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STUDY EXPERIMENTAL OF WASTE UTILIZATION BOTTOM ASH AS MATERIAL STABILIZATION IN PEAT SOIL

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Abstract

Soil is geological material that is in the earth's crust that is used as a working medium or to build buildings on it. Construction on peatlands has the potential to be damaged because the carrying capacity of peat is very low and has high water content, resulting in a very large subsidence. Efforts to be made are chemical stabilization using coal waste from combustion, namely bottom ash. This study used peat soil samples taken from Tanjung Palas, Dumai City. Then the peat soil samples were tested for their physical and mechanical properties in the geotechnical laboratory. There have been many studies using chemicals as peat soil stabilizers, but the use of bottom ash for peat soil in Dumai City has never been done. From the results of this study, it turns out that bottom ash can increase the bearing capacity of peat up to 2.4% in a mixture of 40% bottom ash 60% peat.

Keywords: Peat, Bottom Ash, Stabilization, CBR.

INTRODUCTION

Approximately 30 million hectares in this world are covered in peat. (Adon et al., 2013) Dumai City is one of the cities that is quite large in the territory of Indonesia and is developing quite rapidly in the Riau area. Duami City has a tropical climate with rainfall between 1 to 3 cm and air temperature 24 – 30 C, with the majority of the soil conditions being peat swampland with a depth of 0 to 10 M. (Srihandayani, 2017)

Soil is the basis of civil building construction that functions to receive and withstand a load of a structure above it. In peat soil, there are two main problems. First, the problem of low soil bearing capacity and second, the problem of a large settlement. Another characteristic of peat soil, which is also not profitable, is that it has a high-water content. To overcome this, soil improvement efforts are needed through soil stabilization efforts. Stabilization by chemical means has been widely carried out, and the chemicals that are often used are cement and lime. Chemicals can also be obtained from the factory or industrial waste that can be used as soil stabilization, for example, waste from burning palm shells, namely Bottom Ash. Dumai City is an area of the palm oil agribusiness sector that has rapid development in Indonesia. Besides its development, the solid waste generated in the processing of fresh fruit bunches will increase. The waste is in the form of the rest of the production of crude palm oil; empty coir bunches and palm shells, which are used as boiler material to produce mechanical energy and heat. The problem caused by the remaining boiler fuel is in the form of bottom ash, which is increasing and has not been used optimally. Therefore, this study aims to utilize bottom ash as a soil-

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stabilizing agent by knowing the composition of the bottom ash needed to increase the bearing capacity of peat soil. Soil is a material that plays an important role in construction, so a soil with adequate technical properties is needed so that the construction remains solid. Soils with weak bearing capacity need to be improved physically by mixing the soil with chemicals or mechanically by providing synthetic reinforcement. Peat soil is formed from the process of weathering and decay of organic matter in waterlogged conditions. Peat soil has a high organic content value, a large void ratio and porosity as well as high water content, a large pore number and porosity value and a high water content causing the soil to easily experience compression. (Mochtar, 2014). The porosity of peat soils is relatively high, generally, in the range of 70% - 95%, a large porosity value indicates a large permeability coefficient value (Estu Yulianto, 2017). Peat has a large shrinkage property; this shrinkage property is strongly influenced by the water content in the soil. High shrinkage flowers are bad if they experience changes in water content (Purnama & Ridwan, 2018) Peat soil that has low bearing capacity requires a stabilization process to be able to meet the technical specifications of construction design. The use of chemicals is an option to get satisfactory results. One of the studies that have been carried out using chemicals is the use of DIFA SS on peat soil which aims to increase the bearing capacity of peat as a subgrade so that the use of crushed stone as a foundation layer is reduced.(Srihandayani et al., 2019)Burning palm shells in the boiler will produce waste in the form of dust (ash). According to its size, dust waste is divided into two, namely, fly ash and bottom ash. Bottom ash is waste ash whose size is larger than fly ash, so bottom ash will fall to the bottom of the furnace (boiler). The choice of using Bottom Ash is based on the availability of Bottom Ash, which is quite abundant from the burning of palm shells in industrial areas and some of the chemical constituents in Bottom Ash such as Si, Al, Ti, Ca, and Fe has a role in binding negative particles on the surface. Soil. The use of two types of bottom ash silica-alumina for power generation in Spain is used as a stabilizing material for road works. From the test results in the laboratory, it was found that the CBR value reached 30% for a mixture of bottom ash 15% to 40% of the weight of the soil, thereby increasing the bearing capacity and reducing its plasticity (López López et al., 2015). In addition, the use of bottom ash 5% to 30% on expansive soils can change the characteristics of the soil and increase its bearing capacity (Devi et al., 2018)

Construction on the ground is difficult, soil stabilization needs to be done because soil stabilization is a soil processing process to maintain or improve soil performance as a construction material (Dhakar & Jain, 2020). Soil stabilization through mechanical and physical techniques can be done by reducing the pore rate through compaction (ASTM, 1992) (Zaliha et al., 2013). The use of fibrous reinforcement and geomaterials that cannot be decomposed or physically alter the grain size also involves adjusting the particle size composition of the soil (ASTM, 1992). Through chemical engineering, stabilization can be done using chemicals and emulsions because they function as compaction aids, binders, water repellents and also modify soil behaviour. The reaction between chemical additives and soil particles can bind soil grains through a strong network, resulting in better quality soil compared to mechanical and physical techniques, because higher strength, durability and soil quality can be achieved (ASTM, 1992).

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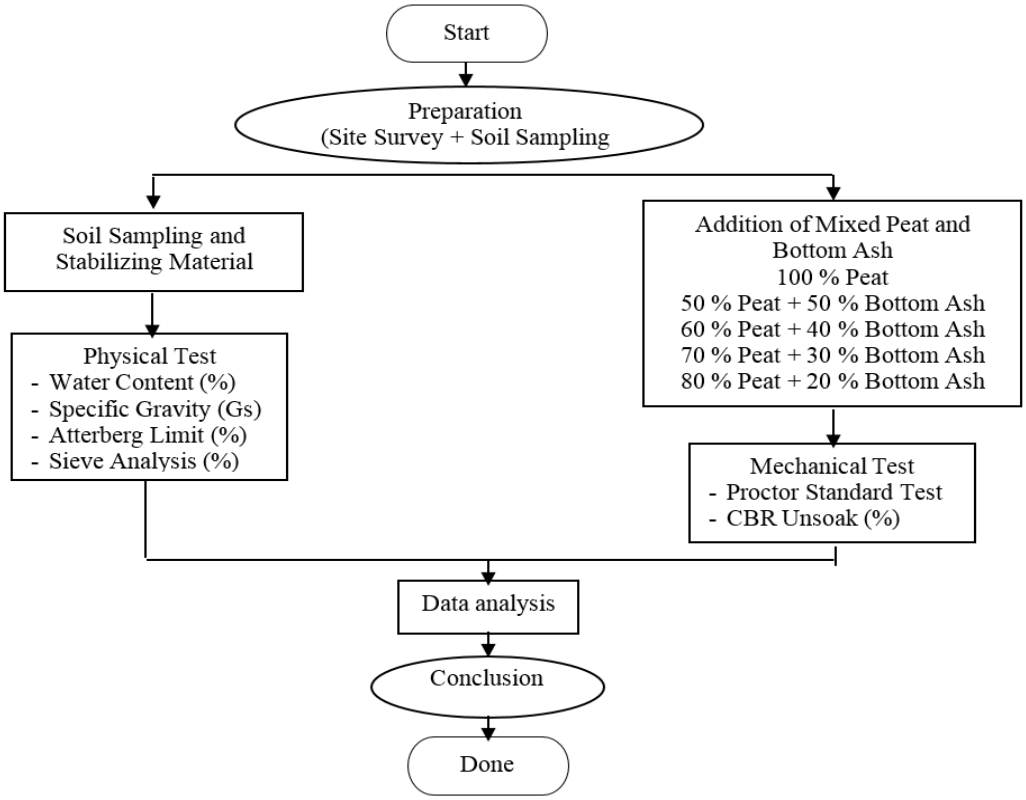
METHODOLOGY

To obtain the desired results, this research begins with a literature study, site survey, and preparation of testing tools and materials. The soil sample used was peat soil from Tanjung Palas, Dumai Riau. The material used as a mixture is Bottom Ash waste taken from PT. Wilmar Nabati Group Dumai. Variations in the use of materials by mixing peat soil that has been cleaned from plant roots, dried by drying.

Table 1: Variation of Mixed peat, Bottom Ash from the dry weight of soil

Variation	Soil Description
1	100 % Peat
2	50 % Peat + 50 % Bottom Ash
3	60 % Peat + 40 % Bottom Ash
4	70 % Peat + 30 % Bottom Ash
5	80 % Peat + 20 % Bottom Ash

The observed modifiers included testing of physical characteristics, which included tests of water content, specific gravity, soil consistency limits, and grain size analysis. Meanwhile, the mechanical characteristic testing includes standard proctor test (maximum dry soil volume weight and optimum moisture content) and CBR test. The CBR test was carried out without soaking (Unsoaked), because the moisture content of the peat soil sample was very high, with a treatment time of 4 days before testing.



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RESULT AND DISCUSSION

The results of testing the physical properties and compaction for each soil variation are presented in Table 2

Table 2: Physical and Mechanical Test Results of Peat

Soil description	w (%)	Gs	γd_{max}	w_{opt} (%)	CBR (%)
100 % Peat	239,3	1,5	1,6 kN/m^3	225,2	0
50 % Peat + 50 % Bottom Ash	128,5	1,8	2,2	126,4	2,3
60 % Peat + 40 % Bottom Ash	130,7	1,76	1,9	128,7	2,4
70 % Peat + 30 % Bottom Ash	179,2	1,73	1,8	165,7	1,3
80 % Peat + 20 % Bottom Ash	189,6	1,6	1,6	184,2	1,2

Physical Test

The high-water content of peat soil weakens the carrying capacity of the soil, with the addition of bottom ash in each variation of the mixture causing the density of the mixture to increase and the water content to decrease, because bottom ash absorbs and fills the pores of the peat soil and the water contained in the soil pores comes out.

Mechanical Test

Table 2 shows the increase in the maximum dry soil volume along with the addition of variations in the stabilization mixture and the density of the mixture also increased. The CBR value obtained depends on the water content at the time of compaction. When the soil is at the optimum moisture content, the maximum dry density is obtained and the maximum CBR value is obtained. The maximum dry density obtained is very dependent on the property index of the peat soil. The CBR value obtained from this study is still below the soil standard as the base layer, namely the mixture of Peat 60% Bottom ash 40% of 2.4%.

CONCLUSION

The conclusion that can be drawn from this research is that the use of bottom ash can change the physical and mechanical properties of peat soil. This can be seen by the increase in the CBR value of fibrous peat with an unsoaked treatment time of 4 days, the carrying capacity of the peat increases, but the CBR value obtained is still below the standard of the soil as the base layer. Further research needs to be done by mixing bottom ash with PCC cement or other chemicals and the peat sample used should contain sand or clay. This shows that peat has high fibre content, in the field, it is necessary to exfoliate or replace the material, because chemical stabilization cannot be carried out.

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