundwater or runoff that flows from the application land and the Palm Oil Parcel will end up in the river.

Table 7. Results of river water analysis

No	Parameter	Satuan	Baku mutu	Rona awal air sungai Suir (Hulu)	Rona awal air sungai Suir (Hilir)	Aliran sungai tidak terdampak(hulu)	Aliran sungai terdampak(hilir)	Air Sungai Pauh-batas kebun	Air Sungai Suir	Air Sungai saluran air terakhir dari titik jebol
1	Suhu	'C	dev.3	26,4	26,3	24,2	24			
2	Bau		-	Tidak berbau	Tidak berbau	Tidak berbau	Tidak berbau			
3	Rasa		-	Tawar	Tawar	Tidak berasa	Tidak berasa			
4	Warna	TCU	-	1	1	3,945	7,074			
5	Kekeruhan	NTU	-	4,02	5,09	82,2	167			
6	TSS	mg/L	50	8	8	38	52	58	60	780
7	pH		6-9	7,66	7,72	8,24	7,94	6,3	6,85	6,05
8	DO	mg/L	4	7,5	7,7	6,11	6,13	6,2	6,7	3,2
9	BOD	mg/L	3	3,2	3	0,43	0,38	1,64	0,9	63,2
10	COD	mg/L	25	8,87	10,33	5	3	15,7	6,88	353
11	Total fosfat	mg/L	0,2	0,039	0,037	0,0491	0,0758	0,305	0,042	1,177
12	Amoniak	mg/L	(-)	0,066	0,061	0,07	0,085			
13	Nitrat	mg/L	10	0,098	0,051	1,823	1,823	3,06	2,38	4,72
14	Nitrit	mg/L	0,06	0,004	0,004	0,043	0,066	0,022	0,017	0,081
15	Sulfat	mg/L	(-)	10,74	10,54	29,83	9,07			
16	Kadmium	mg/L	0,1	0,001	0,001	0,0002	0,0002	0,003	0,003	0,003
17	Tembaga	mg/L	0,02	0,038	0,044	0,0012	0,0272	0,019	0,019	0,019
18	Besi	mg/L	(-)	0,165	0,137	2,7391	4,4966			
19	Timah Hitam	mg/L	0,03	0,152	0,246	0,0158	0,0166	0,002	0,002	0,002
20	Mangan	mg/L	(-)	0,009	0,012	0,0427	0,0517			
21	Air raksa	mg/L	2	0,02	0,02	0,0038	0,0042			
22	btal colifor	mg/L	5000	8	23	18	18			

*Rona awal titik sampling hulu dan hilir sungai Suir di dalam dokumen DELH

From the above data we can see that there has been a very significant decrease in the quality of river water affected by a broken WWTP taken on 12 June 2019. The TSS content (quality standard: 50 mg/L) has decreased from 780 mg/L, 60 mg/L, and 58 mg/L to 52 mg/L, the BOD value has decreased from 63.2 mg/L to 0.38 mg/L, COD value has decreased from 353 mg / L to 3 mg/L, Phosphate content has decreased from 1.17 mg L to 0.07 mg/L, Nitrite content has decreased from 0.08 mg/L to 0.06 mg / L and has been below the river water quality standard. The company will continue to conduct periodic monitoring and recovery efforts so that the aquatic environment after the WWTP collapses back to normal. Sampling of aquatic biota Furthermore, for aquatic biota, samples taken in the river flow are not affected as upstream and the river flow is affected as downstream according to directions from the environmental service living district.

One of the lotic waters is the river. The existence of oil palm plantations / mills in the area around the river will certainly have an impact on physical, chemical and biological factors in the waters. One of the biological factors that can be used as indicators of water pollution is plankton and benthos.

The plankton group that dominates in these waters is the Bacillariophyceae class, followed by the Chlorophyceae group and the lower class of the Euglenophyceae group. In general, that the phytoplankton group by type, was found to be quite high compared to the zooplankton group. That in the order of the food chain, this result is sufficient to support the life of organisms in the body of water.

Judging from the density (K) and Relative Density (KR) of plankton that at the observation point upstream and downstream areas in the waters of the Suir River in the WWTP location is around 105.00 ind./l and 73.93 ind./l. These results can reflect that the waters have a fairly varied density and prevalence.

Seen from the diversity (H) type that at the observation point upstream and downstream of the Suir Tributaries is 2.61 and the Downstream 1.89. The species diversity index of each sampling location is quite high. These results can reflect that the waters are still stable. This means that there is no excessive population development of certain types of plankton. This can also be supported by the equality of each population.

Based on the Mitchael Criteria (1978), the diversity index of plankton in rivers in the WWTP locations surveyed is still classified as moderate. Thus, it can be said that the environmental quality of the identified river waters is in good condition (scale 5).

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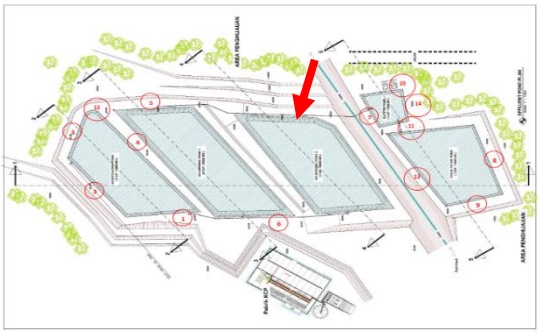
Feasibility Analysis of PT. Binapratama Sakatojaya South Solok

PT. Binapratama Sakatojaya South Solok with the following data:
Length: 81 meters
Width: 75 meters
Height: 6 meters
Volume: 81m x 75m x 6m = 36,450m3

The results of the natural period of the soil are associated with earthquake vibrations
T (average) = 0.8 (short period, medium land)



Embankment height
(H) = 6 m (According to data in the field)

Figure 1. Pieces of dykes

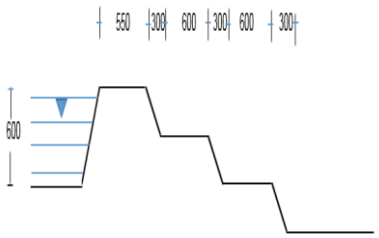


Figure 2. Lengthwise section of embankment in the field

Embankment Analysis - The stability of the embankment wall
Load Combination 1 (without any earthquake wave acceleration)

From the observation data, the maximum water level recorded was up to 6 m. Assume pool water height = embankment height, h = 6 m. So that we can know the amount of hydrostatic force exerted by water:

$Fh = ½ .\rho_{air} .g . h^2$
$Fh = ½ . 1010\ kg/m^3 . 9.8\ m/s^2 . (6\ m)^2$
$Fh = 178.164\ kg$

If we assume the height of the embankment is equal to the height of water H = 6 m and the stability of the embankment will be sought for 1 m width of the embankment, if the width of the embankment is assumed to be a prism height then the volume of the embankment (Vprism) can be sought by the formulation:

$V_{prisma} = L_{alas} .t_{prisma}$
$V_{prisma} = ½ . (B1+B2). H .l$
$V_{prisma} = ½ . (5.50+8.50) .6 . 1$
$V_{prisma} = 42\ m^3$

With the size of the dike like that, it will produce gravity on the dike in the form of gravity with the formulation as follows:

$W = m_{wall} .g$
$W = \rho_{wall} .V_{prisma} .g$

From the results of the soil testing lab (0.75 x 3.23 tons / m3, due to disturbed soil), ρwall = 2.4 tons / m3, the gravity force is used: (g = 9.8 m / s)^2
$W_1 = 2.4*103\ kg/m^3*42m^3*9.8\ m/s^2 = 987,840Kg$
Then the embankment that is given a hydrostatic force by water will give a reaction force in the form of frictional force of magnitude:

$Ff = \mu . W$

For ρwall = 2,4 ton/m^3, the frictional force is:

$Ff_1 = \mu . W_1 = 0,4 . 987.840\ Kg = 395.136\ Kg$

Requirements:

Stability of the dike wall against sliding (sliding):

$Ff > Fh$ → **(Secure)**

Where:
$Ff_1 = 395.136\ Kg$
$Fh = 181.800\ kg$

395.136 Kg > 178.164 N (Safe against sliding)

Because of the measurement results it turns out that Ff is greater than Fh, the dike is stable to shear.

Case combination II (taking into account the earthquake wave acceleration)

Earthquake data:

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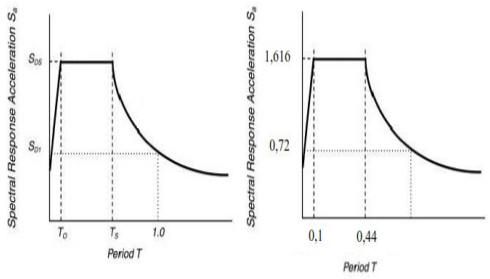


Surface period = 0.1 second. (Earthquake SNI for Dam Pd T-14-2004-A)
Location: South Solok
Land Type: Soft.

Calculation of earthquake load with equivalent static method, SNI1726-2012 for earthquake safe structure planning

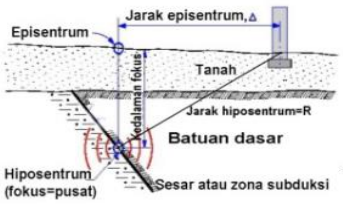
The virtue of the building
Article 4.12 Table 2 page 15 Building embankment = 1 for the risk category I
Types of soil according to table 3 Article 5.3 p. 17-18 types of soft soils
Then: Vs <175 at Vs30
Determine the value of C earthquake coefficient earthquake coefficient

T0	= 0,2 (SD1/SDS)	
Ts	= SD1/SDS	
SMS	= 0,9 x1,2	= 1,08 g
SDS	= 2/3 x1,08	= 0,72
SM1	= 2,4 x1,01	= 2,429
SD1	= 2/3 x2,429	= 1,616
T0	= 0,2 (0,72/1,616)	= 0,08

Atau

SD1	= 0,6 xFaxSSa	= 0,6 x0,9x1,12	= 0,7
SDS	= 1,6 xFaxSS	= 1,6 x0,9x1,12	= 1,161

Article 6.10.4 figure 20
The risk category in the short period is 0.50 <meaning the 4D category (table 6 pg 24)
Building ductality is full ductality R = 1.6 (embankment building)
Building period Ta = 0.8 seconds Article 7.8.2.1.



From the above response spectrum calculations with soft soil conditions, the location in the southern Solok area with a risk level of 1 and the priority level of the building is assumed to be = 1 and the level of performance of the full elastic embankment is obtained C = Sds (r) / T, where Sds (r) = SD X Tc

Calculation of earthquake load:
V = C x I x W x 1 / 8.5
V = 0.88 x 1 x 987,840kg x 1 / 8.5 = 102,270 kg
F earthquake (earthquake load) = 102,270 Kg

Requirements:
Stability of the dike wall against sliding (sliding):
Ff> (Fh + F earthquake) □ (Safe)

Where :

Ff_1	= *395.136 Kg*
Fh	= *178.164 Kg*
F gempa	= 102.270 Kg

395.136 Kg* >178.164*Kg +102.270 Kg
***395.136 Kg* > 284.070 Kg (Safe against sliding)**

Conclusion: from the results of the analysis the value of Ff is greater than (Fh + F earthquake), the dike is stable to shear.

Dike wall stability against overturning:
Load Combination 1 (without earthquake earthquake acceleration)
Requirements:
*W * ½ * b > Fh * 1/3 * h → against the bolster against point A*
From the results of the soil testing lab (0.75 x 3.23 tons / m3, due to disturbed soil), ρwall = 2.4 tons / m3 is used
987.840 Kg ½ *8.5m ... 178.164Kg * 1/3 * 6*
4.198.320 Kg > 356.000 Kgm ***(Safe against sliding)***

Case combination II (taking into account earthquake wave acceleration)

*W * ½ * b > (Fh * 1/3 * h)+(F earthquake * 6m)→ against the bolster against point A*

987.840 Kg ½ *8.5m((181.800Kg + 102.270Kg)*1/3* 6)*
4.198.320 Kg > 568.160 kg
4.198.320 Kgm > 568.160 Kgm
(Safe against sliding)

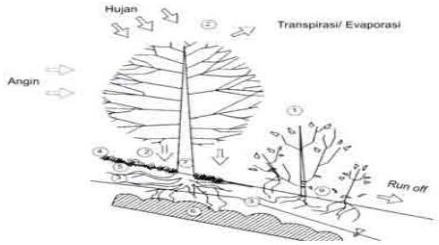
3.4. Increased Ground Shear Strength

Natural factors, one of which is rain water has a big role in the occurrence of surface erosion. Rain is very influential on the stability of the slope namely the intensity and duration of rain, where high rainfall intensity and relatively long duration can cause runoff.

Runoff is the part of rainwater that flows from the catchment area to the river, lake or sea. Runoff consists of surface runoff and ground water runoff. Rain, in relation to soil movement is related to soil surface conditions. For example, heavy rains cause a large surface runoff, which can trigger

landslides on loose soil layers. Ground water runoff, related to rain is an increase in groundwater level as a result of rainwater infiltration.

According to [16][17] plant roots can increase the shear strength of the soil and plant roots can bind soil particles so it is not easy to carry erosion. Rain is captured by trees (leaves/canopy) and then rain water is transmitted to the ground by shrubs. Rainwater will seep in the ground so that it reduces runoff. Soaking rainwater into the soil will fill the ground aquifer.



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will be held by:

1. Soil cohesion which depends on the type of soil and its density, but does not depend on the normal stress acting on the shear plane,
2. Friction between grains of soil whose magnitude is directly proportional to the normal stress in the shear plane

The destructive power of water that flows above the surface of the land will be greater with the longer slope of the ground surface. Plants that live above the surface of the soil can improve the ability of the soil to absorb water and reduce the strength of rain-destroying grain, as well as the dispersion and transport capacity of water flow above the ground surface. The treatment or actions that humans give to the soil and plants on it will determine the quality of the land. The role of vegetation for slope stabilization is:

1. The role of the canopy for storing interception water reduces the amount of rainwater that reaches the ground surface, reduces the amount of infiltrated water and the fulfillment of soil moisture. The higher / heavier density of the canopy's ability to capture rainwater in the form of interception water is also greater.
2. Root morphology, various types of vegetation are characterized by diverse root systems. On sloping lands, vegetation with deep roots and many root fibers is needed. This will increase the traction of the soil by the roots and will be able to reduce the likelihood of soil movement increasing the shear strength of the soil.
3. Evapotranspiration, In areas that have high rainfall intensity, the process of evapotranspiration plays a role in reducing soil saturation so that there is no accumulation of water in the impermeable layer which will actually be the slip material in shallow landslides.

One of the plants that can be used to strengthen the soil shear strength is grass and bamboo. Grass plants and bamboo is a vegetation that is easy to grow in all soil conditions, besides that this plant is a type of fiber which is a cushy or natural net.

4. CONCLUSION

From the results of wastewater, ground water and surface water, it can be seen that water pollution does not occur. This proves that the management of palm oil mill effluent has been treated properly. In other words the Waste Management Pond of WWTP PT. Bratratama Sakatojaya South Solok is Still Eligible For Use. The embankment at the IPAL pond of PT. Binapratama Sakatojaya South Solok, has met the strong requirements for shear and rolling both in combination I (without earthquake load) and combination II (with earthquake load) conditions. Based on the study results of the analysis of the strength of the embankment obtained Safety Factor 1.4 for AP2 Waste Pool, that based on the 2012 SNI for slope and embankment stability is categorized as SAFE.

5. REFERENCES

[1] Boyd, C.E. 1990. Water quality in ponds for aquaculture. Alabama Agricultural Experiment Station, Auburn University, Alabama. 482 p
[2] Eril Arioristanto, Laporan Analisis Pembuatan Tanggul (Gravity Retaining Wall), Fakultas Teknik Sipil dan Lingkungan, ITB, 2015
[3] Hermon, D. Geografi Lingkungan: Perubahan Lingkungan Global. UNP Press. 2010.
[4] Hermon, D. Mitigasi Bencana Hidrometeorlogi: Banjir, Longsor, Degradasi Lahan, Ekologi, Kekeringan, dan Puting Beliung. UNP Press. Padang. 2012.
[5] Greenway, D.R., 1987. Vegetation and Slope Stability – Geotechnical Engineering and Geomorphology, John Wiley and Sons. Chichester
[6] Keputusan Menteri Negara Lingkungan Hidup Nomor 28 Tahun 2003 tentang Pedoman Teknis Pengkajian Pemanfaatan Air Limbah dari Industri Minyak Sawit Pada Tanah di Perkebunan Kelapa Sawit.
[7] Metcalf and Eddy, Inc. 1991. Wastewater Engineering: treatment, disposal, reuse.3rd ed. (Revised by: G. Tchobanoglous and F.L. Burton). McGraw-Hill,Inc. New York, Singapore. 1334 p. Umaly, R.C. dan Ma L.A. Cuvin. 1988. Limnology: Laboratory and field

guide,Physico-chemical factors, Biological factors. National Book Store,Inc. Publishers. Metro Manila. 322 p.

[8] Hermon, D. Geografi Bencana Alam. Jakarta: PT RajaGrafindo Persada. 2015.

[9] Hermon, D. Mitigasi Perubahan Iklim. Rajawali Pers (Radjagrafindo). 2016.

[10]Hermon, D. Climate Change Mitigation. Rajawali Pers (Radjagrafindo). 2017.

[11]Hermon, D. Mitigation and Adaptation: Disaster of Climate Change. Sara Book Publication. India. 2019

[12]Nopianto, Eko S. 2010. Analisa Potensi Biomassa Pada Pabrik Pengolahan Kelapa Sawit PT. Inti Indosawit Subur, PMKS Tungkal Ulu Tanjung Jabung Barat, Provinsi Jambi. Laporan Praktek Kerja Lapangan Jurusan Teknologi Industri Pertanian Fakultas Teknologi Pertanian Institut Pertanian Bogor. Bogor. IPB

[13]Peraturan Pemerintah Republik Indonesia Nomor 82 Tahun 2001 Tentang Pengelolaan Kualitas Air dan Pengendalian Pencemaran Air.

[14]Peraturan Menteri Lingkungan Hidup Nomor 5 Tahun 2014 Tentang Baku Mutu Air Limbah Bagi Usaha Dan/Atau Kegiatan Industri Minyak Sawit.

[15]Peraturan Pemerintah (PP) RI No. 82 Tahun 2001 tentang Pengelolaan Kualitas Air dan Pengendalian Pencemaran Air.

[16]Perhitungan beban gempa dengan metode statis equivalen, SNI 1726-2012 untuk perencanaan struktur aman gempa

[17]Riyanto, 2016. Rekayasa Vegetatif untuk Mengurangi Risiko Longsor. Balai Penelitian Dan Pengembangan Teknologi Pengelolaan Daerah Aliran Sungai