INTERNATIONAL JOURNAL OF APPLIED BIOLOGY AND PHARMACEUTICAL TECHNOLOGY

www.ijabpt.com Volume-3, Issue-4, Oct-Dec-2012 Coden : IJABPT Copyrights@2012

ISSN : 0976-4550

*Received: 19th Sept-2011* *Revised: 14th Sept-2012* *Accepted: 27th Sept-2012*

***Research article***

# MICROBIOLOGICAL AND PHYSICOCHEMICAL STUDIES OF SOIL NEAR BHOKAR OF MAHARASHTRA

[1]Shaikh Parveen R., [2] Bhosle Arjun B. & [3]Yannawar Vyankatesh B.

[1,3]Research Student and [2]Assistant Professor, School of Earth Sciences, Swami Ramanand Teerth Marathwada University, Vishnupuri, Nanded 431606 (MAHARASHTRA) India.
E-mail: abbkandlikar@gmail.com, parveen_earth@yahoo.co.in, vbyannawar@gmail.com
Corresponding author:Tel.No. +91-9049031840

**ABSTRACT:** A field study was conducted at Bhokar for the soil and its various contents during the period of September 2010 to August 2011. A thorough survey was carried out to examine the quality of soil samples collected from agricultural farmlands around Bhokar city of Maharashtra state, India. The soil is mainly alluvial in nature. Data presentation revealed different values of physical and chemical characteristics of the soil. The objective of the study was to assess and compare the physicochemical properties of this soil. The study was carried on few selected physical, chemical and microbiological characterization and that to the quality soil and its nature. The standard analytical methods were applied for the analysis of soil under study.
**Keywords**: Soil quality, Chemical analysis, UV-spectrophotometer.

## INTRODUCTION

Soil is one of the most significant ecological factors, on which plants depend for their nutrients, water and mineral supply. Soil is having living organisms and products of their decay intermingled. The major inorganic constituents of soil are of Al, Si, Ca, Mg, Fe, and K. However, it also contains minor quantities of B, Mn, Zn, Cu, Mo, Co, I and F. The main organic constituent of soil is humus.

The essential plant nutrient elements apart from carbon, hydrogen and oxygen are primarily supplied from the soil. These three, usually make up more than 90% of the mass of fresh plant tissue, differ in that, they come from atmospheric carbon dioxide or water. The soil derived essential elements and their important forms in soil are N, P, S, K, Ca, Mg, Fe, Mn, Cu, Zn, Mb, B, Cl, Co and Se (Johns, 1982).

It is presumed that certain native trees and differences in vegetation type are likely to impart soil properties. This is for the fact that soil supports particular type of flora and fauna (Wild, 1993).

Accumulation of heavy metals in agricultural soil is a subject of increasing concern due to food safety issues and potential health risks as well as detrimental effects on soil ecosystem (McLaughlin et al., 1999).Plants grown on a land polluted with municipal, domestic or industrial wastes can absorb heavy metals in the form of mobile ions present in soil solution, through their roots or through foliar absorption. These absorbed metals get bioaccumulated in the roots, stems, fruits, grains and leaves of plants (Fatoki, 2000).

Both industry and agriculture have contributed to increase the concentration of environmentally important trace elements through many ways such as waste disposal, atmospheric deposition, fertilizer, pesticide use and other media, in many areas around the world (Hesterberg 1998; Kabata- Pendias and Pendias 2001; Cui et al. 2005).Salt accumulation in soil is a major threat to agricultural production and ecosystem sustainability. Globally, 100 million ha (5%) of arable land are damaged by high salt concentrations (Lambers, 2003). In Australia, it is estimated that more than $130 million of agricultural production are lost annually from salinization. The National Land and Water Resources Audit (2000) reported that 5.7 million hectors have a high potential for the development of dry land salinity and predicts this to rise to 17 million ha by 2050.

Copper which is an active ingredient of fungicides is reported as one of the most toxic metal to soil microorganisms and soil health (Dussault et. al., 2008). Heavy metal concentration in agricultural soil of industrialized countries have increased due to the expanded use of the fertilisers and the elevated atmospheric deposition (Banat et al. 2007; Zapusek and Lestan 2009; Jalali and Moharami 2010).

Coden : IJABPT Copyrights@2012 ISSN : 0976-4550

It is well known that soil organic matter is a reservoir for plant nutrients, enhances water holding capacity, protects soil structure against compaction, erosion and thus determines soil productivity. All agriculture to some extend depends on the content of soil organic matter as well as the soil nutrients. Maintenance of organic matter is critical for preventing land degradation (Martius, et al., 2001). Salts in soil cause osmotic stress, which can reduce crop yields (Lambers 2003),

Furthermore, the procedure used in the present study can be applied in many areas that bear similar characteristics with the study area of the present work.

## STUDY AREA

The soil samples were collected from Bhokar area, Bhokar Taluka, Nanded district. The study area is located at latitude $19^0$ 9'54.05"N and longitude $77^0$ 20'15.84"E. Ten sampling sites were selected for study.

It is a village with mountains around with Teak wood trees and a large lake. The major occupation is agriculture, where major people's production is Cotton.

## MATERIAL AND METHODS

### Sample Collection

The soil samples were collected from agricultural farmlands by using a corer and were brought to the laboratory in polythene bags which are properly labeled and analyzed. For determining the pH, first the soil samples were mixed thoroughly, air dried and passed through a mesh sieve. The samples were used for subsequent physico-chemical and biological analysis by following methods.

**Determination of the physico-chemical parameters of the soil samples**

**Soil moisture**:

The soil was dried in an oven at $150^oC$. The difference in the initial and final weight of the soil determines soil moisture.

**Water Holding Capacity (WHC):**

WHC were determined as the amount of maximum water held in saturated solids.

**Electrical conductivity (EC):**

The EC of the soil was determined in 1:5 (soil: water) suspension with the help of a Conductivity meter.

**Soil pH**:

The pH of the soil was determined in 1:5 soil: water suspension with the help of a pH meter.

**Organic carbon (OC)**:

Organic carbon content of the samples was determined by titrometric method as reported by Walkley and Black (1934) and represented as % of OC.

**Organic matter (OM):**

Organic matter content of soil samples were calculated from organic carbon by multiplying it by Von Bemmlen factor.

**Alkalinity**:

Soil alkalinity is due to presence of soil minerals producing sodium carbonate upon weathering. It was determined by titrating the soil suspension with a strong acid using methyl orange as an indicator.

**Calcium Carbonate ($CaCO_3$)**

Calcium carbonate was determined by rapid titration method.

**Chloride**:

The chloride is an essential ion for plant growth. The chloride present in the sample was determined in 1:5 soil: water suspension by Argentometric method.

**Calcium (Ca) and Magnesium (Mg)**:

Exchangeable Calcium and Magnesium were determined in ammonium acetate leachate by titration method (Jackson 1973).

**Sodium (Na) and Potassium (K)**

Exchangeable Sodium and Potassium determined by flame photometric method.

**Sulphate ($SO_4$)**

The sulphate present in soil sample was determined in 1:5 soil: water suspension by turbidimetric method and measured by spectrophotometer.

Coden : IJABPT Copyrights@2012 ISSN : 0976-4550

**Available Phosphorus**

Available phosphorus was determined by extracting it with sulphuric acid by stannous chloride method by spectrophotometer.

**Fluoride**:

The fluoride present in soil sample was determined in 1:5 soil: water suspension by SPANDS method on UV-Spectrophotometer.

**Iron (Fe)**

Iron was estimated by acid digestion of soil using standard Thiocynate method on UV-Spectrophotometer.

**Standard plate count (SPC)**

The soil samples were serially diluted and cultured on SPC medium and count the bacterial colonies after 24 and 48 hours of incubation at ambient condition. (Trivedy and Goel, 1998).

## RESULTS AND DISCUSSION

All physical, chemical and biological parameters of the soil samples are shown in table 1.

The water holding capacity reported for the soil samples vary between 25 to 29 % and soil moisture was 2.16 % to 37.32 %. The soil moisture commonly ranges from 5% to 35%. Generally, it depends on void ratio, particle size, clay minerals, organic matter and ground water conditions. (Martin, 1994). Site no.2 exhibits the highest electrical conductivity (109.5 uS/cm). The lowest electrical conductivity was exhibited by site no. 10 (69 uS/cm). An average electrical conductivity of soil was 88.75 uS/cm .Electrical conductivity indicates the amount of soluble ions (salt) in soil. Higher EC indicates accumulation of salts in the soil.

The pH range depends on the available minerals/salts in the soil. The soil samples of the various farms are found to be slightly alkaline in nature. The pH ranged from 6.85-7.80. The acidic pH is due to more soil organic matter content and high microbial activity which results in high organic acid production. Least acidity may be due to poor addition of soil organic matter by plant species. The chloride content was found to be in the range of 1.065 to 2.13% with an average 1.735%. The alkalinity of soil samples was observed in the range between 1.5 to 2.5 meq/100 gm with an average 1.85 meq/100 gm. The calcium carbonate ranged from 0.5 to 5% with an average 2.9%. The sulphate content was found from 48 to 1843.2 mg/L. The mean value of sulphate content was 950.88 mg/L. The percentage of organic carbon was highest (0.30 %) in site no.1 and lowest (0.018 %) in site no. 10 and the percentage of organic matter was highest (0.517 %) and lowest (0.031 %) at same sites. The mean value of organic carbon is 0.1862% from ten sampling sites. Magnesium ranged from 38.98 to 194.91 mg/g and Calcium from 533.04 to 901.8 mg/g. High concentration of Ca and Mg increases pH of the soil. The mean values of calcium and magnesium were 723.116 and 90.631 mg/gm respectively. The concentration for available phosphorus detected in the range of 0.33 to 3.72 % with an average 1.1305 %. As soil pH is increased from very acid values (pH 3) to near neutrality (pH 7) phosphorous availability therefore increases steadily (Cresser, 1993). The sodium found from 30.1 to 79.8 mg/L and potassium from 00.0 to 72.2 mg/L. The average sodium and potassium content were 42.98 and 8.41 mg/L respectively.

The fluoride ranged from 9.44 mg/L to 21.77 mg/L and Iron from 3.4 to 90 mg/L. In some samples it is above the permissible limit i.e.4.5 ppm (Agriculture dept.). The average fluoride and iron content were 18.587 and 23.62 mg/L. The standard plate count (SPC) from soil samples ranged between 3345.9 to 55046 cells/gm. The average standard plate count of soil samples was 34160.99 cells/gm.

**Table 1: The Physico-chemical and biological properties of soil samples.**

| Sr. No. | Soil Parameters | $S_1$ | $S_2$ | $S_3$ | $S_4$ | $S_5$ | $S_6$ | $S_7$ | $S_8$ | $S_9$ | $S_{10}$ | Mean | S.D. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Soil moisture (%) | 3.12 | 2.16 | 2.72 | 5.48 | 7.26 | 7.58 | 4.10 | 37.32 | 3.78 | 12.90 | 8.64 | 10.56 |
| 2 | Water holding capacity (%) | 28 | 28 | 28 | 28 | 27 | 27 | 26 | 29 | 25 | 28 | 27.4 | 1.173 |
| 3 | EC (uS/cm) | 102.5 | 109.5 | 92.75 | 75.25 | 87.5 | 107.5 | 72.5 | 91.25 | 79.75 | 69 | 88.75 | 14.57 |
| 4 | Soil pH | 7.80 | 7.47 | 7.70 | 7.48 | 7.27 | 7.31 | 6.94 | 7.23 | 7.03 | 6.85 | 7.308 | 0.312971 |
| 5 | Organic Carbon (OC)% | 0.30 | 0.27 | 0.138 | 0.14 | 0.249 | 0.26 | 0.142 | 0.12 | 0.225 | 0.018 | 0.1862 | 0.088 |
| 6 | Organic Matter (OM) % | 0.517 | 0.465 | 0.237 | 0.241 | 0.429 | 0.448 | 0.244 | 0.206 | 0.387 | 0.013 | 0.3187 | 0.155 |
| 7 | Alkalinity (m eq/100g) | 2 | 2.5 | 1.5 | 2 | 1.5 | 2.5 | 1.5 | 1.5 | 2 | 1.5 | 1.85 | 0.411 |
| 8 | Calcium carbonate (%) | 3 | 2 | 0.5 | 2.5 | 5 | 2.5 | 5 | 5 | 2.5 | 1 | 2.9 | 1.629 |
| 9 | Chloride (%) | 1.775 | 2.13 | 1.775 | 1.775 | 1.42 | 1.065 | 1.42 | 1.42 | 2.13 | 1.42 | 1.735 | 0.342 |
| 10 | Calcium(mg/gm) | 765.5 | 806.5 | 857.7 | 585.16 | 793.5 | 581.16 | 701.4 | 705.4 | 901.8 | 533.04 | 723.116 | 124.6 |
| 11 | Magnesium(mg/gm) | 38.98 | 80.4 | 73.09 | 160.8 | 82.84 | 126.69 | 48.72 | 56.03 | 43.85 | 194.91 | 90.631 | 53.10 |
| 12 | Sodium(mg/L) | 79.8 | 62.0 | 47.0 | 40.5 | 36.8 | 30.8 | 41.1 | 31.3 | 30.1 | 30.4 | 42.98 | 16.29 |
| 13 | Potassium(mg/L) | 72.2 | 0.0 | 0.0 | 0.0 | 4.2 | 0.0 | 0.0 | 0.0 | 0.0 | 7.7 | 8.41 | 22.56 |
| 14 | Sulphate (mg/L) | 48 | 153.6 | 576 | 1824 | 1152 | 1843.2 | 1190.4 | 600 | 1824 | 297.6 | 950.88 | 711.8 |
| 15 | Available Phosphorus % | 2.82 | 0.375 | 0.6 | 0.56 | 0.78 | 0.80 | 0.96 | 3.72 | 0.33 | 0.36 | 1.1305 | 1.165 |
| 16 | Fluoride (mg/L) | 21.75 | 27.76 | 21.77 | 9.45 | 26.4 | 9.44 | 21.45 | 16.2 | 22.2 | 9.45 | 18.587 | 7.015 |
| 17 | Iron(mg/L) | 3.4 | 4.8 | 5.8 | 68 | 29.6 | 90 | 7.8 | 5.8 | 17.2 | 3.8 | 23.62 | 30.72 |
| 18 | SPC(cells/gm) | 55046 | 49650 | 24825 | 25904 | 45332 | 48354 | 25904 | 22234 | 41015 | 3345.9 | 34160.99 | 16209.2 |

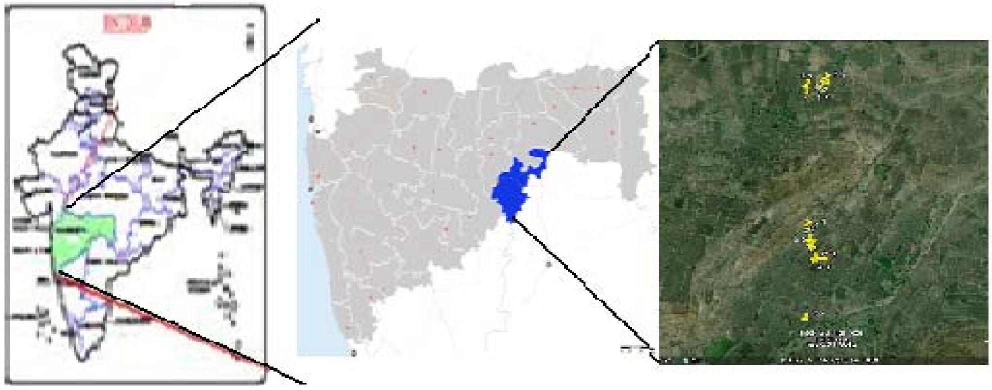

**Figure 1: Location of the study area in Maharashtra.**

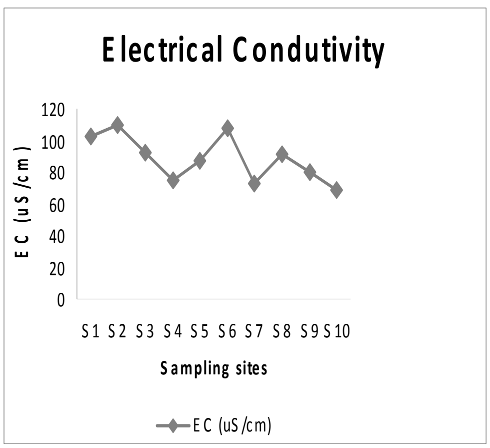


**Fig.2**: Observed Electrical conductivity of soil samples

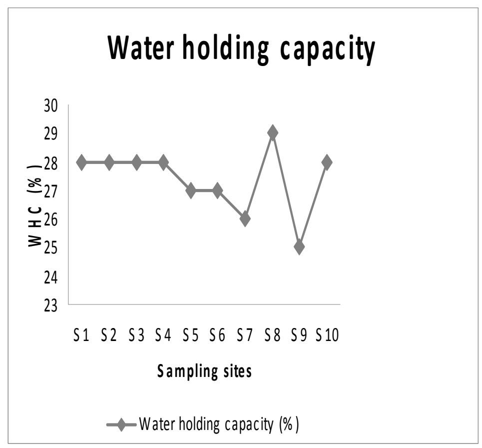


**Fig.3**: Observed water holding capacity from ten soil samples

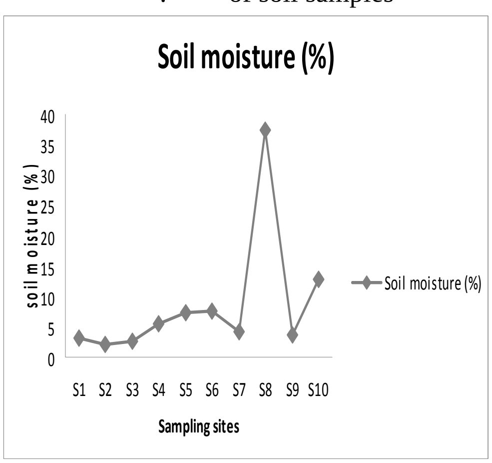


**Fig.4**: Observed soil moisture content from ten soil samples.

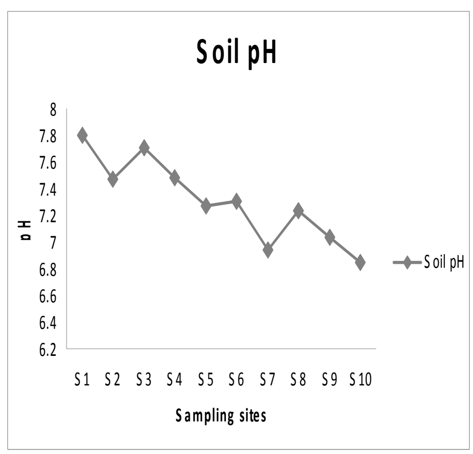


**Fig.5**: Observed pH of soil samples.

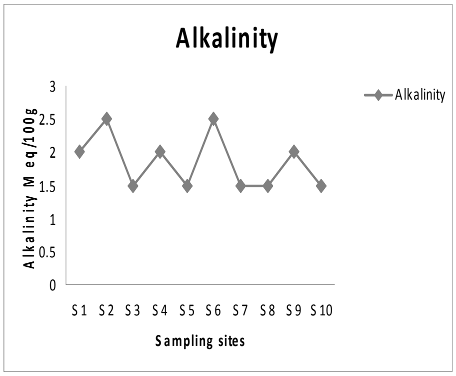


**Fig.6**: Variations in Alkalinity of selected ten soil samples.

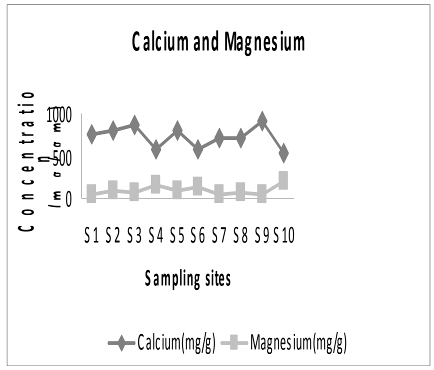


**Fig.7**: Concentrations of calcium and magnesium from different soil samples.

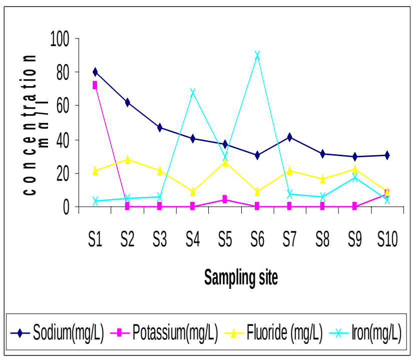


**Fig.8**: Concentrations of sodium, potassium, fluoride and iron from ten soil samples.

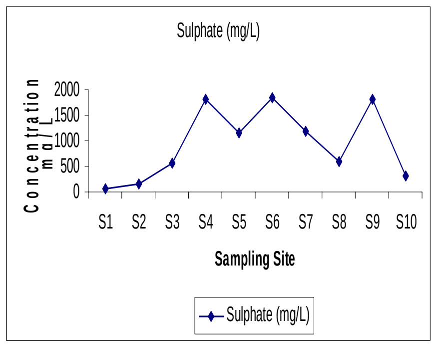


**Fig.9**: Variations in sulphate content in different soil samples.

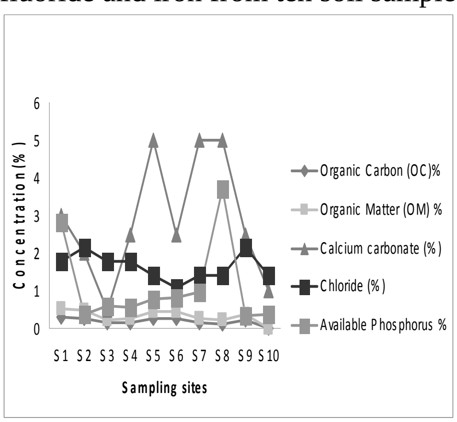


**Fig.10**: Concentrations of organic carbon, organic matter, calcium carbonate, chloride And available phosphorous from soil samples.

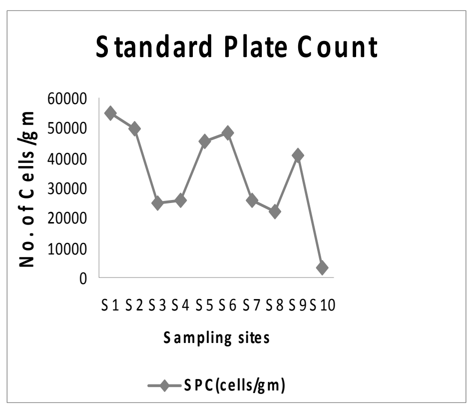


**Fig.11**: Observed standard plate count in different soil samples.

## CONCLUSION

From this study, it was concluded that the Bhokar has black cotton soil, which is rich in calcium and magnesium. The soil is mainly alluvial in nature. The research study shows that the pH of all the soil samples was slightly neutral. The microorganisms are also present in this soil. The organic carbon and calcium carbonate are low in all the soil samples. Most of the soil samples contain iron above the permissible limit. The organic manures must be used for improvement in the fertility of the soil instead of chemical fertilizers. Moreover, increase in the use of natural pesticides to avoid side effects of chemical pesticides is necessary to improve the soil quality.

Coden : IJABPT Copyrights@2012 ISSN : 0976-4550

## ACKNOWLEDGEMENT

We are grateful to the School of Earth Sciences of Swami Ramanand Teerth Marathwada University, Nanded for providing laboratory and library facilities etc.

## REFERENCES

Antwi-Agyei P., J.N. Hogarh and G. Foli., (2009), Trace elements contamination of soil around gold mine tailings dams at Obuasi, Ghana, African Journal of Environmental Science and Technology, Vol. 3, No.11, 353-359.

APHA, (2000), Standard methods for the examination of water and wastewater, 20th edition, American Public Health Association Washington D.C.

Chowdhury Nasrin and Petra Marschner and Richard Burns, (2011), Response of microbial activity and community structure to decreasing soil osmotic and matric potential, Plant Soil, Vol.344, 241–254.

Cresser Malcolm, Ken Killham and Tony Edwards, (1993), Soil Chemistry and its Applications, Cambridge University Press.

Gavin F. Birch and Matthew Vanderhayden and Marco Olmos., (2010), The Nature and Distribution of Metals in Soil of the Sydney Estuary Catchment, Australia, Water, Air and Soil Pollution, Vol.216,581–604.

Georgios Papastergios and Anestis Filippidis and Jose-Luis Fernandez-Turiel and Domingo Gimeno and Constantinos Sikalidis, (2010), Surface Soil Geochemistry for Environmental Assessment in Kavala Area, Northern Greece, Water, Air and Soil Pollution, Vol. 216,141–152.

Jackson, M. L., (1973), Soil Chemical Analysis. Prentice Hall of India Pvt. Ltd., New Delhi.

Johns U.S., (1982), Fertilizers and Soil Fertility, Reston Publishing Co., Virginia.

Khan H. R., Rahman K., Abdur Rouf A. J. M., Sattar G. S., Oki Y., Adachi T., (2007), Assessment of degradation of agricultural soil arising from brick burning in selected soil profiles, International Journal of Environmental Science and Technology, Vol. 4, No.4, 471-480.

Martin N. Sarah, (1994), Standard Handbook for Solid and Hazardous Waste Facility Assessments, Lewis Publishers, USA.

Oluyemi E. A., Feuyit G., Oyekunle J. A. O. and Ogunfowokan A. O., (2008), Seasonal variations in heavy metal concentrations in soil and some selected crops at a landfill in Nigeria, African Journal of Environmental Science and Technology, Vol. 2 , No.5, 89-96,

Pule-Meulenberg F., Moganane B. and Dikinya O., (2008), Physicochemical Properties of Soil from Five Villages in Botswana with Respect to Soil Degradation, Caspian Journal of Environmental Science, Vol. 3 ,No.1,. 29-34.

Rana L., Dhankhar R. and Chhikara S., (2010), Soil Characteristics Affected by long term Application of Sewage Wastewater, International Journal of Environmental Research, Vol.4, No.3, 513-518.

Rosario García and Juan Antonio González, Virginia Rubio and Carlos Arteaga and Almudena Galán.,(2011), Soil Contamination in Dumps on the Karstic Areas from the Plateaus (Southeast of Madrid, Spain), Water, Air and Soil Pollution, 10.1007/s11270-011-0801-1.

Sharma B.K., (2001), Environmental chemistry, IV Ed, Goel Publication House, Meerut.

Shikha Uniyal Gairola, Prafulla Soni, 2010, Role of Soil Physical Properties in Ecological Succession of Restored Mine Land – A Case Study, International Journal of Environmental Sciences, Vol. 1, No 4.

Soil Analysis Report, (2010), Agriculture department, government of Maharashtra, Parbhani.

Trivedy R.K., Goel P.K. and Trisal C.L., (1998), Practical methods in Ecology and Environmental Science, Enviro media publications, Karad.

Vishal D. Joshi, Narahari N. Palei, Punit R. Rachh, (2009), Physico-Chemical Properties of Four Farm site soil in area Surrounding Rajkot, Gujarat, India, International Journal of ChemTech Research, Vol.1, No.3 , 709-713.

Wild A., (1993), Soil and environment- An Introduction, Cambridge University Press.

Yobouet Y. A., Adouby K., Trokourey A. and Yao B., (2010), Cadmium, Copper, Lead and Zinc speciation in contaminated soil, International Journal of Engineering Science and Technology, Vol. 2, No.5, 802-812..