Analysis of the Soil Parameters of 21- Mile Village and Doekwin Village from Pyin Oo Lwin Area, Mandalay Region, Myanmar

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Abstract

The aim of this research is to study the physicochemical analysis on the selected soil samples collected from Pyin Oo Lwin Township, Mandalay Region. The sample 1 was collected from 21-mile village and the sample 2 was collected from Doekwin village, Pyin Oo Lwin. Firstly, the mineral contents in the two samples were determined by using Energy Dispersive X-ray Fluorescence (EDXRF) method. Secondly, the physical properties of the samples such as moisture, pH, texture, bulk density, total dissolved solids and electrical conductivity (EC) were determined by using the AOAC (Association of Official Agricultural Chemistry) method and modern spectroscopic technic. After that, the chemical properties of the samples, such as the amounts of chloride, sulphate, calcium, magnesium and organic matters were also investigated.

Keywords : physicochemical analysis, EDXRF, pH, texture, electrical conductivity

Introduction

Soil is a thin layer of material on the Earth's surface in which plants have their roots.[4] Soil is formed over a long period of time. The soil texture, soil type usually refers to the different sizes of mineral particles in a particular sample. Soil is made up in part of finely ground rock particles, grouped according to size as sand, silt and clay. [6]

The soil profile generally consists out of three main layers (horizons) the top soil (100-200 mm deep) or darker layer, where air, water and humus allow plants to grow in the sub-soil, a more clay-like layer which acts as a reservoir (water store) for the plants, and the bedrock or parent material which is the underlying layer from which the first two horizons are formed. Soil horizons are set apart from other soil layers by differences in physical and chemical composition, organic structure, or a combination of those properties. Soil horizons are developed by the interactions, through time, of climate, living organisms, and the configuration of the land surface (relief). [6] [9]

Soil is a natural surface layer that is capable of supporting plants. Soil forms the upper, most layer of the earth's crust and is made up of inorganic and organic matter. The inorganic components of soil are weathered rock, air, water and minerals. The organic matter is the decomposing fragments of plants and animals. The spaces between the small particles that make up the soil are filled with air or water living plant and animal live in the soil and improve aeration and drainage. [3][8]

Materials and Methods

Preparation of Soil Samples

The soil samples were collected from 21-Mile Village and Doekwin Village, Pyin Oo Lwin Township, Mandalay Region. From each area, sub-soil was taken from the depth of twelve inches of the surface. Samples were broken up into small lamp as and spread out in the shade for air-dry. Gravel and root were discarding. After drying, the sample were

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grounded and sifted through a sieve with round holes 2 mm in diameter. The samples passing the sieve were mixed together very thoroughly and used for analysis.

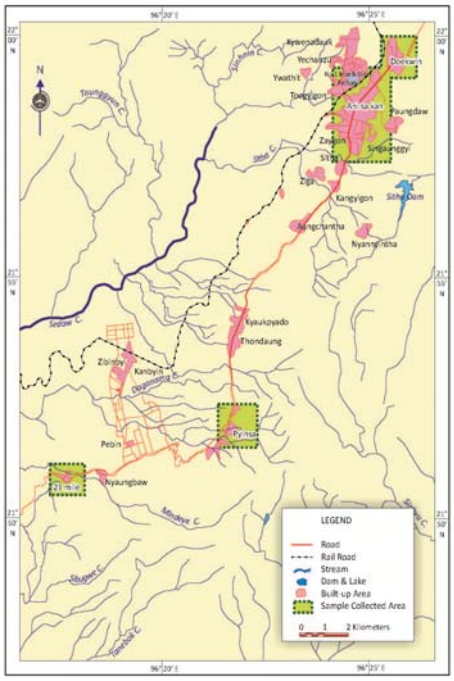

Figure (1). Location Map of Samples Collected Area
Source: UTM Map No. 2196_05 and 2296_08

Characterization of Soil Samples

EDXRF Analysis

Elemental compositions of the selected samples were determined by applying EDXRF (Energy Dispersive X-Ray fluorescence) spectroscopy at Department of Physics, University of Mandalay. (SPECTRO XEPOS EDXRF Spectrometer, Germany)

Figure (2). Spectro XEPOS EDXRF Spectrometa, Germany

Moisture

The moisture contents of the selected samples were determined by oven drying method. [2]

Texture

10 g of sample was weighed accurately and placed in 500 cm^3 conical flask and some amount of distilled water was added. The flask was heated till boiling 10 cm^3 of 10 % sodium

pyrophosphate solution was added to disperse the soil colloids and heating was continued for about fifteen minutes. Then it was cooled. After cooling the contents were transferred to a 1000 cm^3 measuring cylinder and the solution was made up to the mark with distilled water and then kept overnight to allow the soil colloids to settle. The next day, the contents were stirred for about four minutes, the solution from 9 cm depth was pipette with 25 cm^3 pipette and then it was transferred to a porcelain basin and evaporated on a water bath. From this residue, the percentage of clay and silt were calculated.

After four hours of the stirring the solution was pipetted with 25 cm^3 pipette from 4 cm depth and evaporated. From this residue, the percentage of clay was calculated. Then the percentage of silt was obtained by difference. To determine the amount of sand, the remaining solution was poured into 50 cm sieve and clay and silt were washed with water. The percentage of sand was then calculated. [1]

Hydrogen Ion Concentration (pH)

The pH values of the samples were determined by electrometric method direct measurement with pH meter. (GAUTAM, S.P., 21st Edition, 2005)

Electrical Conductivity

The conductivities of the extracts were directly determined by the conductivity meter.

Figure (3). Determination of pH

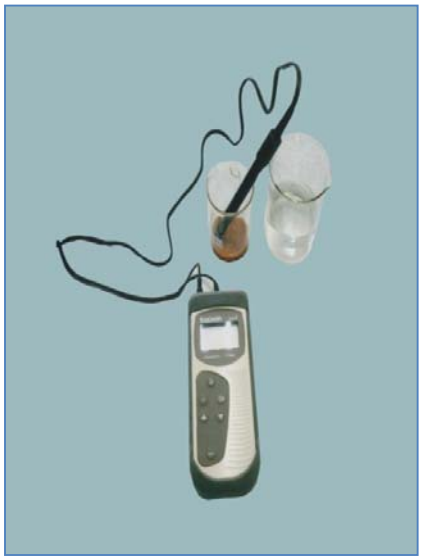

Figure (4). Determination of Electrical Conductivity

Total Dissolved Solid

The total dissolved solids of the collected samples were determined by evaporation method. (GAUTAM, S.P., 21st Edition, 2005)

Bulk Density

Firstly, the dried density bottle was weighed (W_0). The specular sample 1 g was placed into the bottle and weighed again (W_1). Then, the bottle was filled with distilled water and weighed again (W_2). And then, the content of the bottle was removed. Finally, the bottle was filled with distilled water only and weighed again (W_3). [1][7]

W_1 **W_2**

Figure (5). Determination of Bulk Density

Density = $\frac{(W_1 - W_0)}{(W_3 - W_0) - (W_2 - W_1)}$ x density of water *(1)*

Weight of density bottle = W_0
Weight of density bottle + sample (1) g = W_1
Weight of density bottle + sample (1) g + distilled water = W_2
Weight of density bottle + distilled water = W_3

Determination of Chemical Parameters

Chloride

25 cm^3 of the water extract was pipetted into conical flask and 1 cm^3 of 10 % potassium chromate solution was added. Then it was titrated with 0.01 M silver nitrate solution. The end point color was reddish brown. [10]

Figure (6). Determination of Chloride

Sulphate

25 cm^3 of water extract was pipetted into conical flask and the flask was gently warmed to expel carbon dioxide till its content began boiling and 10 cm^3 of 0.01 M barium chloride solution was added. It was cooled to room temperature. Then 5 cm^3 of ammonium buffer solution (pH=10) was added. Eriochrome Black T was used as an indicator. It was titrated with 0.01 M EDTA solution. The end point was blue black. [10]

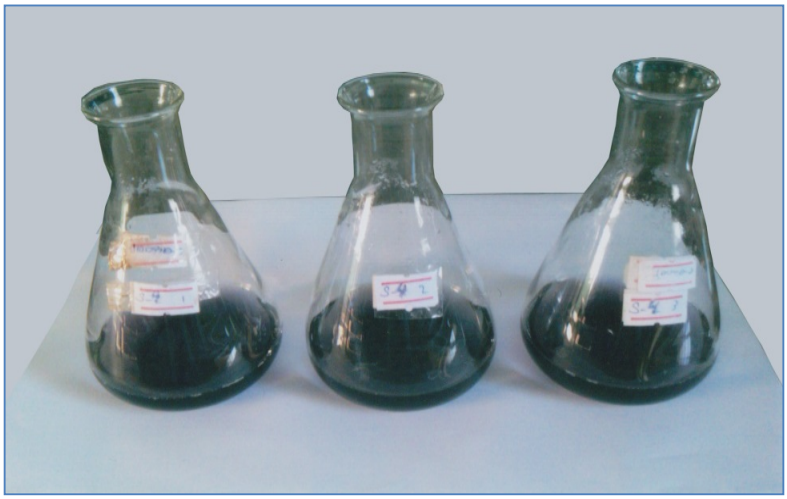

Figure (7). Determination of Sulphate

Exchangeable Calcium and Magnesium

2.5 g of sample was weighed accurately and placed in a 500 cm^3 shaking bottle containing 250 cm^3 of 1 M sodium chloride solution. The bottle was shaken for three minutes and kept overnight and then filtered. To determine calcium and magnesium, 25 cm^3 of filtrate was pipetted into conical flask and then 5 cm^3 of ammonium buffer solution (pH = 10) was added. Eriochrome Black T was used as an indicator. It was titrated with 0.02 M EDTA solution until the color changed to blue.

To determine calcium, 25 cm^3 of filtrated was pipetted into conical flask and then 2 cm^3 of 10 % sodium hydroxide solution was added. Murex ide was used as indicator. It was titrated with 0.02 M EDTA solutions and the end point color was violet. [10]

Determination of Organic Matter

0.2 g of soil in 500 ml Erlenmeyer flasks, exactly 2 ml of 1 M $K_2Cr_2O_7$ was added by pipette and mixed by swirling the flask. Then 4 ml of concentrated H_2SO_4 was added and mixed for one minute by gentle rotation. It was allowed to stand 20 to 30 minutes. 40 ml of water and 2 ml of concentrated H_3PO_4 was added. Then it was cooled at room temperature. 5 drops of indicator was added and titrated immediately with 0.25 M ferrous ammonium sulphate solution until end point of indicator was reached. Normal color changes were green to blue to blackish pink.

Figure (8). Determination of Organic Matter

Results and Discussion

In the present soil analysis, the soil samples were collected from 21-Mile village and Doekwin village, Pyin Oo Lwin Township, Mandalay Region. The results of the values of mineral contents in soil samples were shown in table (1).Moisture, pH, texture, electrical conductivity, density and total dissolved solid of soil samples were determined. In addition, the amount of chloride, sulphate, calcium, magnesium and organic matter were determined by the use of various titration methods. The results were shown in table (2).

Table (1). Mineral Content in Two Soil Samples from Pyin Oo Lwin Area

No.	Elements	Relative Abundance % Sample 1	Relative Abundance % Sample 2
1.	Aluminum	6.914 %	4.061 %
2.	Silicon	20.58 0%	9.006 %
3.	Phosphorus	0.049 %	0.058 %
4.	Sulfur	0.016%	0.012 %
5.	Chlorine	0.041 %	0.071 %
6.	Potassium	2.090 %	0.663 %
7.	Calcium	0.781 %	0.565 %
8.	Titanium	0.481%	0.307 %
9.	Vanadium	0.011 %	0.011 %
10.	Chromium	0.022 %	0.009%
11.	Manganese	0.171 %	0.111 %
12.	Iron	3.662 %	2.905 %
13.	Rubidium	0.014 %	0.003 %
14.	Zirconium	0.039 %	0.023 %

In sample 1, EDXRF spectral data shows 20.580% silicon, 6.914 % of aluminum, 3.662 % of iron, 2.090 % of potassium and 0.781 %of calcium are present. Sample 2 contains 9.006 %of silicon, 4.061 %of aluminum, 2.905 % of iron, 0.663 %of potassium and 0.565 %of calcium. The silicon contents are greater amount in sample 1 and 2. The percentage of some mineral contents in sample 1 is larger amount than that of sample 2. This soil sample was collected from Doekwin village.

Table (2). Comparison of Parameters between Soil Samples

Sample	Parameter					
	Moisture	Texture			pH	Electrical Conductivity (ds/m)
		Sand (%)	Silt (%)	Clay (%)		
1	7.82	62.508	5.94	29.55	6.87	0.00218
2	3.75	51.896	3.63	43.47	7.08	0.00173

Continued

Parameter						
Total Dissolved Solid (%)	Bulk Density (gcm^{-3})	Cl^- (%)	SO_4^{2-} (%)	Exchangeable Ca and Mg		Organic Matter (%)
				Ca (%)	Mg (%)	
0.0288	1.59	0.1349	0.6877	3.136	0.038	0.8765
0.1854	2.600	1.0295	0.6487	2.496	0.038	0.8765

[5][8][10]

Sample 1 – 21-Mile village

Sample 2 – Doekwin village

According to the results of texture, sample 1 may be sandy clay loam soil and the sample 2 may be sandy loam soil. The moisture content in sample 1 is greater than sample 2.All soil samples have neutral pH conditions. The nutrients are available to plants in these soils pH conditions. The EC (ds/m) value in samples 1 is larger than other sample. The total dissolved solids in sample 2 are greater than the other sample. The bulk density of sample 2 is larger value than that of sample 1. The chloride content in sample 2 is greater than that of other and sulphate and magnesium contents in sample 1 are greater than sample 2.The amount of calcium in soil sample 2 is greater than that of sample 1. Percentage of magnesium and organic matter in sample 1and 2 are the same amount.

Conclusion

In this research work, two soil samples were collected from Pyin Oo Lwin area and analyzed by different parameters. The mineral contents in soil sample were determined by using EDXRF method. According to the EDXRF spectral data, the soil samples contain significant amounts of aluminum, silicon and iron. Moreover, sample 1 and 2 contain significant amounts of potassium. Soil pH is the most widely measured soil parameter. This pH measurement determines the degree of acidity or alkalinity in soil materials suspended in water. According to the results of analysis data, such as moisture, pH, total dissolved solids, organic matters and other required minerals, the selected soil samples are suitable for growing plants and nutrients are available to plants in these areas. The soil samples are classified as sandy clay loam for sample 1 and sandy loam for sample 2 character, accordance with the composition of the textural classes of soils used by the United State soil survey.

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