COMPARATIVE STUDY OF SOME GEOTECHNICAL PROPERTIES ON JAPAN AND MALAYSIA PEAT SOIL

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1. INTODUCTION

Peat deposits distribution is extensive and can be found in many countries throughout the world. The peat land consists of nearly 8% of the earth land surface and nearly 60% of the wetland of the world is peat. Peat can be described as naturally occurring, highly organic substance derived primarily from plant materials. Peat is formed when the rate of accumulation of organic matter is greater than the rate of decay. The identification of peat is very important because they are much weaker than mineral (inorganic) soils. As such, they do not provide suitable supports for most engineering works. Peat and organic soil represent the extreme form of soft soil and subject to instability and enormous primary as well as long-term settlement even when subjected to moderate load.

2. BACKGROUND

Most of peat soils are controlled by its organic matter quantity, quality and physical properties. Geotechnically, peat soils described as soil that having an organic content greater than 75%. Japanese soil science classify the soil with more than 5% organic contents as organic soils while with more 50% as highly organic soils and generally called peat particularly by Hokkaido Agriculture Experiment Station. In Malaysia, classification of peat and organic soils is based on the British Standard 5930:1981. Nevertheless, this classification has been upgraded by Public Work Malaysia to make this system more clear and suitable to the Malaysia situation.

3. METHODOLOGY

For this study purpose, some peat soil from Hokkaido, Japan had been used. The depth of excavated samples is about 1m from ground surface. Some test of physical, mechanical and chemical properties of these peats had been conducted like shown in figure 1.

4. RESULT AND DISCUSSION

The results in table 1 revealed that Malaysia and Japan peat soil varies from different geographical locations when natural water content is consent. This is normally due to the influence of different agricultural background of the area and rainfall intensity. The results for water and organic contents as calculated were 580% and 83.21% respectively. These values are consistent with studies conducted by Noto [1] and Hamamoto [2] which revealed that Hokkaido peat have range of water content 110% to 1600% while organic content range 20% to 98%. In Malaysia, these parameters are higher than Japan peat with water contents accounted to 200% and can reach to 2200% whereas organic content range 50% to 98%. Range of 8 to 12 kN/m^3 is common for unit weight of peat in Malaysia. In Japan, range of unit weight is between 7 and 20kN/m^3. Unit weight of the peat will be affected by the water content of peat; as the water content increase, the unit weight will show a sharp reduction. When water content about 500%, the unit weight normally will ranges from 10 to 13kN/m^3. This fact proved by author when obtaining the unit weight of Hokkaido peat with 12.5kN/m^3 at 580% water contents. For peat with an organic content of 75% and greater, the specific gravity is in the range from 1.3 to 1.8 with an average of 1.5. Specific gravity for tested peat was recorded 1.67 which is mean this soil have fairly high degree of decomposition and mineral content.

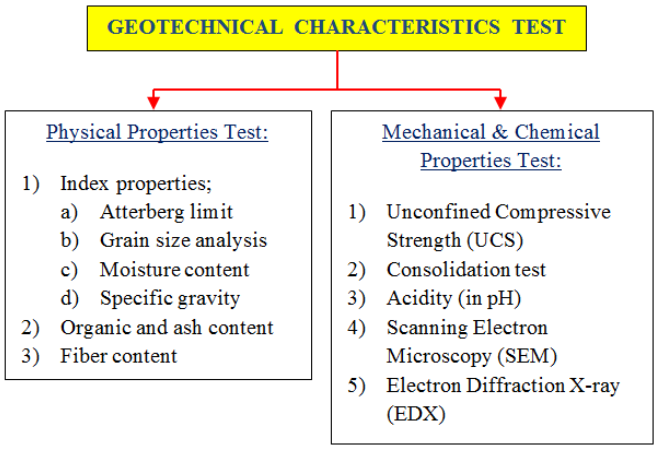

Figure 1 Geotechnical Characteristic Laboratory Test

In fiber content test, calculated fiber content is 41% which is categorized as hemic peat. With 16.79% of ash contents, studied peat is classified in high ash group. In pH test, average pH of soils is quite large with 5.46 compared to Malaysia peat with range of 3 to 7. This means Hokkaido peat are categorized as lightly acidic peat.

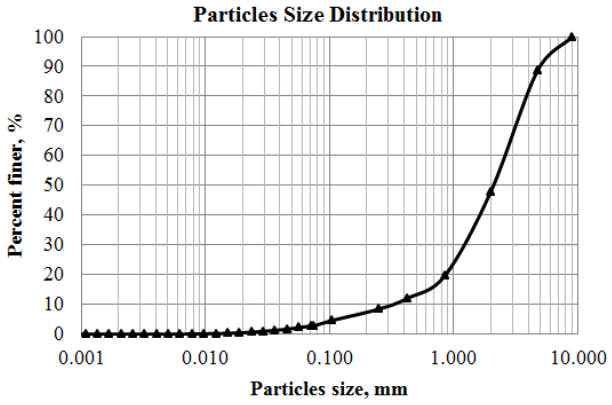

Figure 2 Graph of Hokkaido Peat Particle Size Distribution

Keywords: Geotechnical properties of peat, Japan peat, Malaysia peat
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Table 1 Geotechnical Engineering Characteristic of Malaysia and Japan Peat Soil

Properties		Japan		Malaysia		
		Hokkaido		West	East	Johor
Natural water content, %		580	115-1570	200-700	200-2207	230-659
Loss on ignition	Ash content, %	16.79	2-80	3-35	5-50	1.5-20
	Organic content , %	83.21	20-98	65-97	50-95	80-98.5
Bulk unit weight (kN/m^3)		12.5	7.1-19.7	8.3-11.5	8-12	7-12.3
Specific gravity, G_s		1.67	1.04-2.63	1.38-1.7	1.07-1.63	1.44-1.8
Fiber content, %		41	42-86.9	31-77	-	49
Acidity ,pH		5.46	-	-	3-7.2	3.63
Atterberg limit, %	Liquid Limit	375	-	190-360	210-550	220-380
	Plastic Limit	-	-	100-200	125-297	-
	Plastic Index	-	-	90-160	85-297	-
Compression Index, C_c		2.79	0.3-14	1.0-2.6	0.5-2.5	0.9-1.5
Undrained shear strength, *kPa*		13.20	5-40	8-17	8-10	7-11
References		Authors	[1], [2], [3]	[4]	[4]	[5], [6]

Table 2 Percentages of oxide compounds of the Japan and Malaysia peat

Oxide Compound	CO_2	NA_2O	MgO	Al_2O_3	SiO_2	P_2O_5	SO_3	K_2O	CaO	SrO	TiO_2	ZnO	Fe_2O3	TOTAL	Reference
Hokkaido, Japan	86.78	0.32	0.38	1.5	5.48	1.94	0.22	0.64	0.65	-	0.62	-	1.46	100.0	Authors
Malaysia	93.5	0.045	0.153	0.846	3.28	0.032	0.8	0.043	0.365	0.03	0.021	0.218	0.683	100.0	[8]

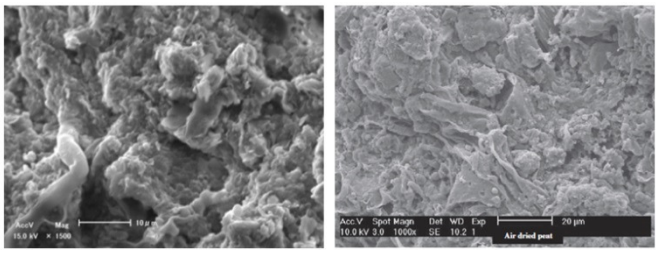

Figure 3 SEM of Hokkaido [Authors] and Malaysia [8] peat

By using normal dry sieve test method, the soil particles distribution obtained as shown in Figure 2. As can be seen, Hokkaido peat consists broadly of sand to fine size base on Unified Soil Classification System (USCS) gradation and on average, 90% of the soil is finer than 4.75mm, and 2% is finer than 75μm. The coefficient of uniformity, (C_u) is 9.3, and the average coefficient of gradation (C_g) is 1.71. According to this information and USCS, the Hokkaido peat will fall in region the SW subgroup. Pattern of Hokkaido peat particle size distribution is quite similar with Malaysia peat conducted by Kalantari [7]. For liquid limit and plastic limit value, Malaysia peat varies from 190% to 550% and 100% to 300% respectively while the studied peat gave the results 375%. For mechanical properties of studied peat, undrained shear strength was gained about 13 kPa while gave quite high compression index compared to Malaysia peat with 2.8. These mean Hokkaido peats are more highly compressible matched to Malaysia peat. Table 2 and figure 3 shows the percentages of oxide compounds and microstructure of the Japan and Malaysia peat by using EDX and SEM respectively. Oxide compound and SEM results for Malaysia peat were obtained from recent research by Wong [8].

5. CONCLUSION

In conclusion, this paper has discovered some review of Japan and Malaysian peat relating to geotechnical properties. Overall, Hokkaido peat that had been studied has many similarities of peat properties with Malaysia peat especially in West region including Johor peat. These similarities display in table 1 which is shows the whole comparison between Malaysia and Hokkaido peat. Studied peat can be categorized as hemic with high ash and lightly acidic peat. This research results also lead to a better understanding of the performance of Japan and Malaysia peat for better geotechnical design in future.

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