Penerbit Akademia Baru

Journal of Advanced Research Design

Journal homepage:
https://akademiabaru.com/submit/index.php/ard
ISSN: 2289-7984

Peat Soil Classification Study: A Case Study in Ayer Hitam, Muar, Johor

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ARTICLE INFO

Article history:
Received 1 March 2024
Received in revised form 6 September 2024
Accepted 4 November 2024
Available online 30 November 2024

Keywords:
Peat Soil; classification; von Post scale; Ayer Hitam; degree of humification

ABSTRACT

Peatland in Malaysia are unique and important ecosystems characterized by the accumulation of organic matter in waterlogged conditions, resulting to formation of peat. The classification of peat soil is important to identify the degree of decomposition of the peat soil and the presence of the dominant plant species, affecting its stability and suitability for various applications. This study focusing on the peat classification work using von Post scale and peat physical properties using ASTM Standards for the samples taken from Ayer Hitam, Muar, Johor. The degree of humification of the sample collected in Ayer Hitam is observed to be dark brown in color and is classified with the von Post scale level of H6 to H7. The study also presents preliminary results on the pH level, moisture content level and ash content, which are obtained at 3.65 ± 0.072, $81.02\% \pm 1.04\%$ and 2.36% respectively. This preliminary work outlines an identification for classification method to be used for the future works about the peat treatment and modification to improve its properties.

1. Introduction

Carbon-rich soil, commonly referred to as peat soil, stands apart from mineral soil due to its distinctive characteristics [1,2]. Peat soil exhibits a spongy texture and is primarily composed of partially decomposed organic matter, encompassing remnants of plants, animal remains, and even human residues [3-5]. Peat soil's high carbon content distinguishes it from mineral soils, making it an essential component of ecosystems like wetlands and bogs [6]. When peat is soaked or saturated, it typically comprises around 5-10% solid components and approximately 90-95% water content [7], making it a biogenic deposit [8]. Peat soil is renowned for its ability to retain moisture, serving as a natural reservoir and aiding in flood control. Moreover, it plays a crucial role in addressing the issue

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https://doi.org/10.37934/ard.122.1.113128

of carbon sequestration, storing significant amounts of carbon and thus contributing to mitigating climate change [9,10].

Peat soil accumulates in areas with consistently waterlogged conditions conducive to peat formation [11,12]. One of the greatest challenges is due to the characteristics of peat soil may exhibit variations depending on the specific geographic location and the prevailing natural climate in the areas [13]. The differences are also governed by other factors spanning from type of vegetation and organism remains. The degree of decomposition is a common condition which has considerable impact on peat color characteristics, which is influenced by several factors, including the amount of organic matter, aeration, water body pH, and temperature [14,15]. This color variation serves as an indicator of decomposition and physical characteristics. Peat soil exhibits a range of colors, spanning from deep black to pale yellow, and can be classified using the von Post scale method with black being the most decomposed and vice versa. Microbial activity in peat soil contributes to peat soil formation in both aerobic and anaerobic conditions. The black colored characteristic of peat soil mostly found in Asia signifies a higher degree of decomposition due to rich microbial activities in anaerobic environments resulted from the waterlogged conditions [16]. The color range of peat soil can also be affected by the type of plants on the area, for an example on how sphagnum megellanicum being the dominant species on the northern hemisphere contributing the reddish and purplish color [17,18].

The physical characteristics of peat soil can be attributed to its distinctive composition and formation process, as highlighted by Konstantinov *et al.,* [19]. The high void ratio within 5-15 of peat soil directly contributes to its remarkable porosity, consequently leading to low bulk density [16]. Peat soil's unique attributes, including its high-water retention capacity of up to 850%, are primarily a result of the cellular structures and large voids present within decaying plant material [20]. The spongy texture of peat soil is a consequence of the decomposition of organic material, with varying degrees of decomposition acting as both the framework and the foundation of peat soil's spongy characteristics [21]. Compressibility behavior of peat soil can differ affected by degree of decomposition, organic content, moisture content and the type of plant decaying which can be used to classify the peat soil itself. Peat soil can be further classified into fibric, hemic and sapric [22,23]. Fibric hemic having the highest compression index followed by hemic and sapric [24]. Fibric peat high fiber content more than 67% contributing to its higher compressibility behavior compared to sapric and hemic peat type [22,25,26].

The degree of decomposition can also serve as a fundamental guideline for understanding the engineering properties of peat soil. The von Post scale classification has been instrumental and widely used in peatland research, engineering, and environmental studies. It helps researchers and practitioners understand and classify the stage of peat formation, estimate organic content, assess carbon sequestration potential, and evaluate the suitability of peat soils for various applications [27]. However, the classification using von Post Scale only is subjectively challenging and it is important to note that the von Post scale is a qualitative method and is subject to some degree of subjectivity and variability. Several researchers have been used and proposed to combine it with other quantitative measurements, such as bulk density, organic matter content, or carbon content, to obtain a more comprehensive understanding of peat soil characteristics [28]. There is a growing body of literature such as those by [29-36] specifically discuss the characteristics of peat samples using von Post Scale, encompassing both their physical and engineering properties to evaluation their peat classification. Table 1 indicates few examples of researchers who used von Post scale in peat soil classification studies from 2018 to 2022, to assess the degree of humification in their peat samples. The von Post scale is widely utilized for identifying organic soils, primarily peat, due to its simplicity and visual assessment approach, making it accessible to a broad range of users without specialized equipment.

Its historical use and widespread adoption have resulted in a wealth of data and research referencing this scale.

This qualitative method helps quickly categorize peat samples based on color, texture, and consistency, aiding in assessing organic content and the suitability of peat for various applications, such as agriculture and carbon sequestration estimation. Most studies in the field of peat soil have only concluded and reported their peat scale rating without any graphical or images and less description of how the evaluation is conducted. What is not yet understood is the precise nature of the evaluation degree of decomposition based on the condition before and after squeezing. The question has been raised about the degree of squeezing while conducting the in-situ or lab classification.

Table 1
Previous literature works used von Post scale method in their classification studies

Author (year)	Scope of study	Location	Von Post scale
Yacob *et al.,* 2020 [30]	Utilization of magnesium oxide in peat stabilization study	Pontian, Johor	H3
Sapar *et al.,* 2020 [32]	Peat soil physical and morphological study	Beaufort, Sabah	H6-H7
Kolay *et al.,* 2018 [33]	Geotechnical study on peat soil	Sarawak	H3-H7
Paniagua *et al.,* 2021 [34]	Norwegian peat soil database study	Norway	H2-H3, H5-H10
Granlund *et al.,* 2021 [35]	Degree of humification study on peat soil supported with VNIR/SWIR	Aapa mire, Finland	H1-H2, H3-H5, H6-H9
Zolkefle *et al.,* 2018 [36]	Study on engineering properties of peat sample based on different location	Parit Nipah, Johor Pontian, Johor Beaufort, Sabah	H4, H5, H6
Bechtold *et al.,* 2018 [37]	Water retention study on peat soil site	Genamoos, Germany	H7-H10
Canakci *et al.,* 2019 [38]	Compressibility study on peat strengthened with sand column	Sakarya, Turkey	H1-H4
Dehghanbanadaki *et al.,* 2019 [39]	Natural filler addition study in treating peat soil	Pontian, Johor	H3
Afip and Jusoff 2019 [40]	Characterization study of peat soil in Sarawak	Kg Meranek, Kota Samarahan, Sarawak	H7
Mikhailov *et al.,* 2020 [41]	Relationship study between peat porosity and fractal properties	Tver region, Central Russia	H1, H4
Dettmann *et al.,* 2021 [42]	Optimum drying temperature study in drying peat soil	Joikioinen, Finland, Donaumoos, Germany	H2 H5, H9-H10
Azmi and Kassim 2022 [43]	Study on agriculture effect on peat soil characteristic	Ayer Hitam, Johor	H3-H8
Wahab *et al.,* 2022 [44]	Characterization study of peat soil at Pahang district	Pekan, Pahang	H5-H7
Rasfina Mahyan *et al.,* 2022 [45]	Strength enhancement study on peat soil study	Kg Meranek, Sarawak	H8

Several studies within the range of 2018-2022 have been conducted related to peat soil study highlighted the peat soil characterization as the first step before the treatment and any modification intended as summarized in Table 2. In addition to von Post scale, the identification of peat soil characteristics can also be conducted by considering a range of physical properties. These properties include but are not limited to moisture content, organic content, compaction behavior and pH level. Moisture content refers to the amount of water present in the soil at a given time, expressed as a percentage of total mass of peat soil. Organic content on the other hand refers to the peat soil proportion of present organic material. These common physical properties evaluation of peat soil can have been conducted in accordance with American Society for Testing and Material (ASTM) and British Standard (BS).

Table 2
Summary of researchers who conducted classification method using ASTM or BS method

Author (year)	Scope of study	Characterization method	Standard used
Wahab *et al.,* 2023 [23]	Effect of modification on peat soil study in term engineering properties	i. Fiber content ii. Ash content iii. pH level iv. Chemical composition	i. ASTM D1997 ii. ASTM D2974 iii. ASTM D2976 iv. ASTM C150
Yacob *et al.,* 2020 [30]	Utilization of magnesium oxide in peat stabilization study	i. Moisture content ii. pH level iii. Ash content iv. Organic content v. Unconfined compressive strength (UCS)	i. ASTM D2974-71 ii. ASTM D2976-71 iii. ASTM D2974 iv. ASTM D2974 v. ASTM D2166
Kolay *et al.,* 2018 [33]	Study on physical, geotechnical and stabilization of tropical peat soil	i. Moisture content ii. Organic content iii. Specific gravity iv. Fiber content v. Liquid limit vi. pH level vii. Maximum dry density (MDD) and Optimum Moisture Content (OMC) viii. Unconfined Compressive Strength (UCS)	i. BS 1377 ii. ASTM D2974 iii. BS 1377 iv. ASTM 1997-91 v. BS 1377 vi. BS 1377 vii. BS 1377 viii. ASTM D2166
Wibisono and Febrie, 2019 [46]	Peat soil modification by using cement–lime mixture	i. Natural water content ii. Specific gravity iii. Unit weight iv. Dry unit weight v. Ash content vi. Organic content vii. Fiber content	i. ASTM D4427
Paul *et al.,* 2020 [47]	Indian peat soil treatment with cement study	i. Moisture content ii. Organic content iii. Maximum Dry Density (MDD) and Optimum Moisture Content (OMC) iv. Unconfined Compressive Strength (UCS)	i. ASTM D2974 ii. ASTM D2974 iii. ASTM D698 iv. ASTM D2166
Zambri *et al.,* 2018 [48]	Peat stabilization study using lime and cement	i. Moisture content ii. Shear strength	i. BS 1377:1990-2 ii. BS 1377:1990-7
Sulaiman *et al.,* 2022 [49]	Stabilized peat soil mechanical properties study	i. pH level ii. Moisture content iii. Image analysis iv. Chemical analysis	i. BS 1377-2
Bahadori *et al.,* 2022 [50]	Peat soil stabilization study using natural and artificial pozzolans	i. Standard proctor compaction test ii. Unconfined compressive strength iii. California Bearing Ration (CBR) iv. Shear strength	i. ASTM D698 ii. ASTM D2166 iii. ASTM D1883 iv. Aashto T193

However, some studies of the peat classification are mainly focused in addressing their specifics aim of study and not focusing on the variability of evaluation using von Post scale. For example, Wibisono *et al.,* [46] and Paul *et al.,* [47] using the identical approach by utilizing cement. The difference come in place when the characterization method specified by Paul and Hussain [47] exclude the specific gravity determination of peat soil. Yacob *et al.,* [30], examined the utilization of magnesium oxide in peat soil stabilization, assessing parameters like pH levels and unconfined compressive strength also utilizing ASTM standard. Zambri *et al.,* [48] also discuss the utilization of lime and cement mixture in treating peat soil. In contrast, the standard used in determining the moisture content and shear strength is by following the British Standard (BS 1377:1990) part 2 and 7. Furthermore Zambri *et al.,* [48] and Sulaiman *et al.,* [49] also utilizing the same standard which is BS 1377-2. Bahadori *et al.,* [50] and Wahab *et al.,* [23] studying the physical characteristic alteration of peat soil upon treatment in which both studies utilizing ASTM as the standard referred, in contrast, Kolay *et al.,* [33] referring to both ASTM and BS even though the scope of study is the same.

There is still uncertainty about the few questions raised about the degree of squeezing and its evaluation to give the scale H1-H10, due to very little literature who have attempted to investigate the peat classification using von Post scale with graphical approaches in describing and evaluating the scale given. Therefore, this paper explores the way in which evaluating the scale by reporting using graphical comparison. This paper is aimed to identify, test, and compare the suitable classification methods von Post Scale and American Society for Testing and Material (ASTM) to be used for the future work of the authors in conducting a peat treatment for reducing fire hazards. The study presents a preliminary work on the classification of the peat soil samples from Ayer Hitam, Muar, Johor, Malaysia. This finding would provide some fundamental data for the peat treatment and modification, mainly intended for the purpose of agriculture and plantation.

2. Methodology

2.1 Physical Characterization Method

2.1.1 Peat soil sample collection

The work on peat classification is mainly divided into two main parts, firstly the identification of the peat classification method and secondly preliminary evaluation of the physical properties of the peat soil from the surrounding area of Ayer Hitam. The paper is intended to identify and evaluate the suitable method to be used for classification, followed by the evaluation of preliminary study of physical properties, mainly with regards to the moisture content level, pH level and ash content level. The evaluation of the peat soil is conducted based on the sample collected in Ayer Hitam area. Figure 1 below shows the peat soil digging process and its depth of peat soil collection level. The samples taken are mainly collected in the plantation area, used for pineapple field. The samples are dug in an approximately one and half feet in depth, based on the suitability of the plantation application. The samplings are also based on a few locations in the area or zones to obtain a few sets of samples.

Fig. 1. Example of the peat soil sample digging process and the depth of the peat soil level collected

2.1.2 Von Post scale

The von Post method is a classification method used to understand the degree of decomposition and humification of peat. The classification method is conducted based on the von Post scale as shown in Tables 3 and 4, respectively. The main aim of this preliminary investigation is to identify and compare the suitable method to be used for classifying the peat soil and capture the related factors to be considered. The von Post scale is applied by having a handful of wet soil, which is small enough to cover with the fingers of one hand, the soil is squeezed very hard, until the soil can be extruded through the fingers, as much as possible. The observation is made based on the color, viscosity of exudate, proportion, and condition of remaining fiber and other properties, to assign a score based on the description in the tables.

Table 3 shows the description of the von Post scale based on the physical properties' evaluation, which mainly rank the organic soils by degree of humification (decomposition). This scale was devised by Lennart von Post first introduced this method in the 1926 Soil Survey of Sweden for measurement of degree of decomposition of dead plant matter such as Sphagnum moss [29]. This von Post scale is a test to evaluate a few main parameters such as fiber integrity, color, and viscosity of exudate, and presence of colloidal particles. This scale provides a descriptive framework across a wide range of organic soils and assigns a numerical value from 1 (undecomposed) to 10 (colloidal). The 10 steps represent the percentage of decomposition i.e., 1 = 10% or undecomposed plant material, and 10 = 100% decomposed or colloidal, such as the highest caloric value burnable black peat. The USDA/FAO summarized von Post's 10 steps into three levels (fibric, hemic, sapric), thereby reducing its diagnostic usefulness at field scale.

Table 4 shows von Post scale based on degree of decomposition, which includes more description of evaluation guidelines. The degree of decomposition is categorized based on condition before and after squeezing the peat samples. The von Post scale categorizes peat decomposition into several classes or stages, typically ranging from H1 (undecomposed) to H10 (completely decomposed). Peat samples with a lower von Post value indicate less decomposed or more organic-rich material, while higher values indicate more decomposed or less organic-rich material. These classes are determined by observing the color, texture, and consistency of the peat sample. This scale provided more detail guideline for evaluation to be conducted. The von Post method, which does not require any instrumentation, is well-suited for field use. The degree of squeezing is assessed by firmly squeezing a handful of peat soil in the palm until as much material as possible is extruded through the fingers, or until about one-third is removed between the fingers. This procedure was performed by a single individual to maintain consistency in the evaluation. The assessment of the soil's color prior to squeezing was conducted through a visual-manual inspection in the field, also by the same individual. A classification study was carried out on the peat soil sample from Ayer Hitam following the guidelines provided. Additionally, a literature review was conducted to identify and compare the suitability of various classification methods for peat sampling in this project.

In addition to von Post scale method, the classification of peat based on fiber content, ash and acidity is also established by American Society for Testing and Material (ASTM), which classified peat soil into three categories as presented in Table 5.

Table 3
Von Post humification scale [29]

Symbol	Description
H1	Completely undecomposed peat which, when squeezed, releases almost clear water. Plant remains easily identifiable. No amorphous material present.
H2	Almost entirely undecomposed peat which, when squeezed, releases clear or yellowish water. Plant remains still easily identifiable. No amorphous material present.
H3	Very slightly decomposed peat which, when squeezed, releases muddy brown water, but from which no peat passes between the fingers. Plant remains still identifiable, and no amorphous material present.
H4	Slightly decomposed peat which, when squeezed, releases very muddy brown water. No peat is passed between the fingers, but plant remains are slightly pasty and have lost some of their identifiable features.
H5	Moderately decomposed peat which, when squeezed, releases very muddy water with a very small amount of amorphous granular peat escaping between the fingers. The structure of the plant remains is quite indistinct although it is still possible to recognize certain features. The residue is very pasty.
H6	Moderately highly decomposed peat with a very indistinct plant structure. When squeezed, about one-third of the peat escapes between the fingers. The residue is very pasty but shows the plant structure more distinctly than before squeezing.
H7	Highly decomposed peat. Contains a lot of amorphous material with very faintly recognizable plant structure. When squeezed, about one-half of the peat escapes between the fingers. The water, if any is released, is very dark and almost pasty.
H8	Very highly decomposed peat with a large quantity of amorphous material and very indistinct plant structure. When squeezed, about two-thirds of the peat escapes between the fingers a small quantity of pasty water may be released. The plant material remaining in the hand consists of residues such as roots and fibres that resist decomposition.
H9	Practically fully decomposed peat in which there is hardly any recognizable plant structure. When squeezed, it is a fairly uniform paste.
H10	Completely decomposed peat with no discernible plant structure. When squeezed, all the wet peat escapes between the fingers.

Table 4
Degree of decomposition according to von Post scale [30]

Condition before squeezing				Condition after squeezing		
Scale	Color	Decomposition degree	Structure	Extracted solution	Squeezed material out between fingers	Characteristic of leftover material
H1	Yellow or white	None	Easily identified	Clear, colorless yellowish/ pale brown, yellow	Nothing	Not pasty
H2	Very pale brown	Insignificant	Easily identified	Clear, colorless yellowish/ pale brown, yellow	Nothing	Not pasty
H3	Pale brown	Very slight	Still identified	Dark brown muddy	Nothing	Not pasty
H4	Pale brown	Slight	Not easily identified	Dark brown muddy	Some peat	Somewhat pasty
H5	Brown	Moderate	Recognizable but indistinct	Very dark brown, muddy	Some peat	Strongly pasty
H6	Brown	Moderately strong	Indistinct (Clearer after squeezing)	Very dark brown, muddy	About one third of the peat	Very strongly pasty
H7	Dark brown	Strong	Faintly recognizable	Very dark brown,	About one half of the peat	Very strongly pasty
H8	Dark brown	Very strong	Very indistinct	pasty	About two third of the peat	Very strongly pasty
H9	Very dark brown	Nearly complete	Almost unrecognizable	Very dark brown, muddy	Nearly all peat as fairly-uniform paste	Very strongly pasty
H10	Black	complete	No discernible	Very dark brown, muddy	All the peat; no free water visible	n/a

Table 5
Class of peat in ASTM according to fiber content, ash content and acidity [31]

Classification of peat based on ASTM standard (ASTM, 2013)	
Fiber content (ASTM D1997)	Fibric: Peat with greater than 67% fibers Hemic: Peat with between 33% and 67% fibers Sapric: Peat with less than 33% fibers
Ash content (ASTM D2974)	Low ash: Peat with less than 5% ash Medium ash: Peat with between 5% and 15% ash High ash: Peat with more than 15% ash
Acidity (ASTM D2976)	High acidity: Peat with a pH less than 4.5 Moderate acidic: Peat with a pH between 4.5 and 5.5 Slightly acidic: Peat with a pH greater than 5.5 and less than 7 Basic: Peat with a pH equal or greater than 7

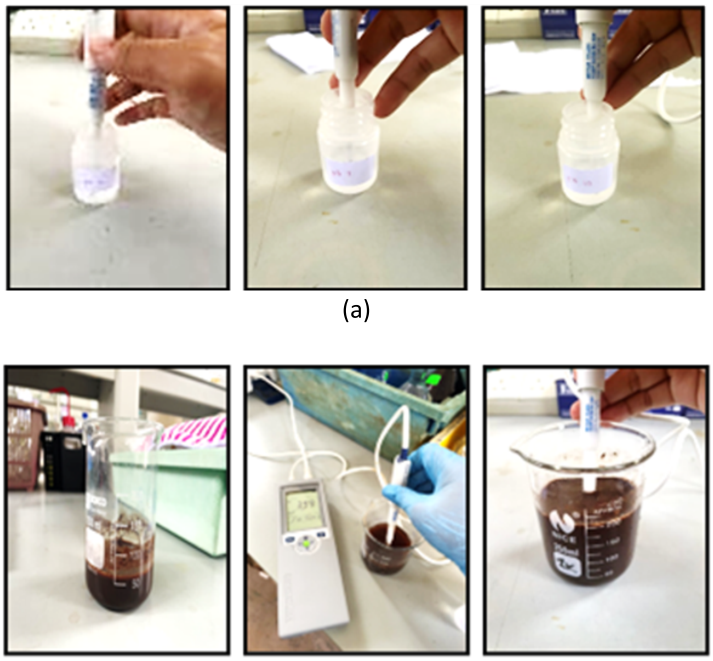
2.1.3 Moisture content measurement

The moisture content measurement of the peat samples is conducted according to ASTM D2974-71, the peat soil sample approximately with a weight of 50 g ± 10 g is prepared and is dried in an oven set at the modified temperature of 70°C ± 5°C for approximately 24 hours, i.e., until a constant mass is achieved. The initial and final masses after the drying are recorded to measure the moisture content of the sample. The peat soil samples are prepared for three sets of samples and the average moisture content is obtained. The measurement method is shown in Figure 2 below.

Fig. 2. The moisture content measurement process of the peat soil sample

2.1.4 pH level

The evaluation of the pH level is conducted to indicate the acidity level of Ayer Hitam peat soil as shown in Figure 3. The pH meter was calibrated according to the manufacture's manual by using buffer solutions of pH 4, 7 and 10. The peat soil samples are prepared for three sets of samples. The peat soil samples of approximately 10 g weight are prepared and weighed using analytical balance and are immersed into 50 ml of distilled water. The mixture is mixed and stirred for three minutes to ensure the mixture soil is fully dispersed in the water. The mixture is allowed to rest for 30 minutes before taking the pH measurement. The measurement is conducted for three times and is calculated their average values.



(a)

(b)

Fig. 3. The measurement of pH level (a) Calibration process (b) Measurement process

2.1.5 Ash and organic content

The evaluation of the organic content is conducted according to ASTM D 2974 as shown in Figure 4. The peat soil samples are prepared by placing the dried sample on a clean and dry crucible, followed by a burning process in a furnace at 440℃± 40℃ for 24 hours. After the burning process, the residuals are collected and placed in a desiccator to cool. Once cooled, the mass is calculated to obtain the ash and organic content, expressed in percentages, are recorded accordingly.

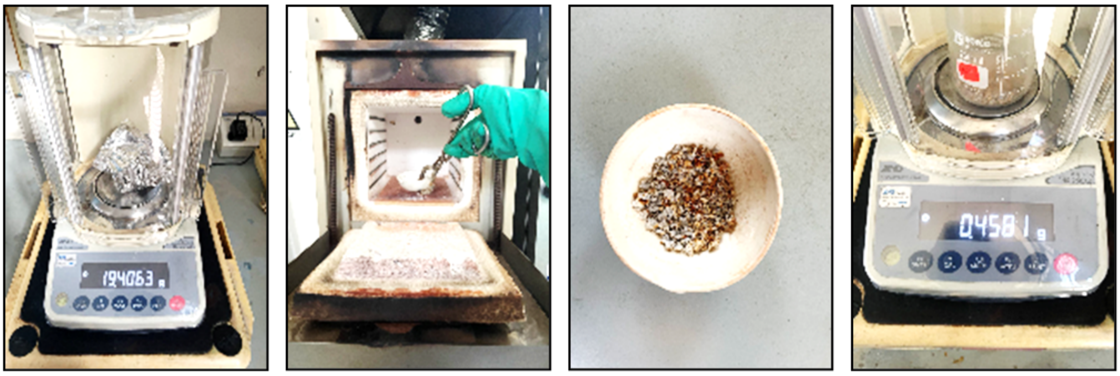


Fig. 4. The evaluation of ash and organic content of the peat soil sample

3. Results

3.1 Physical Characterization

3.1.1 The von Post scale classification

In the preliminary study, an evaluation was conducted to determine the degree of humification in the peat soil of Ayer Hitam following the von Post scale method. The results presented in Tables 6 and 7, illustrate the observation made based on the guidelines from Tables 1 and 2, respectively. The degree of humification in peat soil refers to the level of organic matter decomposition. In the case of the peat sample collected from Ayer Hitam in Malaysia, it is expected to exhibit a degree of humification ranging from H6 to H7. This range indicates varying levels of decomposition of the organic matter present in the peat. The waterlogged nature of Malaysian peatlands plays a crucial role in determining this degree. Peatlands are characterized by continuous water submergence, which creates anaerobic conditions by limiting oxygen availability. In such conditions, decomposition occurs primarily in the absence of oxygen. Consequently, the decomposition process in Malaysian peatlands experiences reduced oxidation, which occurs in the presence of oxygen during organic matter breakdown. The limited oxygen availability impedes the oxidation process, resulting in slower decomposition rates. As a result, partially decomposed plant material accumulates over time in submerged peat soils.

It can be concluded that these scale ratings process greatly affected by the degree of squeezing and inconsistent evaluation of color and residual leftover, especially if conducted by a few different persons for each set of samples. The classification works should also consider the effect of different depth and time of sampling taken. The results raise intriguing questions regarding the nature of the degree of squeezing conducted and giving suggestions for future work to develop a full picture of peat classification work using von Post scale using graphical approaches evaluation. The results indicate that peat classification using the von Post scale and physical properties requires further investigation, considering variations in the degree of squeezing, different peat depths, as well as the time and location of sampling. Additional experimental work is necessary to explore the factors affecting peat treatment and the modification of its properties. The identification should be further supported by conducting testing using instrument as per standard and advanced laboratory apparatus.

Table 6
The peat evaluation using von Post humification scale based on Zulkifley *et al.,* [29]

Symbol	Description				
H7	Sample 1				
	Sample 2				
	Sample 3				
Description		Highly decomposed peat	Contains a lot of amourphous material with very faintly recognizable plant structure	When squeezed, about one-half of the peat is squeezed out of the fingers	The water, if any, is very dark and almost pasty

Table 7
Von Post scale humification scale according to Yacob *et al.,* [30]

Condition before squeezing				Condition after squeezing		
	Color	Decomposition degree	Structure	Extracted solution	Squeezed material out between fingers	Characteristic of leftover material
H7	Dark brown	Strong	Faintly recognizable	Very dark brown, pasty	About one half of the peat	Very strongly pasty
S1						
	Color description follows H7 indication	Decomposition condition follows H7 indication	Squishy texture with few coarse materials attributed by	Follows H7 indication	A small amount of sample lefts in the grip	Few organic materials such as roots revealed after

Table 7
Von Post scale humification scale according to Yacob *et al.,* [30]

	Condition before squeezing			Condition after squeezing		
	Color	Decomposition degree	Structure	Extracted solution	Squeezed material out between fingers	Characteristic of leftover material
			unfinished decomposed organic material			squeezing the sample
S2						
	Color description follows H7 indication	Decomposition condition follows H7 indication	Squishy texture with few coarse materials attributed by unfinished decomposed organic material	Follows H7 indication	A small amount of sample lefts in the grip	Few organic materials such as roots revealed after squeezing the sample
S3						
	Color description follows H7 indication	Decomposition condition follows H7 indication	Squishy texture with few coarse materials attributed by unfinished decomposed organic material	The extracted solution posses muddy texture and fall off the beaker's base slowly leaving traces and viscous	A small amount of sample lefts in the grip	Few organic materials such as roots revealed after squeezing the sample

3.2 Moisture Content, pH Level and Ash Content

The average moisture content of the peat soil obtained in the measurement is 81.02% $\pm$ 1.04%. Moisture content refers to the amount of water present in the soil at a given time, expressed as a percentage of total mass of peat soil. Organic content on the other hand refers to the peat soil proportion of present organic material. These parameters play an important role in discerning the attribute of peat soil. In contrast with von Post scale method, these physical properties can be evaluated and quantified resulting in values that can be measured. The increasing trend of moisture content is affected by the higher organic content. The presence of decaying organic matter such as plants resulting peat soil to be having a spongy-like texture. This attribute causes higher water holding capacity due to the higher porosity which acting as a trap, holding moisture between the particles of decomposing organic material. Organic matter also causes the condition where the evaporation process slows down as it acts as a mulch, creating a barrier on the surface of peat soil.

The pH level of Ayer Hitam was anticipated to be low, indicating high acidity. Monitoring of pH levels confirmed a recorded pH level of 3.65 $\pm$ 0.072, in line with expectations. The pH values influenced by the depth of the soil, it may be suggested to further the experiments to study pH rate and depth to observe the relationship. Based on literature work by Talib *et al.,* [21], the deeper the peat, the higher the pH, which leads to the greater the decomposition rate.

For the ash content measurement, it is observed that the residual mass of the ash is recorded at 2.36% $\pm$ 0.6 in average. This concludes that the average loss of ignition of organic content is approximately 97.64%, in which in agreement with the peat known as organic soil with organic content of more than 75% to be classified as organic soil. The peat soil characterization in term of moisture and ash content is significantly important properties to be evaluated in stabilizing the local climate and serves better measurement when recently the peatland has been extensively explored, and some of the area has been burned, especially for the agricultural purposes [51]. In general, moisture content, organic content, and pH level, has significantly affected depth of peat and location of sampling. These will be highlighted and emphasized to be further explored in the author's future work to establish the characterization findings prior to any treatment conducted.

4. Conclusions

A work of peat classification is presented here. This finding is presented to identify, compare, and highlight the variations of the classification methods used for peat soils from Ayer Hitam, Muar, Johor. This preliminary finding of the moisture content, ash content, and pH level, is concluded to outline the design of the experimental for the future works of the authors, considering various parameters. These results suggest that peat classification using von Post scale and by physical properties, must be further investigated by considering the variation degree of squeezing level, different depth of peat, time, and location of sampling. More experimental works are needed to investigate the factors influencing the peat treatment for modification of its properties. However, this preliminary study provides an insight for the identification method of classification and the characterization as well as its parameters to be observed. It is also highlighted the importance in identifying the degree of decomposition of the peat soil and the presence of the dominant plant species, affecting its stability and suitability for various applications.

Acknowledgement
This research was funded by a Short-Term Research Grant (STRG) from Universiti Kuala Lumpur Malaysia (UER21006).

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