Characteristics and Correlation of the Index Properties Peat Soil: Parit Nipah

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ABSTRACT
Malaysia is the ninth largest peat soil land in world. For the Peninsular Malaysia, southern state was rich of the peat soil especially at the Muar and Batu Pahat district, Johor. This paper is investigating the selected physical and chemical properties of the peat soil which at Parit Nipah, Batu Pahat. Previous researchers mostly investigated the peat soil characteristic between the different place, and limited to the interlayer. The behavior of the different depth is believed that governed by the degree of the humification. A sample is taken every 0.5m until to the clay layer. In this study, peat soil is taken until 4m. Different physical and chemical test was done such as Von Post classification, natural water content, Loss on Ignition (LOI), Total Organic Carbon (TOC), pH, Conductivity. According to the result and previous researchers, the correlation between the properties will determine. Correlation between the moisture content with the soil organic content and von post was determined. Graph for total organic carbon versus organic content was established. Besides that, characteristic of the Parit Nipah peat soil also determined. Moisture content was increase by the depth and reach the peak point at the depth 2.5m. Von post of the peat soil can be classified as 2 types of peat soil in this point. 0m -1.5m as fibric peat soil, for depth 1.5-4m was hemic peat soil. Soil pH is in the range 3.5-4.2, peat soil at Parit Nipah can be classified as acidic soil.

INTRODUCTION

Peat soil is one type of soft soil which compose of leaves, roots and the other fibers under the water condition and fossilized. In the geotechnical field, peat soil is defined as soil which is formed by the accumulation of organic matter and vegetable. (Edil, 2000). In geotechnical field, peat soil also defined as problematic soil because it has very high water content, which is more than 500%. High moisture content causes the peat soil to have characteristics of low permeability, low shear strength and high acidic. (Bujang,B.K, 2009). These problematic characteristics had given hazardous to the engineering work. Low shear strength and low permeability will result to high settlement. High settlement will make the road construction become hard and in long term, the road will low strength and easy broken. Jamil et al., (1989). In Sibu, Sarawak, the depth of the peat soil is more than 10m. The road condition is broken and hard to be maintained. This is one of the challenges for engineers to improve the characteristics and the behaviors of peat soil.

Nowadays, in Malaysia was rapid development, peat soil is need to used for the future development, In Malaysia, it is estimated that there are around 2.5 million ha of peat soil land. Sarawak is the largest peat soil land in Malaysia. Most of the peat soil land in Sarawak is located at the Delta of the Rajang River, Baram, and Limbang system. (Jarret P.M., 2003). Sibu is one of the towns in Sarawak which is constructed on peat soil land. The depth of peat soil in Sibu is recorded more than 10m in some of areas.

In this study, Johor state is chosen. According to the (Felix N.L.Ling, et al., 2013), Peninsular Malaysia was recorded that there are 0.14% of the total peat soil land in Malaysia. Peat soil sand in Peninsular Malaysia mostly located at the east and west coastal.

Biggest peat soil land in Peninsular Malaysia was located at Johor state. Johor is reported that there are around 0.22 ha of peat soil land. In Johor case, most of the peat soil area is located at west coastal which is in Muar and Batu Pahat (Paramananthan, 2010). This two area are located at the west coastal of the Johor. For the site, that have chosen which is Parit Nipah, which is located at Batu Pahat. Parit Nipah is a pineapple plantation.

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area. According to the previous researchers, Batu Pahat peat soil land is not deep and depth is around 4m. According to previous researchers, the index properties of the Peninsular Malaysia are different when compared to Sarawak. (Huat, 2004). According to the result of previous researchers, peat soil behaviors will be affected by different location and different land activities.

Fig. 1: Major peat soil areas in Peninsular Malaysia.

In this study, the main objectives are to determined out the characteristic of the peat soil at the Parit Nipah by layer. Every 0.5m until to the clay layer, peat soil index properties will determine and comparison between the layer. Furthermore, in different depth, there will have slightly different between the properties and properties was affect by each others. In this study, correlation between properties was observed.

**Methodology:**

In this study, peat soil sample was taken from Parit Nipah, which is located in Batu Pahat, Johor. The peat soil sample was taken from a point but with different depth until reached the clay layers. Samples test was done by the depth, comparison by depth, not by the location. Peat auger was used as the peat sampling and the sample was taken at every 0.5m depth. It was taken until 4m. There were totally 8 samples with different depth for this study. Each sample was labeled as 0-0.5m, 0.5-1m, 1-1.5m, 1.5-2m, 2-2.5m, 2.5-3m, 3-3.5m and 3.5-4m. Every samples was wrapped by 2 layers of plastic bags to ensure the sample in good condition and water in the soil was not evaporated. (Andriesse, 1988).

Every sample for every 0.5m depth was directly used to do von post classification on site. The humidification was recorded. Peat soil that was used to do the von post classification will not be put inside the sample bag because the water in that peat soil sample had been squeezed out. The sample which its water had been squeezed out will affect the result of moisture content. When carried out moisture content test, the samples were dried at 50˚C because higher temperature or in 105˚C will burn up the fiber.

During squeezing, the soil water was collected. After that, it was use in the conductivity test and the results were recorded with the correct unit. It is very important that the conductivity test must proceed in the early stage because humidification of the fiber will affect the conductivity of soil. Another factor that will affect the conductivity was room temperatures. Therefore, it is a must to ensure the conductivity probe was calibrated before used and temperature was recorded. For the peat soil sample, it needed more time to be dried. All the samples must be ensured that they were dried completely because the samples need to be grained into smaller size for specific test.

After the sample was grained into powder form, there were 2 Total Organic Carbon Tests (TOC) had been proceeded. For the TOC, Total Organic Carbon Analyzer was used to determine organic carbon content. For preparation, the sample boat was needed to be baked in the furnace at 9000˚C to remove any carbon content by oxidation. After the sample was taken out form the furnace, it was needed to be put in dessicator to reduce the air contact, which in the atmosphere a lot of the carbon. For the TOC sample, formula is shown as below:

\[
\text{TOC} = \text{TC} - \text{IC}
\]

**RESULTS AND DISCUSSION**
The results of selected physical and chemical properties are presented in Table 1. For the result of the level humidification, Von Post Classification was used to determine the types of peat soil. From Table 1, the level of the humidification of the peat soil at Parit Nipah is increasing with the depth. The peat soil samples can be categorized into two types. For the depth of 0-1.5m, the level of humidification is H3, which can be categorized as Fibric. While for samples from 1.5m to 4m, which are H4 and H5 can be categorized as Hemic.

**Fig. 2:** Peat soil Sample at the Parit Nipah, Batu Pahat.

In this site, the water level was determined at 1.2m. For the moisture content, the result showed that the percentage of the water is increasing with the depth, and then reached a peak point which is 1139.244% by the samples of 2-2.5m. After the depth of 2.5m, the water content in the peat soil decreases. The standard for the test was follow by the ASTM D2974.

For the LOI test, the result showed that, organic matter in the peat soil was increasing by the depth also. The higher of the soil organic matter was at the depth 1.5m-2m which is recorded as 62.4%, and the lowest of the soil organic matter was at the depth 2.5m-3m. Besides that, for the total organic carbon, the trend slightly same to the soil organic matter. The higher of the total organic carbon was at the depth 1.5m -2m which is 5.35%. The standard for the test was follow by the ASTM (2007) D4427.

Furthermore, in Parit Nipah site, pH for the peat soil was increasing from the 3.5 to 4.12. pH for this Parit Nipah site was increasing by the depth. Deeper of the layer of the soil, pH become more neutral. For the pH range, 3.5-4.12, it categorized as acidic soil. Conductivity result show that, 0-0.5m is the lowest conductivity which are recorded as 0.07 µs/cm. The higher conductivity was recorded at the depth 1m-1.5m which are 112.3 µs/cm.

**Correlation between properties:**

Moisture content is very important for the geotechnical engineering. Level of the humidification shows the poor correlation between moisture content. From table 1, when the moisture content increases, the von post classification becomes higher. This is because peat soil is decomposed by the vegetative debris. The fresh debris will be on the top of the soil. It will absorb water and roots still good in shape. For this layer, roots and plants still identifiable, but the water is mostly used by the organism to resolve the roots. For the high level humidification, moisture content is higher than others. Besides that, water level will affect the result of the moisture content. In this study, the water level is at 1.2m. Therefore, the first two samples are a bit lower than other samples. For the samples 3.5m to 4m, moisture content is lower, this could be because of peat soil had mixed with some of the clay soil. (Aminur M. R., 2011).

Furthermore, peat soil is mostly in high water content due to its natural water holding capacity. The water holding capacity is slightly depend on the organic content. So, moisture content also has correlation between the Loss On Ignition. The high natural water holding capacity is because of the soil structure that characterized by organic coarse particles (fibers) which can hold a considerable amount of water since the soil fibers are very loose and hollow. (Mutalib, A.A., lim, 1991).
Table 1: Index Properties of the Parit Nipah Peat Soil.

<table>
<thead>
<tr>
<th>Test/Depth</th>
<th>0m-0.5m</th>
<th>0.5m-1m</th>
<th>1m-1.5m</th>
<th>1.5m-2m</th>
<th>2m-2.5m</th>
<th>2.5m-3m</th>
<th>3m-3.5m</th>
<th>3.5m-4m</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moisture content (%)</td>
<td>510.554</td>
<td>622.267</td>
<td>993.11</td>
<td>1109.39</td>
<td>1139.244</td>
<td>979.879</td>
<td>846.453</td>
<td>524.309</td>
</tr>
<tr>
<td>LOI (%)</td>
<td>57.72</td>
<td>59.326</td>
<td>56.05</td>
<td>62.439</td>
<td>62.209</td>
<td>54.2</td>
<td>62.986</td>
<td>58.602</td>
</tr>
<tr>
<td>TOC (%)</td>
<td>3.59</td>
<td>4.01</td>
<td>4.06</td>
<td>5.35</td>
<td>4.27</td>
<td>3.99</td>
<td>4.05</td>
<td>3.84</td>
</tr>
<tr>
<td>Von post conductivity</td>
<td>H3</td>
<td>H3</td>
<td>H3</td>
<td>H4</td>
<td>H5</td>
<td>H4</td>
<td>H4</td>
<td>H5</td>
</tr>
<tr>
<td>conductivity</td>
<td>0.07</td>
<td>85.3</td>
<td>112.3</td>
<td>99.8</td>
<td>103.8</td>
<td>91.3</td>
<td>94.6</td>
<td>97.6</td>
</tr>
<tr>
<td>Soil pH</td>
<td>3.6</td>
<td>3.53</td>
<td>3.5</td>
<td>3.8</td>
<td>3.87</td>
<td>3.85</td>
<td>3.78</td>
<td>4.12</td>
</tr>
</tbody>
</table>

Fig. 2: Total Organic Carbon Versus Organic Content.

For the correlation between the total organic carbon and organic content is present as equation 2 below.

\[ y = 0.0834x - 0.7892 \]

From the graph that has established, the soil organic content increase, total organic carbon also increases. Total organic carbons have poor correlation between them. The loss on ignition involves destruction of all the organic matter in the soil by heating the soil with 440°C. Sometimes, this method tends to give an overestimation in organic content because of the structural water loss of the clay mineral. Besides it, some other inorganic impurity might also destructed under 440°C which also leading to an overestimation of the organic content.

Conclusion:

From the variable laboratory results, several conclusions can be made. Firstly about the properties of the Parit Nipah, Batu Pahat. Depth of the peat soil Parit Nipah was 4m which can classified it as the middle deep peat soil land. Furthermore, the water level was 1.2m depth. Moisture content was increase by the depth until 2.5m. Decreasing dramatically at the depth 3.5m to 4m was affected by the organic content inside the peat soil and boundary between the peat soil with the clay soil making the slightly soil mixed. Soil pH of the Parit Nipah also increase by the depth and it was acidic. Soil pH is recorded at the range 3.5 to 4.12. For the total organic carbon result, highest percentage is at the depth 1.5m to 2m.

Furthermore, conclusion for the correlation between the index properties was made. According to the result at Table 1, weak correlation between the moisture content with LOI and Von Post classification are made. Higher of the organic content, higher of the moisture content which are cause by the absorption of the fibers. Furthermore, higher of the humidification, higher moisture content of the soil. This is because decompose fibers. Besides that, correlation between pH with the von post can be found. With the humidification level increase, pH of soil also increase. Graph total organic carbon versus organic content was established. There are poor correlation between them which getting the R² is around 0.23. From the result, total organic carbon increase, organic content increase.

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REFERENCE


