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The Stabilization Effect of Peat Soil Using an Effective Microorganism Reviewed from CBR Value

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Abstract-The behavior of peat soil physical characteristic and mechanism is extremely influenced by the decomposition degree. The higher the decomposition degree, the faster the compaction process, and the occurrance of land subsidence is smaller when the peat soil received a load. One of the ways used to accelerate decomposition process is by adding a decomposer microorganism that could parse the fiber of peat soil. The purpose of this study is to know a physique range alteration and mechanism of the peat soil fibrous reviewed from the enhanced value of CBR after it is stabilized using Effective Microorganism (EM). The volumes of EM which inserted and combined with the peat soil are variations of 20% and 40% that ripened for 14 and 21 days. The process of mixing peat soil with EM is done by using water content closed to the weight volume of original peat soil obtained from the standard proctor test, thus it is close to its original condition. The results showed that EM affects the physical characteristic and mechanism of peat soil. The most optimal percentage of EM would result in the maximum decomposition rate. The most significant change in the physical characteristic and mechanism of peat soil is EM solution for 40%, and The maximum decomposition rate occurs at the 14-day ripening period. The fiber content is reduced from 60% to 52%, and decomposition rate 0% fiber/day to 0,57% fiber/day. The increase value of unsoaked CBR from 3.28% to 7.47% and in soaked condition 3.01% to 6.11%.

Keywords- *The Soil Peat Fibrous, Decomposition, Effective Microorganism (EM), CB*

I. INTRODUCTION

South Kalimantan has a pretty abundance of peat soil, predicted as 475.628.000m^3 and spread in four districts, including Banjar, Tapin, Hulu Sungai Utara, and Balangan [1]. According to Ma'ruf and Yulianto (2016), the large peat soil area represents an obstacle in developing infrastructure territory. The peat soil is a very soft soil with low bearing capacity, and has an ease compressed feature if there is weight load on it. Therefore, the peat soil is a land problem that needs to be repaired [3].

The physical characteristic and mechanism of peat soil are influenced by the decomposition value's degree. If the higher the decomposition degree, the lower the fiber content within. Less fiber content may cause the compressed process become faster and the land subsidence become smaller when the land receives a load [4]. The decomposition of peat soil is often obstructed because the bacterium that decomposed lignin and cellulose decomposition on peat soil is limited. Another main problem is the acidity level of peat. Most bacteria live in a neutral optimum pH, while those that can survive in acidic conditions are limited [5].

According to Prativi (2018), one way to speed the decomposition process in acquiring the degree of a higher peat soil decomposition is by adding decomposer microorganisms which is able to parse cellulose and lignin of peat soil fiber [4]. The Effective Microorganism (EM) is a bacterium that can live in acid condition and decompose cellulose and lignin until the ripeness level of peat or decomposition process decomposition can be accelerated. In construction field, the peat soil condition with high decomposition degree is needed to avoid the land compression after the construction operates. Yusof et al. (2018) use Effective Microorganism (EM) as a mixture of peat soil stabilization reviewed from the Unconfined Compressive Strength test (UCS) [3]. They found that there is additional 10% of EM with controlled water content controls for 50%, which can increase the significant UCS value of peat soil for 44% up to 65% after rippened for 21 days.

Therefore, this study has objective to improve the peat soil stabilization using eco-friendly material, that is Effective Microorganism (EM), because it is able to speed up the decomposition process of peat soil. This study aims to describe the influence on physical change and power enhancement of peat soil with Vane Shear test and California Bearing Ratio (CBR) test.

II. METHODOLOGY

The sample of peat soil takes in Malintang, Tipe A Gambut Barakat terminal in Km.17 Gambut district, Banjar regency, South Kalimantan, Indonesia. The test samples are fiber peat soil widely spread in Banjar Regency. The retrieval of land samples conducts in two ways; disturbed and undisturbed. The disturbed sample gets manually to use strainer because the peat soil has submerged water. While taking an undisturbed sample uses the *paralon* pipe because a sample of peatland belongs to the highly tender soil.

The Effective Microorganism (EM) uses is the EM4 of conventional farming shapes and easy obtain liquid in the farm market. The composition of Lactobacillus sp. bacteria as 1,09 x 107cfu/ml and Saccharomyces sp. bacteria as 4,30 x 10^7cfu/ml are the functional bacteria remodels a material organic such as *selulolitik* and *lignolitik* with a negative *patogenisitas.*

The sample of initial peat and compost with the mix of Effective Microorganism (EM) is done the physique nature test and mechanism. All of the laboratories activity to test physique parameters and mechanisms will do in the Laboratory of Soil Mechanics Faculty of Engineering, Lambung Mangkurat University, Banjarbaru.

The total amount of test sample for every analysis in this research was 156. The standard used to test the water content of organic soil was ASTM D 2974-87. ASTM D 2974-87 also used to test the organic content. Organic content is a part of the burnt peat soil in the temperature of 440℃, which then obtained the ash content with the comparison of ash mass towards the dry weight of oven 105℃. While, the remaining is consideredas the organic percentage.

A. The standard used to test of weight volume (γ) was ASTM D 4253-91.

B. The Limit Atteberg Test

In *atteberg* examination of limit peat soil was not drying on air then pounded, however a direct spread out and testing of limit *atteberg*. Because the land of peat would not absorb the water again. The limit *atteberg* examination done was PL, LL, and PI tests. The standard used to do a limit *atteberg* was ASTM D 4318-84.

C. The Specific Gravity Test (Gs)

In the land of specific gravity, examination needs to be oven on 105℃ to dispose of all of the land water rate. Then, the land filter with no. 40. This experiment did not use the pipe water on the usual experiment but used *kerosen* because the pipe water cannot precipitate peat soil, meaning the air cavity cannot enter by the pipe water. The standard used by doing an examination was ASTM D 854-83.

D. The Fiber Rate and Fiber Distribution of Peat Soil Test

The standard used to do this experiment was ASTM D 1997-91.

E. The Standard Proctor Test

The standard discussed of examination was ASTM D 698.

F. The Vane Shear Test

The standard examined of test was SNI 03-2487-2008 referred to ASTM D 2573-72.

G. The CBR Test

The standard discussed of test was ASTM D-1883.

The stabilization method used in this study was based on the weight of dry (v/w). The first weight volume test was to know the weight volume of initial peat soil from the undisturbed sample. After knowing the value of weight volume, the peat of land disturbed, and then doing the proctor standard compaction test to know the water rate needs to be mixed with taking the value of drier content weight approached the weight value of peat soil initial volume. We used that water rate as the mix control of the design water rate was controlled. Then, prepare a mixture of Effective Microorganism (EM) with the variation of volume 20% and 40 %. The stir of each aqueous Effective Microorganism (EM) the concentration to the peat soil, afterward mix evenly used by hand. The peat of land had stabilized with the variation of Effective Microorganism volume, then closed with plastics and put hole above as the curing air of survival the bacteria.

III. RESULTS AND DISCUSSION

Based on Table 1, the peat soil is classified as the hemic fiber based on the degree decomposition, as the medium ash peat based on the ash content value of H4-H6 type in Von Post scale.

A. The Influence towards a Fiber Content Value (Fc)

In the sample with adding an Effective Microorganism (EM) of 40% showed the most decreased of fiber content was 52% in 14 days and 49,33% of curing periods in 21 days mean as much as 18% of fiber test sample decomposed from the first condition, if compared with the percentage 20% EM = 53,33% in 14 days and 52,67% of curing periods on 21 days reduction of 12%. It was similar to the result of research by [4] that said to fast decomposition, peat soil can to parse lignin, and cellulose was the main element formed of peat fiber. The decreased fiber content amount curing periods on 21 days indicated in the long curing periods of test sample then higher of decrease fiber content happen. Corresponding by Kalantari & Prasad, 2014 research that the long curing periods, during sustainability save of decomposer microorganism guaranteed then it was getting bigger of fiber content would decompose.

B. The Influence of Decomposition Content

In figure 2, the fiber content of the test sample experienced a decrease significate on curing periods up to 14 days. Because the decline of fiber content happened a pretty large in curing periods, many bacterial in Effective Microorganism (EM) activated to process the lignin decomposition and cellulose on the fiber of peat soil in the curing process. It showed the maximum decomposition rate in curing of 14 days.

TABLE I. THE RECAPITULATION RESULT OF EM INFLUENCE TOWARDS THE TEST SAMPLE.

Parameter	Unit	Initial	EM20%-14	EM40%-14	EM20%-21	EM40%-21
γ	t/m^3	1.06	-	-	-	-
LL	%	114.30	92.71			
PL	%	NP	NP	NP	NP	NP
PI	%	-	-	-	-	-
Gs	%	1.86	1.20	1.27	1.28	1.26
e	%	6.46	4.14	4.08	4.04	3.80
w natural	%	326.56	-	-	-	-
Ac	%	13.98	11.59	10.46	10.58	9.75
Oc	%	86.02	88.41	89.54	89.42	90.25
Fc	%	60.00	53.33	52.00	52.67	49.33
-Rough Fiber	%	52.10	49.70	45.82	48.68	43.69
-Medium Fiber	%	26.60	31.10	42.50	32.87	42.54
-Soft Fiber	%	21.30	19.20	11.70	18.45	13.77
w_{opt}	%	61.52	59.79	57.32	56.75	56.04
γ dry max	t/m^3	0.82	1.01	1.29	1.23	1.38
CBR unsoaked	%	3.28	4.91	6.63	5.32	7.47
CBR soaked	%	3.01	3.72	6.09	4.41	6.11
Vane Shear Test	kPa	55	72	98	84	106
Classification (ASTM D 4427-92)		*Hemic, Medium Ash Peat*				

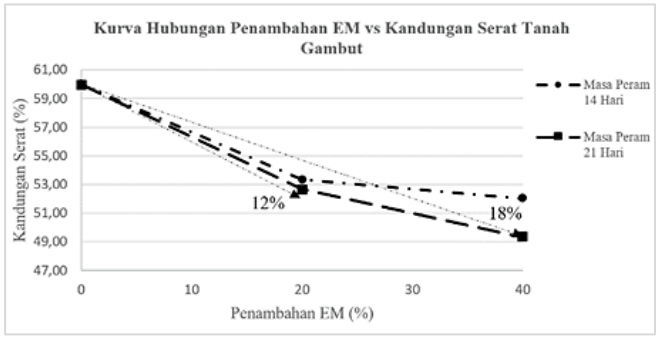


Figure 1. Replenishment Influence of Effective Microorganism towards the Amount of Fiber Content Peatland

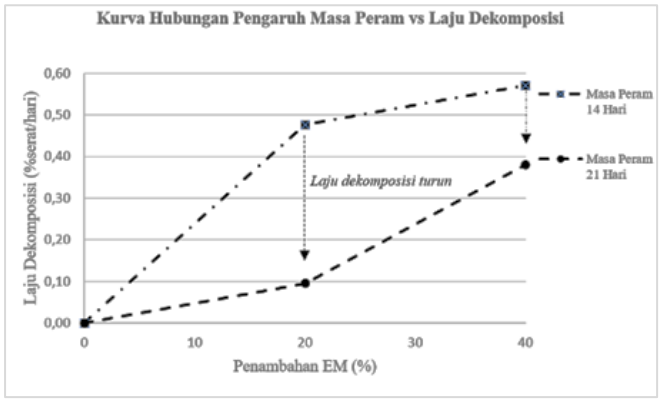


Figure 2. The leverage of Curing Periods towards the Amount of Peatland Fiber Content

Subsequently, with increasing the curing periods up to 21 days, reduction of fiber content seems less. It showed that getting the curing periods, the possibility of bacteria total in Effective Microorganism (EM) capable of living, in the sample become less, then the rating process of decomposition slows down.

C. The Impact towards value of Void Ratio (e)

The curve of relation influenced of curing periods towards vid ratio value (e) in Figures IV.3, the value of the void ratio (e) at first when Microorganism (EM) added up to curing periods 14 days tend to decrease in the value of tiny vid ratio around 2% only. The value of specific gravity (Gs) peat on EM20% and EM40% curing of 14 days was not much different was 4.14 and 4,08. The differences on curing of 21 days, the value of void ratio expertized a pretty significant increase. It can be seen from the peatland sample that adding EM20% and EM40% curing of 21 days had a constantly void ratio value of 4,04 and 3,80. Intercalation EM20% caused the reduction of void ratio (e) of 37%, while EM40% of outstanding was 41%. The fiber of peat soil decomposes results of other Effective Microorganism (EM) caused the value of specific gravity (Gs) when the sample dropped, so the value of void ratio also passed.

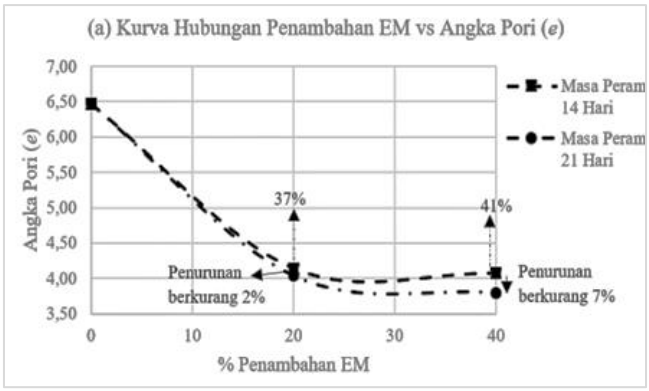


Figure 3. The Influence of additional EM towards e

D. The Effect of Ash Content Value

Concerning curve effected curing towards ash levels value (Ac) in Figures 4, the value of ash content (Ac) every test sample constantly was decreased. The peat of soil added EM20% during curing that experienced a reduction of 17,1%, and up to curing periods 21 days of 8,7%. Reduction of ash content value (Ac) the great happened on test sample add EM40%, was decreased 25,2% during the curing 14 days and up to down in 6,79% on curing periods 21 days. Miskiyah & Widaningrum, 2010 in Karina et al., 2019 said that ash content showed the material's great mineral content because a mineral was an organic substance not burned during the combustion process. Getting high of ash content generated then it higher the mineral content. Puspitasari & Mohammad, 2009 said that microorganisms needed a specific mineral to growth and metabolize. It verified that increasing the value of ash content

(Ac) on the test sample affected the bacteria viability in Effective Microorganism (EM) to cause the decomposition rate on test sample also experienced the reduction.

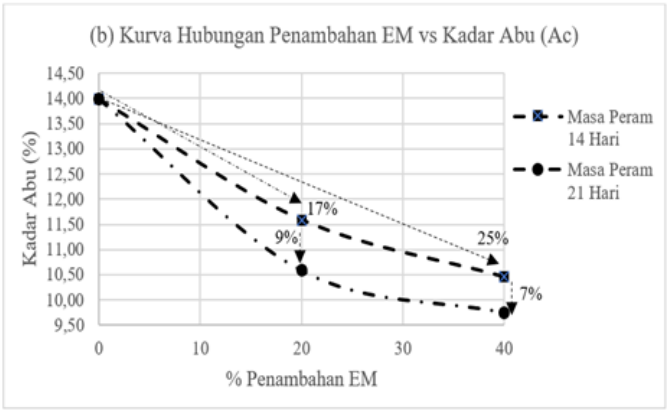


Figure 4. The Effect of Additional EM towards Ac

E. The Leverage towards Value of Organic Rate (Oc)

The relation curve affected curing periods against the value of organic content (Oc) in Figures IV.5 showed that the percentage of organic (Oc) on every test sample encountered an escalation. It was an augmented EM20% and constantly improving 2,78% and up to 21 days of curing as much as 1,14%. The organic rate increment (Oc), the prominent test sample that happened on additional samples 40% EM, was profuse of 4,09% and constantly improved during the curing in 21 days of 0,79%. The higher the organic levels (Oc), the better the soil if reviewed from the activity of soil biochemical, the organic rate also influenced peat pH value. It identified the effectiveness of Effective Microorganism (EM), especially the EM4 purposed in this study, increased the peat fertility by reorganizing an organic material transform into organic elements.

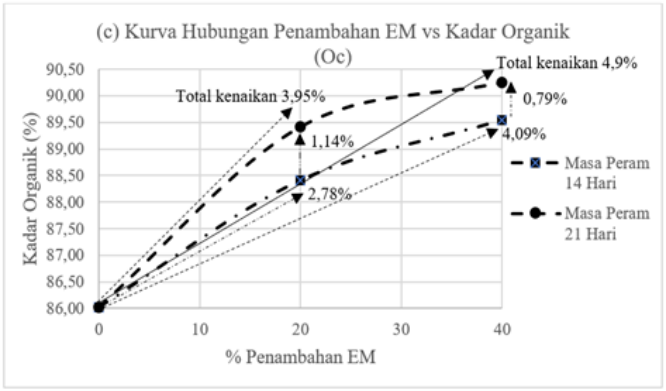


Figure 5. The Influence of additional EM towards Oc

F. The Affect towards The Su Value of Vane Shear Test

In curve, relation added Effective Microorganism (EM) towards vane shear value in figures IV.6, enhancement of shove strength value from the great of vane shear test added EM20% and EM40% in curing periods 21 days was constantly 84kPa and 106kPa.

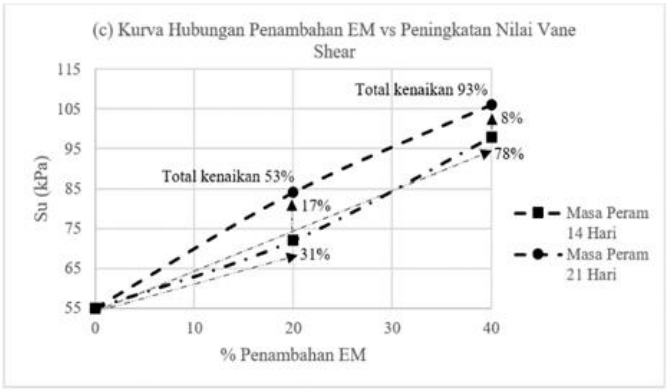


Figure 6. The Influence of Additional EM towards shear strength undrained (Su) from vane shear test

G. The Impact towards CBR Value

In curve, relation added EM versus the value CBR escalation of the test sample on Figures IV. 7, about the curve relation of curing towards CBR value, can be known that great of CBR value showed on test sample add Effective Microorganism (EM) 40% in curing 21 days around 7,47% to unsoaked condition and 6,11% to soaked condition. Escalation of the great CBR value happened on the test sample of unsoaked condition CBR added EM40% on curing 14 and 21 days. Proving that an Effective Microorganism (EM) improved the strength of peatland viewed from the enhancement of CBR value.

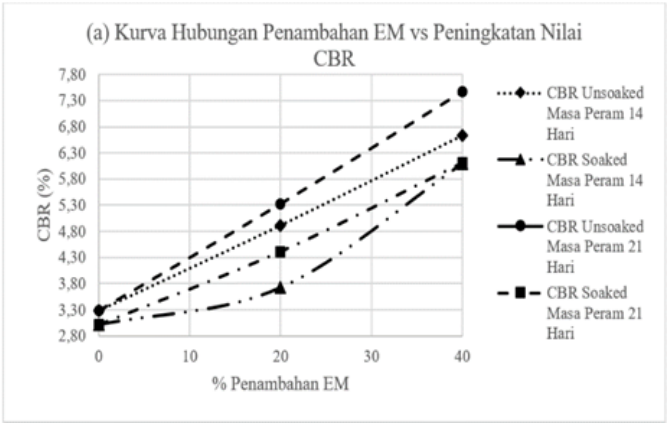
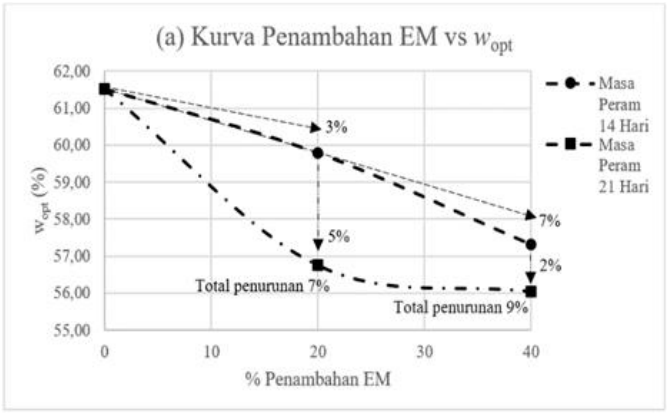


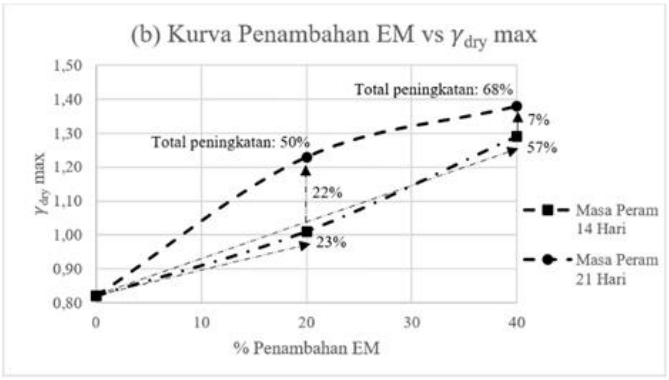
Figure 7. The Impact of Additional EM towards Increment of CBR value.

H. The Influence towards Compact Value

In Figures IV.8(a), always happen the reduction of optimum water content value (w_{opt}) in the test sample added EM, it was similar with the study by Karisma, 2012, the significant percentage added then it would bigger of decreasing. In line with enhancement of CBR value, because it was optimum of the smallest water content value than bigger of the weight value of drier content the maximum (γ_{dry}) getting from solidification test (Figures 8 (b)).



(a)



(b)

Figure 8. The Influence of Additional EM towards Compact Value

IV. CONCLUSION

The study aims to know about the peat soil stabilization effect using eco-friendly material reviewed from CBR value. The resuls showed that The peat soil from Malintang, Type A Baccarat Peat terminal in km.17, Gambut District, Banjar, South Kalimantan is classified as hemic fiber peat soil based on its decomposition degree and as medium ash peat based on its ash content value types H_4-H_6 according to Von Post scale. Moreover, it is found that adding EM can reduce the amount of peat soil fiber content for about 40% with rippened duration for 14 days. The life-span of the bacterium within EM can be reduced if the rippened duration is longer and the decomposition rate will be slow.

Decomposed peat soil fiber because of EM caused the specific gravity value (Gs) on the sample decreased and the void ratio value (e) also decrease. While the decrease of ash content (Ac) affect the life-span of the bacteria that may lead to the slow decomposition rate.

1) The percentage of organic content (Oc) in every test sample had increased. The organic rate increased (Oc) the great in test sample happened on the additional sample 40% EM was 4,09% and up to increase during the curing in 212 days of 0,79%.
2) The improvement of the great CBR value showed on sample test the additional of Effective Microorganism (EM) 40% during curing of 21 days was 7,41% to unsoaked condition and 6,11% to soaked condition.
3) The improvement of slide strength value from vane shear test showed on the test sample added EM40% in curing 21 days was 106kPa.
4) The value of optimum water content dropped (w_{opt}) on the test sample that added the Effective Microorganism (EM), the more significant percentage added then the largest falls. It was the most significant of drier content weight value maximum (γ_{dry}) obtained from the compaction test.

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