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Electrical and mechanical properties of soil at rubber plantation in West Anjir Serapat, Central Kalimantan, Indonesia

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Abstract. Rubber plantations can grow optimally when it is planted at the precisely of the altitude and latitude, in addition soil of rubber plantation also has unique characteristics. Typical soil characteristics are caused by the physical properties of the soil. This study aims to examine the electrical and mechanical properties of soil in rubber plantations at West Anjir Serapat Village, in Central Kalimantan Indonesia. The soil samples were collected by using Hand Auger drill with 4cm diameter along 450cm. Measurement of electrical properties and water content using EM50 with sensor 5TE per cm and mechanical properties using sieve analysis. Both of these parameters were analyzed to the depth. The results showed there were two distinct electrical properties layers. The upper layer to 197 cm associated with clay soil have the high conductivity layer (2.52 - 1.48 dS/m) and up to 197 cm associated with silty clay soil have the low conductivity layer (1,33-0,16 dS/m). The mechanical properties supported the electrical properties showed there were two soil layers.

1. Introduction

Environmental pollution by heavy metals in Indonesia is increasing nowadays, mercury is the most. Indonesia is the second country producer of rubber and the largest area of rubber plantations in the world [1]. Thailand, Indonesia and Malaysia produce the rubber is almost 70% in world [2]. Rubber plantations usually grow well on the geography coordinate at 15S to 15 N and at 200 m above sea level with 80% of humidity. The area of rubber plantations in Indonesia exceeds Thailand but rubber production of Indonesia is still below Thailand [3].

Indonesia have 3-4 hectare areas and at the Central Kalimantan is one of the province has area of rubber plantations. In the Central Kalimantan have economic potentially of rubber plantations [4, 5]. There are many researches at rubber plantation subject, except the electrical conductivity, the electrical conductivity really contribute to the soil properties [6]. The aim of this research comperes the electrical conductivity with mechanical properties at rubber plantation and validation with organic soil.

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2. Methods

This research was done in June 2015 in the dry season at rubber plantation in the West Anjir Serapat village, Kapuas Regency, Center Kalimantan Province, Indonesia with the geography coordinate at $3^{o}05'24.9"S$ and $114^{o}26'42.9"E$. Sample soils were taken to 450 cm by Auger hand, the samples wrapped with aluminum foil before stored at PVC pipe to keep humidity of sample soil.

The electrical conductivity and water content measurement were done by every cm 5TE sensor from Decagon Devices Inc. USA. All the data stored into data logger EM50. The mechanical properties of sample measurement at mechanical of soil laboratory at Tek-Mira (Research and Development of Mineral and Coal Technology) were used by the number sieve of 10, 20, 40, 60, 140 and 200. The sample soil was filtered from the smallest sieve number to the highest sieve numbers. Filtered sample of soil must be weighed. The mass of sample soil was 200 gram; the sieve number 10 to 60 filled the sand soil. The sieve number 140 was for the silt soil and sieve number was 200 for the clay soil.

Furthermore C-Organic test at chemical laboratory with The Wakley-Black method, which is dry sample soil with 0.1 to 2 gram of mass (texture 0.2 mm) put in Erlenmeyer flask, then it was entered into Erlenmeyer flask 10 ml with 0,167 M $K_2 Cr_2 O_7$ by volumetric pipette and it was added 20 mL H_2SO_4, then it took 20 to 30 minutes to mix slowly and softly. Then it was added distilled water and 2 ml 80% $HSPO_4$, 0.2 gram NaF and 6 drops of diphenylamine indicator, after that titrated is done quickly with 0,5 N Fero Amino Sulfate or 1N Fero Sulfate so that we can see the changing of colors.

3. Result and Discussion

The result of measurement electric conductivity and water content properties of soils to the depth are shown at Figure 1 and Figure 2. Based on measurement of electrical conductivity, every 1 cm shows that there is a changing of electrical conductivity in the depth, its 0.16 – 2.52 dS/m range of electrical conductivity.

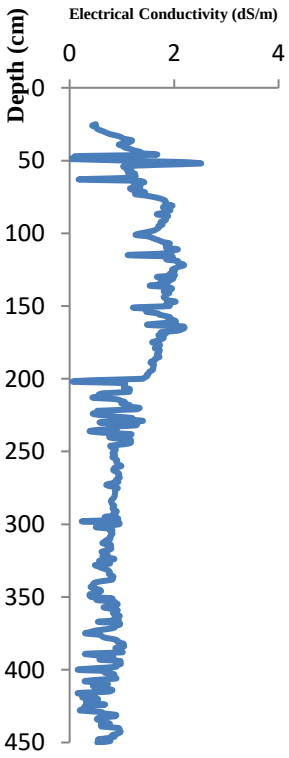

Figure 1. Profile of electrical conductivity to the depth.

Figure 2. Profile of Water Content to the depth.

In the Figure 1 shows that the pattern changes of electrical conductivity to the depth, there is deeper of depth is smaller of the electrical conductivity and there is a significant changing of electrical conductivity on the depth of 197 cm. On the surface to 197 cm depth, the value of electrical conductivity is 1.48- 2.52 dS/m and it is associated as the first layer while the depth is deeper than 197 cm is associated as second layer is smaller of electrical conductivity than the first layer.

The next result of the laboratory measurement is water content properties that is measured per centimeter while has range of 0.129 – 0.382 m^3/m^3. It can be seen in the Figure 2 that the changing of water properties, it is seen decreasing tendency toward greater depths, although the pattern of water content no significantly like electrical conductivity properties

The pattern changes of electrical conductivity will analysis by soil texture and porosity. The measurement was done in every soil layer, in the first layer is contained of clay almost, and while in second is contained by silt and clay, it shown in Table 1. The data of the Table 1 shows that is plotted into Triangle soil from USDA (United States Department of Agricultural) [7] and the result of the first layers was associated clay soil. It can be seen on the Figure 3 with circle blue color while in the second layer with red circle was silty clay soil**.**

Table 1. Texture and porosity of Soil layer at Rubber Plantation

	Layer 1	Layer 2
Sand	17.10 %	13.00 %
Silt	34.80%	45.80 %
Clay	47.10%	41.20%
Natural Porosity	71.48%	64.94%

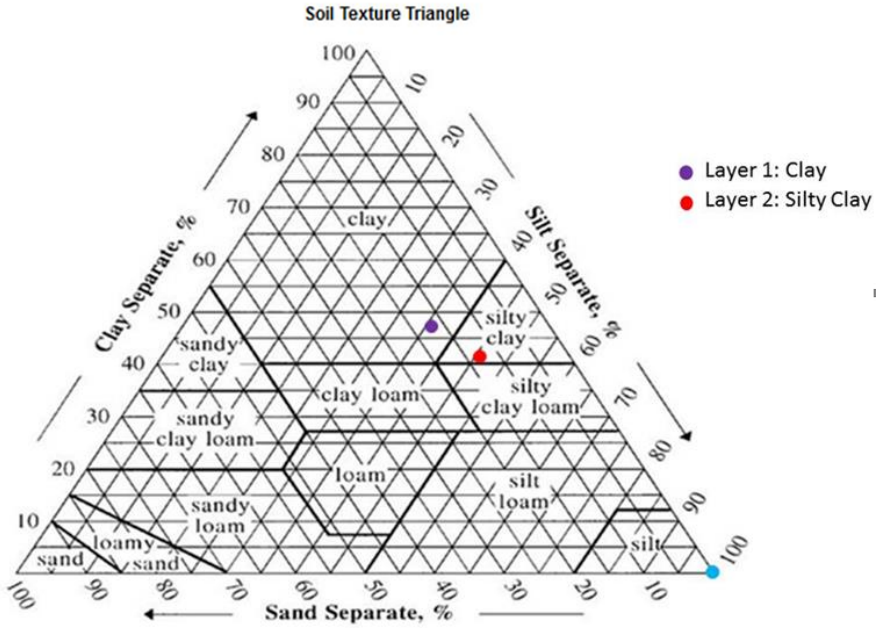

Figure 3. Soil texture of soil layer at Rubber Plantation

The result of measurement shows that the first layer has electrical conductivity 2.52 - 1.48 dS/m is clay while in the second layer the result of electrical conductivity is 1,33-0,16 dS/m is silty clay. This measurement result is the same as the research of Islam et.al (2010) in Madhupr and Kanajhora, in Bangladesh [8]. The result of porosity at the first layer is bigger than the second layer, its opposite with result that clay has lowers porosity than silty clay. To make validation of this result so that the test of C organic is done, it shows that C organic in the first layer is 0.82% and second layer is 0.49%. In Asian countries where the tropical weather which has lower organics [9, 10]. Although the value of C-organic in every layer is very small but the result or value C-Organic influence the porosity in soil. In first layer with high electrical conductivity associated clay with C-organic more than second layer with lower electrical conductivity associated silty clay with C-organic less.

4. Conclusion

The value electrical conductivity as higher as the content porosity so that electrical conductivity can identify the layer of soil in the rubber plantation for this reason that water content properties, texture soil, porosity and C-Organic content.

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