CHARACTERIZATION OF PALM OIL ASHES (POA) UNDER IMPULSE

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ABSTRACT

The characteristics of soils as used in earth electrode systems were investigated. In this project, the material proposed is palm oil ashes. The work involved particle size distribution, moisture holding capacity, compactness and also breakdown voltage under impulse. For particle size distribution, moisture holding capacity and compactness tests, it had been conducted in Geotechnic Lab, Faculty of Civil Engineering, UTM. The size chosen for every test in this project was 600μm and below. Meanwhile, for a breakdown under impulse test, it had been conducted in IVAT building, FKE. The particle chosen were 600μm because after the particle size distribution test, it is found, it covered 74% from the total of 300g POA. As for moisture holding capacity, it is found, that it can absorb 150% water referring to its dry mass. In the compaction test, the result shows that the optimum compacted are at 25% water added. As for the breakdown voltage impulse, it is found that the breakdown voltage of wet soils is always lower than the dry soils.

KEYWORDS: *Palm oil ashes; Grounding; Breakdown; Earthing; Impulse*

1.0 INTRODUCTION

Earthing systems play a main role as a protection to electrical equipments and also living creatures, including humans during fault or lightning. Earthing systems are important such as to provide a low impedance path when fault happen, to drive a greater energy to the ground during atmospheric discharge, minimize the ground rise potential and to protect electrical systems and surrounding during fault and established voltage reference level.

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In terms of words for electrical earthing, the American electrical engineers called its grounding whilst the British engineer used the word earthing. In ideal condition, the best grounding systems should have 'zero impedance'. This means that the fault current will flow directly to the earth ground without any resistance.

The effects of a failure grounding system are devastating. As we know, one of the important roles of earthing system is to protect electrical equipments. In power system networks, the equipments used is expensive. So the use of protection system and earthing system is crucial.

In year 1980, Jones had proposed the use of bentonite as backfill. Bentonite is a clay consisting of the mineral montmorillonite (a hydrous aluminium silicate). The bentonite can absorb up to 13 times its dry volume or five times its weight (Jones, 1980). The researcher also did field test using the bentonite rods at three sites. First site consists a very dense hardpan silt with an average resistivity of 37 ohm-M. The second site consists of a clay mixed with cobbles and gravel with an average resistivity of 75 ohm-M. While the third site consists of a mixed soil consisting of sand and silt underlaid with a sandstone layer having an average resistivity of 107 ohm-M. He found that by using the bentonite rods, the resistivity of the site were reduces. Nor (2006) had used a wet clay and sand mixed with a controlled amount of NaCl and water content to investigate the behavior of soils under high current magnitudes. From their studies, it was found that under impulse conditions, the apparent resistivity of wet clay decreased with increasing current magnitudes.

While Eduful (2009) had done a test to determine the moisture holding capacity of Palm Kernel Oil Cage, Tyre ashes, Wood Ashes and Powdered cocoa shells. They also had done experiments to examine the efficiencies of the conductive backfill as stated above. The chemical properties of the samples were tested. Parameters tested for are: moisture holding capacity, and pH level. As for the efficiencies of local backfills for the ground resistance, the application of tyre ashes as a conductive backfills lowers ground resistance by 80%.

Laboratory tests with spherical earth electrode half buried in soil placed in the hemispherical tank has been conducted by Berger (1946). Tests were conducted for different types of soils and various sizes of spherical electrode. Petropoulus (1948) also had used similar hemispherical as Berger model to estimate the cell breakdown voltage.

Meanwhile cylindrical test geometry was used by Loboda and Scuka (1996). They had applied high magnitude impulse tests of up to 1kA and current front times up to 12us on a vertical rod inside a coaxial cylinder test cell. As for the testing material, they used three types of soils with 40 until 2150 Ωm resistivity. What they found is the resistance decrease with increasing currents due to the ionization process.

2.0 CHARACTERIZATION OF PALM OIL ASHES

Several tests had been conducted for the characterization of the palm oil ashes. The test conducted was the particle size distribution test, moisture holding capacity test, compaction test and breakdown voltage under impulse test. The first test is to determine the particle size distribution of the palm oil ashes. The method used for this test is BS 1377: Part 2: 1990: Section 9.3. This section described on how doing a particle size distribution test by using the dry sieving method.

Moisture effect on the resistivity is widely known. In this study, a test to determine the moisture holding capacity of the material is done according to BS 1377: Part 2: 1990: Section 3.1 and 3.2. This section described the steps for oven drying method for moisture determination test.

Compaction is a process of increasing the density of a soil by packing the particles closer together. Determination of compactness of this material is done in accordance to BS 1377: Part 4: 1990: Section 3.1, 3.2 and 3.3. This section described the method of using 2.5 kg rammer for compaction test.

As for the breakdown voltage under impulse, it is done in accordance to BS EN 60052. An applied impulse voltage which follows IEC standard waveform was applied to the test cell. The test cell chosen was a cylindrical type with a diameter of 15 cm and a length of 20 cm.

Figure 1 shows the arrangement for breakdown voltage under impulse test. Its shows on how the set-up is done. Meanwhile, in Figure 2 shows the terminal to monitor the experiment. The oscilloscope is used to capture the current and voltage for the test.

Figure 1. Arrangement for the breakdown voltage under impulse

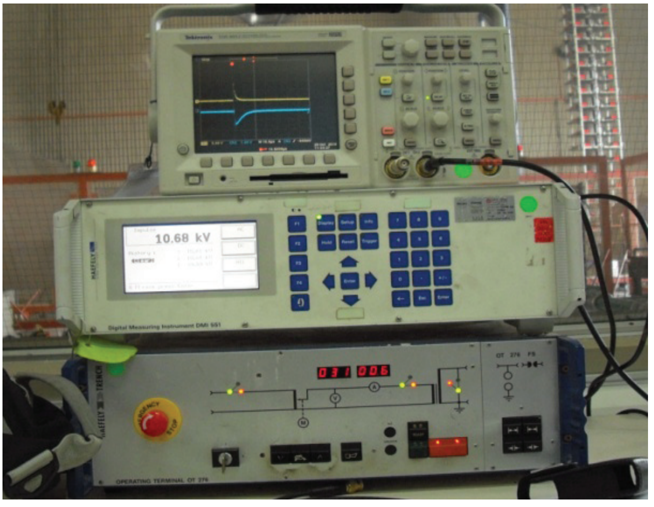

Figure 2. Terminal for the impulse test

3.0 RESULTS

Particle size distribution was done by passing them through a stack of sieves of decreasing mesh-opening sizes and by measuring the weight retained on each sieve. Table 1 shows the particle size distribution for 300 g of palm oil ashes.

Table 1. Particle size distribution for palm oil ashes

Initial Dry mass = 300g					
BS Test Sieve (mm)	**Distribution retained (g)**			**Average (g)**	**Average (%)**
	Sample 1	**Sample 2**	**Sample 3**		
1.18	34	32	43	36.3	12.1
0.6	39	41	42	40.7	13.57
0.425	27	28	26	27	9
0.3	28	24	30	27.3	9.1
0.212	32	33	34	33	11
0.15	37	40	42	39.7	13.23
0.63	69	82	80	77	25.67
Passing 0.63	34	20	3	19	6.33
Total	300	300	300	300	100

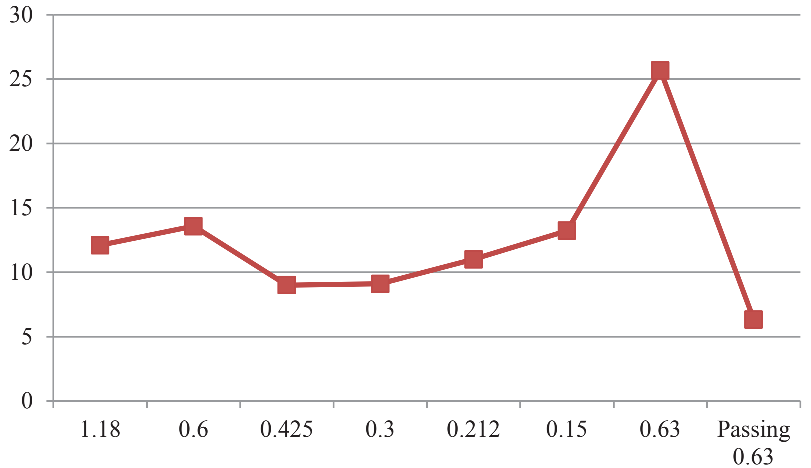

Figure 3. Graph of particle size distribution

Based on the distribution, it is found that the highest particle in the palm oil ashes is particle passing the 150 μm sieve with 25% while the smallest percentage was particle passing the 63 μm sieve. From this experiment its can be said that further refine the palm oil ashes is difficult or impractical for use in earthing system. This is due to the percentage of the material passing the 63 μm sieve.

Based on the data collected, the author had decided to use particle which passing the 600 μm only for other experiments. The reason is because its covered 74% of the total material.

As for the moisture holding capacity test, it is found that the average of water holding capacity of the palm oil ashes is 150%. This means the material can hold up to 1.5 times it dry mass. As for comparison purpose, the result obtained was compared with the result obtained by Eduful (2009). Eduful found that the Palm Kernel Oil Cake (PKOC) can hold 102% water while the Powdered Cocoa Shell (PCS) can hold 337% water. By comparing the results it can be concluded that the data obtained from this experiment is acceptable.

Table 2. Moisture holding capacity of the palm oil ashes

Moisture Holding Test			
Container (m1)(g)	**Container + wet soil (m2)(g)**	**Container + Dry soil (m3)(g)**	**Moisture (%)**
29.78	124.81	68.229	147
29.601	118.53	66.232	142.8
29.561	131.451	69.106	157.6
29.665	121.341	65.903	153
Average			150

Meanwhile results from the compaction test shows that the maximum dry density is 1895 mg/m^3 and the moisture is 24.67% respectively. Figure 4 shows the data obtained from the test. For compaction test, it is determined by the weight of the quantity of the material can be compacted. This means that when more material can be compacted it is better because the particle was closely packed.

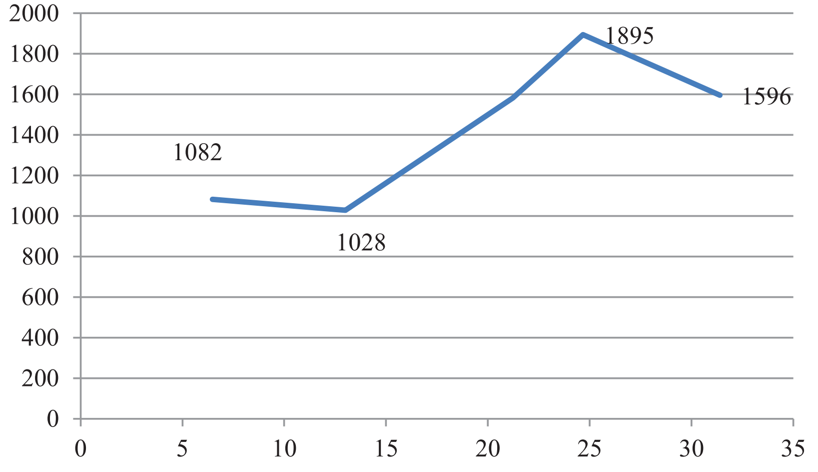

Figure 4. Graph for the compacted material.

The impulse breakdown voltage test had been successfully conducted in the laboratory for dry and wet soils. It is then compared with local soil which is from laterite type. As for the local soil, it is taken from around the IVAT building, Faculty of Electrical Engineering, UTM.

The impulse wave is specified by defining their front time (rise) and tail time (fall) to 50% of peak value, and the value of peak voltage. Thus, 1.2/25 μs, 10 kV wave represents an impulse voltage wave with a front time of 1.2 μs and tail time of 50% peak value of 25 μs and a peak value of 10 kV.

For this experiment, the voltage drop drastically to zero in less than 10 μs at 33.47 kV using dry POA. So it can be said that the breakdown has occurred because the tail time is set at 25 μs.

The experiment was continued by adding water to the material tested. Table 3 shows the data obtained. It can be seen in the palm oil ashes, the voltage decreases when moisture was increased. Meanwhile, for the local soil, the voltage is up and down. For POA, the highest breakdown voltage is 33.47 kV during dry and this voltage drop drastically when the water content of the material at 20%. At 20% the voltage drops to 9.33 kV which is the smallest.

As for the local soil, the highest voltage is at 41.13 kV when dry and the lowest at 34.38 kV during water content up to 10%. But at 20% the voltage increase to 37.39 kV. From this experiment it is found that by increasing the water, the voltage breakdown decreasing.

Table 3. Comparison between POA breakdown voltage and local soils

Moisture (%)	Breakdown Voltage (kV) Palm Oil Ashes	Local Soil (laterite)
0	33.47	41.13
10	29.39	34.38
20	9.33	37.39

4.0 CONCLUSION AND DISCUSSIONS

This research has successfully covered the tests for the particle size distribution, compactness, moisture holding capacity and breakdown voltage under impulse.

In the particle size distribution, it had been shown in the results section. For moisture holding capacity, it is found that it can hold up to 1.5 times its dry mass volume. This indicated that it can consume more water and contribute to soil resistivity because it is known water effect in soil resistivity.

At 25% water content, it is found that it can be compacted at optimum at 1875 Mg/m^3. Results from the breakdown voltage also show that the breakdown voltage drop significantly to around 10 kV. Meanwhile, based on the breakdown voltage under impulse, it is found that the breakdown voltage for wet soils is always lower than the dry soils. This proved water effect the resistivity in grounding.

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