International Journal of Geology, Earth & Environmental Sciences ISSN: 2277-2081 (Online)
An Online International Journal Available at http://www.cibtech.org/jgee.htm
2013 Vol. 3 (2) May-August, pp.28-34/Sumithra et al.

Research Article

A CASE STUDY ON PHYSICO - CHEMICAL CHARACTERISTICS OF SOIL AROUND INDUSTRIAL AND AGRICULTURAL AREA OF YERRAGUNTLA, KADAPA DISTRICT, A. P, INDIA

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ABSTRACT
Soil provides all the basic needs to us and is the most important medium for growing plants. Eleven soil samples from 10 – 20 cm depth were collected in the vicinity of industrial and agricultural land, Yerraguntla, Kadapa district (India). The physico – chemical parameters such as pH, EC, water holding capacity, organic carbon, sodium, potassium, sulphate, phosphate, calcium and magnesium of soil were analysed. The result reveals that soil exhibited alkaline characteristics, high in calcium and magnesium.

Key Words: *Soil Samples, Industrial, Carbon, Water Holding Capacity*

INTRODUCTION

Soil is one of the important and valuable resources of the nature. All living things are directly and indirectly dependent on soil for day to day needs and 95 % of the human food is derived from the earth. Making plan for having healthy and productive soil is essential to human survival. Soil is a natural body consisting of layers (soil horizons) of mineral constituents of variable thicknesses, which differ from the parent materials in their morphological, physical, chemical and mineralogical characteristics. Soil is composed of particles of broken rock that have been altered by chemical and mechanical processes that include weathering and erosion. Soil has complex function which is beneficial to human and other living organism. It acts as a filter, buffer storage, transformation system and thus protects the global ecosystem against the adverse effects of environmental pollutants. Environmental neglect by society, since the dawn of the industrial revolution has resulted in severe contamination of soil and water resources (Ramaswamy *et al*., 2007).

Soil pollution is developed due to constant fall of cement dust, resulted in the formation of colloidal gels of calcium silicate and calcium aluminate.

The cement dust, produced by cement manufacturing units is considered one of the most hazardous pollutants which affect the surrounding environment. These particles can enter into soil as dry, humid or occult deposits and can undermine its physico – chemical properties. The deposit of these particles is complex and it is controlled by the atmospheric stability, the roughness of the surfaces as well as the diameter of the particles (Hosker and Linderg, 1982).

Soil has important ecological functions in recycling resources needed for plant growth. Soils have purification property as well. Soil supports terrestrial life through five processes: (Ramasamy *et al*., 2007) biomass productivity, (Hosker and Linderg, 1982) restoration and resilience of ecosystems, (Jha and Singh, 1991) purification of water, (Bray and Kurtz, 1945) detoxification of pollutants, and (Lal Singh, 2012) cycling of C, N, P, S, and H_2O. Inherent soil physico – chemical properties influence the behavior of soil and hence, knowledge of soil property is important. Soil is one of the planet's largest reservoirs of carbon in the form of organic matter. If we lose soil organic matter from fields, more carbon dioxide goes into the atmosphere and climate change is promoted. If we increase soil organic matter, carbon dioxide is withdrawn from the atmosphere, and climate change is moderated.

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Soil physico – chemical properties deteriorate to the change in land use especially from agriculture and forest. Cropping and leaching of soil nutrients, in turn adversely affects physico – chemical properties of the soil. The waste materials discharges from industrial activities cause adverse effects on soil and soil organic matter. The change in physico – chemical properties of soil leads to infertile or barren soil that does not support normal growth of vegetation for years (Jha and Singh, 1991).

MATERIALS AND METHODS

1. Study Area

Yerraguntla is a census taluk and mandal in Kadapa district in the Indian state of Andhra Pradesh. It is a land of cement factories having latitudes 14° 38'0"N and longitude 78° 32'0"E. Yerraguntla is also famous for stones, which is used for houses flooring and construction of houses.

2. Soil sampling location in the study area

Soil samples taken at 10 – 20 cm in depth were collected from different locations in the vicinity of the cement plant, stone quarrying, mining, agricultural, and non agricultural soil within the study area. The soils are ground and passed through 0.2 mm sieve and were used for the analysis.

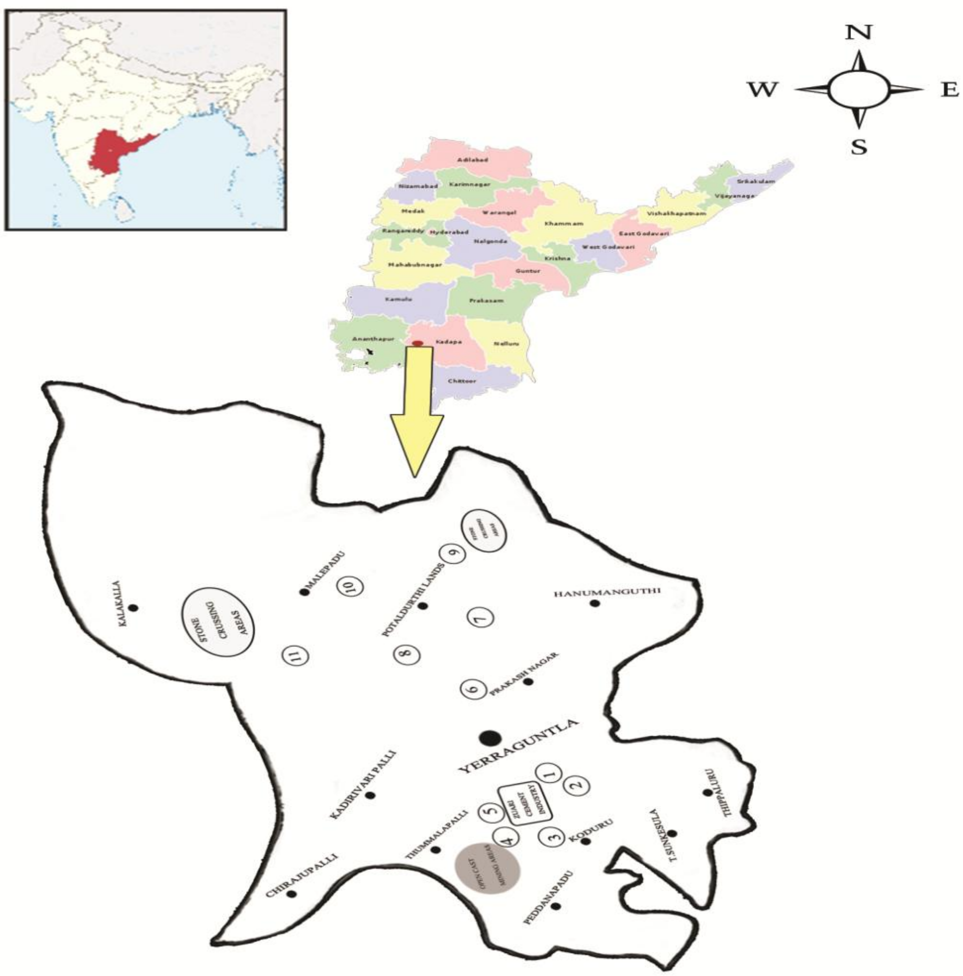

Figure 1: Map of Study area

Table 1: Physico - Chemical properties

Soil pH	pH Meter
Electrical Conductivity	Conductivity Meter
Water Holding Capacity	Filtration method
Available Phosphorous	Bray's method (Bray and Kurtz, 1945)
Sodium	Ammonium acetate method (Lal Singh, 2012)
Potassium	Ammonium acetate method
Organic Carbon	Rapid titration method (Walkley and Black, 1934)
Sulphur	Turbidimetric method (William and Steinbergs, 1959)
Calcium and Magnesium	EDTA titration method (Tucker and Kurtz, 1961)

% OM = % OC x 1.72
% N = % OC/10 (Ali et al., 2012)
OC: Organic Carbon, OM: Organic Matter, N: Nitrogen

RESULTS AND DISCUSSION

To study the adverse effect of pollutants, the soil samples were collected from various spots in the study area and the results of physico – chemical analysis are shown in Table 2 & 3. The pH of the soil taken from the depth of 10 – 20 cm at different sites ranged from 7.6 to 9.4 which indicate that the soil is alkaline. The high soil pH can be attributed to the leakage and spread of alkaline effluent generated from the cement industry, as it was well known that high sodium content gives rise to high pH in the soil (Elango *et al*., 1992).

Electrical conductivity (EC) is a measure of ions present in solution. The conductivity of a solution increases with the increased amount of ions. In the agricultural field electrical conductivity plays an important role, because of salinity aspect. Conductivity depends upon the dilution of soil suspension. In the present study, EC of the soil was found to be higher for S6 and S10 sample containing 2763 µs/cm and 4140 µs/cm respectively.

The water holding capacity is an index of a number of physical properties of soil. Good water holding capacity shows the good physical condition of soil. The uses of sewage water in agriculture increase the water holding capacity (Soffe, 1995). The water holding capacity of soil varies in range between 17.68 %-97.68 %. Samples S8 and S9 showed water holding capacity of 55.7 %, whereas S11 has showed 97.68 % of water holding capacity.

Table 2: Results of Physical parameters of soil samples

Sample	**S1**	**S2**	**S3**	**S4**	**S5**	**S6**	**S7**	**S8**	**S9**	**S10**	**S11**
pH	8.64	8.88	9.45	8.85	8.80	8.06	9.08	9.23	9.48	7.66	8.74
EC (µs/cm)	139.1	110.8	225.7	112.7	103.7	2763	242.7	183.5	235.4	4140	915
WHC (%)	40.12	52.72	21.97	33.91	40.65	45.07	17.68	55.72	55.77	43.05	97.68
Colour	Black	Black	Red	Black	Black	Black	Black	Black	Yellow	Black	Black

Table 3: Results of Chemical parameters of soil samples

Sample	Org. C (%)	% OM	Na (%)	SO_4^{2-} (ppm)	Available P (Kg/ha)	K (%)	% N	Ca & Mg (Meq/L)
S1	1.607	2.77	2.77	90	12.5	2	0.16	272.75
S2	2.127	3.67	3.3	40	30	1.5	0.212	242.75
S3	0.591	1.08	1	138	30	2	0.059	145
S4	1.607	2.77	1.85	ND	15	2	0.16	236.75
S5	1.359	2.34	1.38	ND	17.5	2.6	0.135	227
S6	0.989	1.70	31	1600	ND	1.5	0.098	230
S7	1.242	2.14	0.25	120	47.5	2.6	0.124	241.75
S8	0.865	1.49	1	36	17.5	2	0.086	204.88
S9	0.104	0.18	0.25	206	ND	2	0.01	179.88
S10	0.702	1.21	55.75	5400	37.5	2.6	0.07	234.63
S11	0.123	0.21	1	2260	ND	5	0.012	74.5

ND= Not detected

Phosphorus is a part of every living cell in plant. The every activity of plant such as growth, respiration and reproduction depends upon phosphorus levels of the soil in which the plant grows. In the present study the amount of available phosphorus at S7 and S10 are 47.5 and 37.5 kg/ha, whereas at S1 there is reduction in available phosphorous content i.e 12.5 kg/ha. Similar results have been reported in soil irrigated with sewage and canal water of Dehradun city, India (Swapnil *et al*., 2011). S6, S9 and S11 has no available phosphorous (Table 2 and Figure 2).

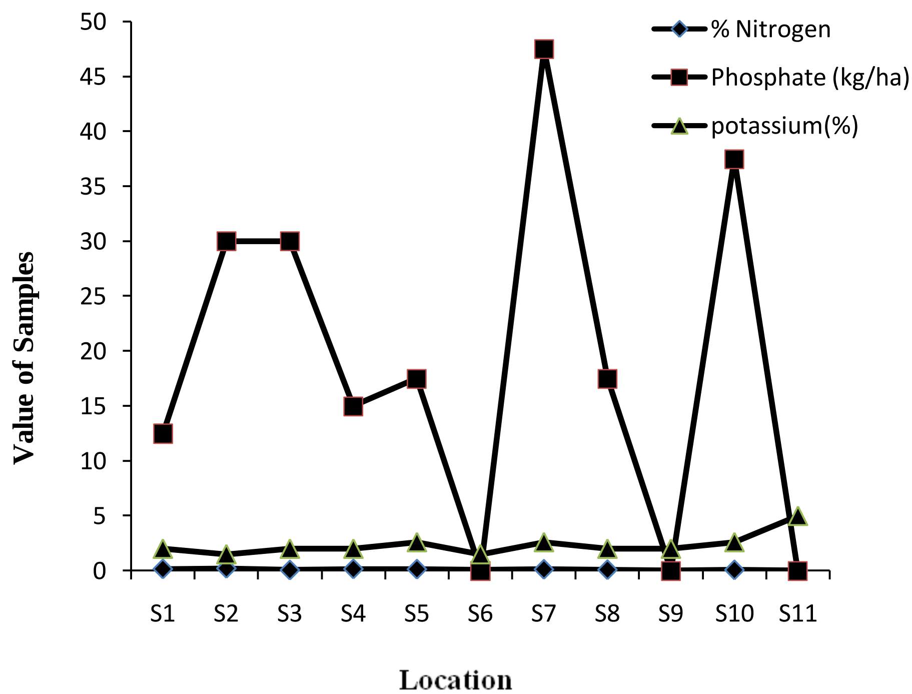

Figure 2

Nitrogen is the most important fertilizer element. Plants respond quickly to application of nitrogen salts. This element encourages above ground vegetative growth and gives a deep green colour to the leaves. Plant roots take up nitrogen in the form of NO_3 and NH_4. In the present study the S2 showed 0.2 % of nitrogen whereas S9 showed less percentage of 0.01% (Table 2 & Figure 2). Similar report was observed in soil of Sanganer region of Jaipur Rajasthan (Nidhi and Ashwani, 2008).

Potassium is not an integral part of any major plant component but it plays a key role in a vast array of physiological process vital to plant growth from protein synthesis to maintenance of plant – water balance. In the present study S5, S7 and S10 showed 2.6 % of K whereas S11 showed 5 % (Table 2 & Figure 2). Potassium is a very soluble cation in solution, yet its mobility in soil is very slow. The K ions, on being adsorbed by the colloids displaces other ions such as Ca, Mg or Na. Soils ability to absorb and hold K is of great importance as it serves to decrease leaching and provides more continuous supply of available K.

Soil carbon is the last major pool of the carbon cycle. The carbon fixed by plant is transferred to the soil via dead plant matter including dead roots, leaves and fruiting bodies. Carbon is taken out of the atmosphere by plant photosynthesis about 60 gt annually is respired or oxidized from soil (Lal, 2008). Soil carbon is primarily composed of biomass and non – biomass carbon sources. Some of the carbon substrates will bind to the mineral soil becoming encapsulated in soil aggregates or forming chemical complex. Soil organic carbon improves the physical properties of soil. It is widely accepted that the carbon content of soil is a major factor in its overall health. The results of organic carbon and organic matter of study area, shows a highest range of 2.12 % and 3.67 % in S2. The S9 and S11 showed 0.104 % and 0.123 % of organic carbon (Table 2 & Figure 3). Similar study was observed in impact of industries on soil characteristics of Mysore city (Shiva Kumar *et al*., 2012).

Organic matter is the source of 90 - 95 % of the nitrogen in unfertilized soil. Organic matter commonly increases water content at field capacity, increases available water content in sandy soil and increases both air and water flow rates through fine textured soil (Ramulu, 2001).

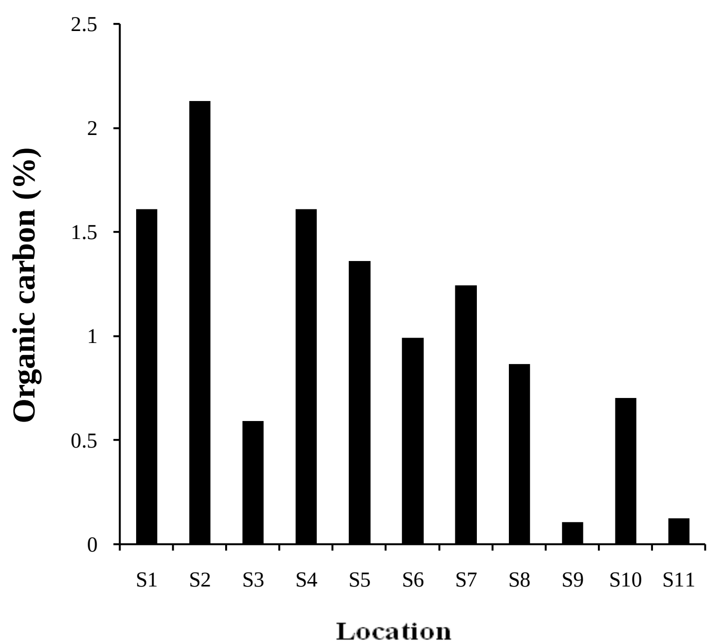

Figure 3

Sodium is a component of sodium chloride (NaCl), a very important compound found everywhere in the living environment. Sodium is a compound of many foodstuffs for instance. The minimum requirement for sodium is 1,500 mg/day (The American Heart Association, 2010). In the present study, the sodium content of samples ranges from 0.25 to 55.75 % (Table 2).

Higher concentration of Na causes the decrease in bulk density as well as water holding capacity by decreasing the porosity in clay soil due to deflocculation of clay particles in the presence of higher Na content as it affects the cation exchange capacity in the soil (Vinod Kumar and Chopra, 2011). Values of sulphate in different samples vary from 40 to 5400 ppm (Table 2 & Figure 4). S4 and S5 have no sulphate content. Higher value of sulphate in soil samples represented a good quality of soil. Industrial effluent is quite rich in sulphate content and there may be low degradation by microorganism. Most soil sulfur comes from the weathering of sulfate minerals such as gypsum.

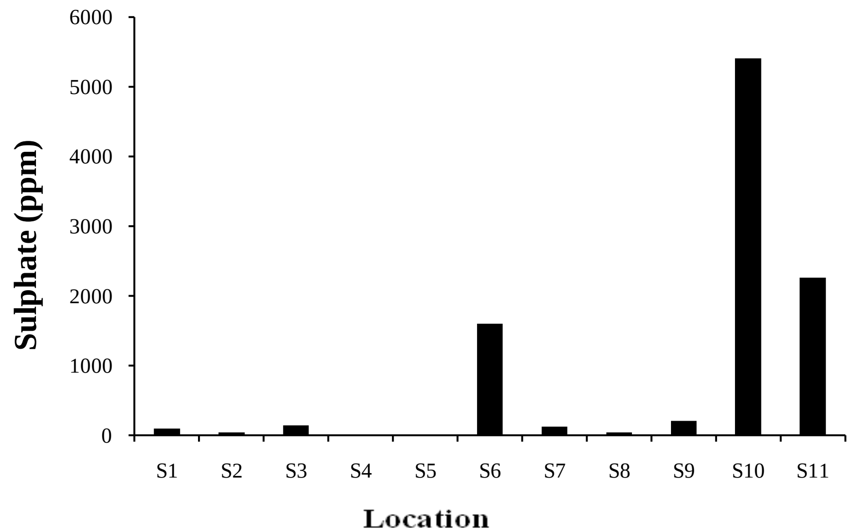

Figure 4

Calcium and Magnesium are very important elements for plant life. It is the most abundant mineral in soil. These are, however, required in comparatively small amount and are known as secondary nutrients (Swapnil *et al.,* 2011). In the present study calcium and magnesium ranges from 74.5 to 272.75 Meq/L. In fields, calcium shortages are most likely on irrigated sands, acid soils, or rich soils, whose presence inhibit calcium uptake. High levels of soil potassium may also induce magnesium shortage in plants.

Conclusion

The present study shows that the soil is rich in calcium and magnesium. The pH of most of the soil samples was found to be alkaline. Electrical conductivity was high near stone crushing area indicating the effect on soluble salts content of the soil. The organic carbon of soil was high near Zuari cement industry area as well in agricultural land which clearly indicates the fertile soil. The level of sodium and sulphate were high near stone crushing area but no sulphate content near mining and cement industry area. Phosphate was high in agricultural and near by stone crushing areas whereas potassium level was medium in most of the studied areas. The physico – chemical properties of soil around industrial and agricultural area under study show significant variations.

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