A Study on the Chemical Characteristics of Soil near the Petroleum Land Area, Maubin Township, Ayeyarwady Region

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Abstract

The production of our food and the quality of our environment are so importantly related to the wise use of the soil. The aim of the present reseach is to study the quality of soils collected from near the Petroleum Land Area, Maubin Township, Ayeyarwady Region. Three sampling sites were chosen for this investigation. The sampling Site –1 is the right hand side of factory, Site –2 is the back side of factory and Site –3 is the centre of two sampling sites –1 & 2. These areas were arable cultivation especially paddy and mung bean. Some physicochemical properties such as pH,moisture contents, bulk density, particle density and porosity were examined. The nutrients (NPK) for soils were also determined by recommended methods. These values are favourable for cultivation of plants. Some heavy metals (Fe,Cu,Pb) contents were measured by atomic absorption spectrophotometer (AAS). Based on the observations, it was found that soils from the vicinity of petroleum land area were not affected by the industrial wastes and suitable for the cultivation of paddy and mung bean.

Keywords: physicochemical properties, textual classes, nutrients, heavy metals

Introduction

The process of soil quality assessment is an evaluation of the physical, chemical and biological nature of soil in relation to natural quality, human effects and intended uses, particularly uses which may affect human health and the health of aquatic system itself.

Soil quality assessment includes the use of monitoring to define the condition of the water, to provide the basis for detecting trends and to provide the information enabling the establishment of cause effect relationships. Important aspects of an assessment are the interpretation and reporting of the results of monitoring and the making of recommendations for future actions (Cockroft, 2000).Therefore, the aim of the research work is to study the chemical characteristics of soils collected near the petroleum land area, Maubin Township, Ayeyarwady Region.

Soil makes up the thin layer of the earth where we live. Soil has a wide range in size of particles. Some particles are large rock fragments. Some particles are sand sized,

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like those in sand dunes. Particles of silt and clay size are usually so small they feel smooth and cannot be seen with the naked eye.

Further, the plants produce organic matter in the soil. Plant growth and weathering usually occur together in the soil formation. In soil formation the plants roots excrete carbon dioxide that dissolves in the soil water and forms carbonic acid (Henry, 1970).

Soils, naturally, found vary widely in their composition depending on their origin along with time and the natural forces involved in their formation process. Soil testing is an important management tool require for maintaining the proper chemical and microbiological balance within a soil necessary to optimize crop production without depleting the nutrient reserves (Tucker, 1985).

The Composition of Soils

Mineral soils are composed of three major constituents: sand, silt and clay. A fourth component, organic matter, although extremely important in the biological, chemical and physical aspects of the soil, is not generally considered in the textural make up of mineral soils. The different components of a soil are referred to as fractions; namely, the sand, silt, clay, and organic fractions. Soil which contains high clay content is known as clayey or finely textured soil; the silt loam, loam, clay loam, and silts are medium textured soils; and the sands are called course textured soils. Each soil type has been characterized by field and laboratory tests which are based on certain common chemical and physical properties (Hudson, 1994).

The problem of soil pollution arises due to mixing of toxic and polluted materials in the soil. Illegal dumping is the biggest reason for soil pollution, which adversely affects the quality of soil and the health of people living on it. Soil pollution also spreads through polluted water absorbed by the soil. Chemical compost used in agricultural work, litter and dirt also badly pollutes the soil. The soil is also polluted by the mineral oil spread on the land accidently. Pollutants present in the air also contribute to polluting the soil. Through the rain water, pollutants present in the air descend on the ground which ultimately results into polluting the soil (Hashmi, 2018).

Materials and Methods

This section deals with all the experimental procedures involved in the present work. The chemicals used throughout the experiments were analytical and reagent grade. In all the investigations, the methods and techniques involved both conventional method and modern instrumental techniques by using standard recommended techniques and specific catalogues.

Sample Collection

In this study, soil samples were collected from three different sites from the vicinities of Petroleum Land in Maubin Township area. The respective samples were taken systematically from the centre of the factory. Soil samples were taken about 20cm depth from the surface in a zigzag manner. Sampling site –1 is at the right hand side of the factory, sampling site –2 at the is back side of the factory and sampling site –3 in is the center of sampling site –1 and 2. The photographs of sampling places are shown in Figure 1 to 4.

The soil samples were mixed thoroughly and dried in the shade before sieving. Afterwards, gravel, roots, etc. were discarded. Then the soil samples were passed through the (80) mesh. The soil samples were stored in polyethylene bags and clearly labeled.

Methods of Analysis

In all analytical procedure of the experiments, recommended standard methods and techniques were applied. The chemicals were used from British Drug House (BDH) England.

- Oven (Ambient 2 ± 2°C, Griffin, England)
- pH meter (MD 100, Photometer, Lovibond)
- Balance (Blance Sartorius AG Gottingen BL 1015)
- Atomic Absorption Spectrophotometer(AA–7000 Series), Shimadzu, Japan

Table 1. Location site of Petroleum Land Area

No	Sampling Site Number	Sampling Place
1	Sampling Site –1	Right hand site of the factory
2	Sampling Site –2	Back site of the factory
3	Sampling Site –3	Centre of two sampling sites 1&2

Figure 1. Location site of Petroleum Land Area

Figure 2. Sampling Site 1 (right hand site of the factory)

Figure 3. Sampling Site 2 (back site of the factory)

Figure 4. Centre of Sampling Site 1 and Site 2

Results and Discussion

Soil texture

Soil texture refers to the relative percentage of sand, silt and clay in a soil. In the present work, the soil texture classes were clay loam for sampling Sites –1 and 3.Silty clay loam for sampling site (3). Silt loams are the best soil types for plant growth and agriculture. Clay loam contains a good deal of plant nutrients and supports most types of plants and crops (Brady, 2008). Based on the above observation, it was found that the soil from the collected area were good quality for cultivation of plants. These results are shown in Table 1.

Table 1. Results of Soil Texture Class in Collected Soil Samples

Sampling Sites	Soil Parameters			Texture Class
	Clay (%)	Silt (%)	Sand (%)	
Site–1	61.85	35.95	1.10	Clay Loam
Site–2	61.35	36.25	1.15	Clay Loam
Site–3	46.15	51.15	1.25	Silty Clay Loam

Physicochemical Properties of Soil Samples

pH

Soil pH is a measure of acidity and alkalinity in soils. Acid soils have a pH below 7 and alkaline soils have a pH value greater than 7. In this present work, the pH value of sampling site (1) was found to be 3.87. In sampling site (2) and (3), pH values were 4.53 and 4.55. These results are shown in Table 2. According to the resultant data, the pH of soil was strongly acid medium for all sampling sites. Therefore some treatment is required for plants growth.

Moisture contents

The moisture content of soil is the quantity of water contained in a material, such as soil, rock, ceramics, crops or wood. In this research work, the moisture contents were found to be 6.07 % in sampling site (1) , 6.09 % in sampling site (2), 4.59 % in sampling site (3). Therefore, soils from all sampling sites were dry soils.

Bulk density

Bulk density of a soil is inversely related to the porosity of the same soil, the more pore space in a soil the lower the value for bulk density. Bulk density is an indicator of soil compaction. Bulk density is typically expressed in gmL^{-1}. High bulk density is an indicator of low soil porosity and soil compaction. It may cause restrictions to root growth, and poor movement of air and water through the soil. Compaction can result in shallow plant rooting and poor plant growth, influencing crop yield and reducing vegetative cover available to protect soil from erosion. Bulk density reflects the soil's ability to function for structural support, water and solute movement, and soil aeration. It is used to express soil physical, chemical and biological measurements on a volumetric basis for soil quality

assessment and comparisons between management systems. This increases the validity of comparisons by removing error associated with differences in soil density at time of sampling (Mc Kenzie, 2002). In the present work, the bulk density values of soils were found to be 0.6020 gmL^{-1} for Site–1, 0.6009 gmL^{-1} for Site–2 and 0.6094 gmL^{-1} for Site–3. According to the results, the bulk density of the soil is a good indication of the suitability for root growth. All results are shown in Table 2.

Particle density

Soil particle density is an important soil property for calculating soil porosity expressions. The particle density of the soil measures the mass of a dried soil sample in a given volume of particles. If the particle density is high, the soil consists of minerals that have a high. Soil particle density depends on the chemical composition and structure of the minerals in the soil. Most mineral particles in soils have a particle density ranging from 1.60 to 2.75 gmL^{-1}. However, the density can be as high as 3.0 gmL^{-1} for very dense mineral particles, and as low as 0.9 $gmL^{-1}$for organic particles. Particle density focuses on just the soil particles themselves and not the volume they occupy in the soil (Paustian, *et al.,* 2000). These results were 1.0200 gmL^{-1} for Site –1, 1.0120 gmL^{-1} for Site–2 and 1.1129 gmL^{-1} for Site–3. Therefore, the soils from collected area were suitable for plants growth. In the present work, the values of particle density are shown in Table 3.

Porosity

Porosity of surface soil typically decreases as particle size increases. The gap between solid particles is the porosity of soil, which contains water and air. Hydro char has an important impact on soil porosity. The soil volume required to immobilize hydrocarbons depends on soil porosity, the physical properties of the hydrocarbons, and the volume of released hydrocarbon. Porosity is the fraction of the total soil volume that is taken up by the pore space. The relationship of bulk density and porosity is reciprocal. The good soil for growing most plant contains about 50 % of pore space and 50 % solids (Kostecki & Dragun, 2005). For this study, the porosities of soils were 31 %, 30 % and 32 % for each site. The resultant values are also suitable for plant growth.

Table 2. Some Physico–Chemical Properties of Collected Soil Samples

Soil Parameters	Sampling Sites		
	Site–1	Site–2	Site–3
pH	3.87	4.53	4.55
Moisture	6.07	6.09	4.59
Bulk Density (gmL^{-1})	0.6020	0.6009	0.6094
Particles Density (gmL^{-1})	1.0200	1.0120	1.1129
Porosity (%)	31	30	32

Nitrogen, Phosphorus, Potassium (N P K)

Nitrogen, phosphorus and potassium are the main components of soil fertilize. In the present work, nitrogen contents of sampling Site–1 were found to be 0.21%, 0.15% in Site–2 and 0.15% in Site–3. Phosphorus contents of all sampling sites were very low. The exchangeable cation(Potassium) contents of sampling were found to be 0.025% in Site–1, 0.30% in Site–2 and 0.02% in Site–3. Exchangeable cation of K^+ in sampling Site–1 and 2 was higher than Site–3. Available nutrients of phosphorus were not much enough but oxide form of potassium were high in all sampling sites. The results are shown in Table 3.

Some Metal Contents in Collected Soil Samples

The concentrations of some metals in collected soil samples were analyzed. Some three metals (Fe, Cu, Pb) contents in soil samples collected from three sampling sites were determined by using Atomic Absorption Spectrophotometer (AAS). In this research work, iron content of sampling Site–1 was found to be 5435 mg/kg. For sampling Site–2 and 3, the observed values were 3407 mg/kg and 3209 mg/kg.Copper contents of sampling Site–1, 2, 3 were found to be0.0523 mg/kg, 0.0421 mg/kg and 0.0262 mg/kg respectively. These values are lower the contamination levels of EPA guide line. Lead content of sampling Site–1 was found to be 0.0046 mg/kg and Site–2 was 0.0105 mg/kg. Moreover lead content in Site–3 was 0.0150 mg/kg .The results indicate that the some heavy metal (Fe, Cu, Pb) contents in soil samples were found to be lower the contamination levels of EPA guideline (2008).These results are shown in Table 4.

Table 3. Results of Nutrient Values in Collected Soil Samples

Sampling Sites	Nutrient Values		
	N(%)	P (ppm)	K^+ (%)(Exchangeable cation)
Site–1	0.21	0.63	0.025
Site–2	0.15	1.33	0.030
Site–3	0.15	0.62	0.020

Table 4. Results of Some Metal Contents in Collected Soil Samples

Sampling Sites	Some Metals (mg/kg) (dry wt)		
	Fe	Cu	Pb
Site–1	5435	0.0523	0.0046
Site–2	3407	0.0421	0.0105
Site–3	3209	0.0262	0.0150

Conclusion

In this research work, the soil samples were collected from three sampling sites of Petroleum Land Area in Maubin Township, Ayeyarwady Region. The various modern techniques and instruments were used to determine the physicochemical properties, nutrient and some metal contents of soil samples.

For the overall assessments, the pH values of collected soil samples were found to be acidic because the pH values were 3.87, 4.53 and 4.55. The moisture content of soil samples were observed in the range of 4.59 % to 6.09%. It indicated that soils in these areas were dry soils. The value of bulk density was found in the range of 0.6009 gmL^{-1} to 0.6094 gmL^{-1}. The particle density of soil sample was observed in the range of 0.0120 $gmL^{-1}$to 0.1129 gmL^{-1}. The porosity of soil samples were found in the range of 34 % to 36 %. The soil texture class was found in silt loam for sampling Site–1 and Site–3 and clay loam for sampling Site–2, respectively. In nutrient values of soil samples, the nitrogen content of soil was found to be in the range of 0.20 % to 0.22 %. The phosphorus content of soil was observed to be in the range of 0.00063% to 0.00133 %. The potassium value (exchangeable cation) of soil was found to be in the range of 0.02 % to 0.03 %. In the metal contents of soil samples, the Fe contents of soil were found to be 5435 mg/kg in Site–1, 3407 mg/kg in Site–2 and 3209 mg/kg in Site–3. The Cu value of soil was observed in the range of 0.0762 mg/kg to 0.1373 mg/kg and the content of Pb of soil was found to be in the range of 0.0204 mg/kg to 0.0226 mg/kg, respectively. The results indicate that the metal (Fe, Cu and Pb) contents in soil samples were found to be lower than the contamination levels of EPA guideline (2008).

Overall assessments of these observations, it can be concluded that the quality of soil was not greatly affected by Petroleum Factory but all the soils showed acidic character based on the pH values. Therefore some treatment on soil is necessary for cultivation.

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