STUDIES ON PYSICO CHEMICAL PROPERTIES OF SOIL AND IMPACT OF COAL MINE ON SOIL COLLECTED FROM SOHAGPUR, REGION DHANPURI (M.P.) INDIA

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Abstract: A blend of quality soil and different climatic parameters favours the growth of plants and agriculture which is considered to be the back-bone of the economy of any country. The paper thin layer of soil as compared to the total crustal thickness (33km) of the earth not only provides us food but also the habitat of soil microorganism which are driving force of many ecosystems. Mine spoil characteristics of the dump area and the native soil are analysed critically to evaluate any deterioration in soil properties. The required level of soil nutrient of mine spoil is less than that of the native soil. Available nutrients (N, P, K), exchangeable cat ion (Ca, Mg, Na, K) of the native soil suggest that open cast mining changes the soil quality. Other physical properties of the mine spoil such as, moisture content are lower than those of native soil. Mining method alters the soil texture from silt loam to sandy soil, The content Phosphorus ranged between 36.5 – 38.9kg/ha which is far higher than normal range (11-20 kg/ha) There have been no such significant differences in trace metal content in mine spoil and native soil.

Keywords: mining, physicochemical characteristics, exchangeable ions, biochemical tests, native soil.

Introduction: Soil is a dynamic natural body developed as a result of pedogenic processes during weathering of rocks. The soil in fact the very heart of the life layer called Biosphere. It consists of mineral and organic constituents, exhibits definite physical, chemical and biological properties, has variable depth over the surface of earth and provides a suitable medium for plant growth. [2]

Soil mainly composed of 50% pore space (air and water) and 50% solid phase .The solid phase is broadly composed of 45% mineral matter and 5% of organic constituents. The liquid phase of the soil (40-50%) is an aqueous solution of salts. The soil act as reservoir for supplying water to plants. The gaseous phase of soil consists of same nitrogen and oxygen content as of air but carbon dioxide concentration is much higher (0.1%). All these phases of soil system have a definite role to play. The solid phase provides mechanical support and nutrients to plants. The liquid phase supply dissolved nutrients to plant roots. The gaseous phase satisfies the aeration needs of plants. These three phases share the soil's responsibility to sustain plant growth [2]. Agricultural actions near mining project may be predominantly affected. According to a study commissioned by the European Union: "Mining process routinely alter the surrounding landscape by exposing before uninterrupted earthen materials. Erosion of exposed soils, take out mineral ores, tailings, and fine material in waste rock piles can effect in considerable sediment loading to surface waters and drainage ways. In adding, spills and leaks of hazardous materials and the evidence of contaminated windblown dust can direct to soil contamination [9, 11, 12, 13] An attempt has been made in this study to address the problem of alteration of native soil in the S.E.C.L. coal fields Sohagpur region Dhanpuri of this part of India which is long overdue. The main objective of the study is to understand the effects of these mine spoils on the natural vegetation (if any) of the area and also to highlight the Health problems of the adjacent locality .

Methods and methodology:

Study area and Sampling: The present study area are belongs to South Eastern Coalfields Limited (S.E.C.L) under Sohagpur, region Dhanpuri O.C.M (Open Cast Mine)sector 'E' Sanjay Koyla Nagar M.P., India. There are five sites selected for the sample first field distance -200 meter, second field distance -150 meter, third field Saraswati Higher Secondary School Sanjay nagar-70 meter Fourth Field Raghav Higher Secondary School Sanjay nagar-50 meter, Fifth Field M.K. Gandhi higher Secondary School Sanjay Nagar-100 meter, The coals are relatively high in moisture (7-10%) and high in ash (18.6-29.4%). The deposits are at a depth of 0-1200 meters.Mine spoils were collected from un reclaimed overburden dumps and nearest native soils were collected from the surroundings of mines where local vegetation is already established. The overburden mine soils are collected by random grid method of 10 m x 10 m grid. [5, 8] One composite sample has been collected from each grid. The samples are packed in polyethylene bags and assigned a number. [5, 8]

Physicohemical Analysis: All the samples were analysed for the following physicochemical characteristics. (pH, nitrogen(kg/ha), potassium (kg/ha), electrical conductivity, total phosphorus (kg/ha), magnesium(kg/ha), organic carbon%, boron(mg/kg), zinc(mg/kg), sulphur(mg/kg) and iron(mg/kg) [1, 4, 10, 11].

pH: In native soil pH is more than those of fresh mine spoil the pH of the soil suspension can be

determined by electric pH meter and colorimetric method. [2, 6, 7],

Sulphur: Sulphate-S in a monocalcium phosphate extract is measured either with a nephelometer or by ion chromotography. The nephelometer analysis is a measure of turbidity developed by adding BaCl2 to the soil extract[1, 4, 6, 12],

Nitrogen: Nitrogen occurs in soil samples in bound forms as NH_3, NO_2^- and organic nitrogen. Total nitrogen can be determined by Kjeldahl method and Kjeltec Auto 1030 Analyser Method. [1, 2]

Phosphorus. Phosphorous in the form of phosphate is extracted from soil by Olsen method using ammonium molybdate. [2, 5, 6],

Potassium: Determination of Potassium in soil is done by Flame Photometry at wavelength 766.5nm. [2, 6],

Electrical Conductivity: The total solute concentration in the various extracts is normally estimated by measuring EC. Makeupstandardo.010 M KCl solution to automatically adjust cell constant internal to the meter Read conductivity of extracts using EC probe and meter. Report results in SI units of dS /m [1, 2, 7],

% Carbon Organic: Matter content of the soil is used to adjust nitrogen (N), sulphur, herbicide, and/or lime recommendations. The dry combustion method measures total C whereas the chromic acid methods determine only that C which is easily oxidizable. [1, 8],

Iron: Most laboratories are following the procedure of Atomic absorption, inductively coupled atomic emission (ICP) or direct current plasma atomic emission spectrometer. [7, 11, 12].

Boron: The Spectrophotometric Method (ICP) is highly correlated with the Curcumin Method (r = 0.985) and the Azomethine-H Method (r = 0.990) for the measurement of B extracted from many soils

Result and Discussion: An examination of soil samples (Table 2) shows that the values for pH range from 7.32 to 8.52 indicating that the soils are alkaline and under such conditions the solubility of minerals decreases creating nutrient deficiency. The organic carbon (%) ranges from 0.38 to 1.25%. The organic soil matter includes all the dead plant materials and live or dead animals. In the study area mine spoils are more or less sandy type where cation exchange capacity is lower than their respective native soils which are mostly silty-loam type.

Table 1: Standard Categories for deficiency/sufficiency of Physicochemical properties in soil
*Critical limit for Zinc(Zn) is 0.60mg/kg, *Critical limit for Iron(Fe) is 4.50mg/kg

	Very low	Low	Medium	High	Very high
pH	< 5.0	5.1-6.5	6.6-7.5	7.6-8.0	> 8.0
Conductivity (dS/m) %	-	< 1	1-2	2-3	> 3
Organic carbon(%)	0.25	0.50	0.51	0.76-1.00	> 1.00
Nitrogen (kg/ha)	150	151-250	251-400	401-600	> 600
Phosphorous (kg/ha)	5	6-10	11-20	21-40	> 40
Potassium (kg/ha)	200	201-250	251-400	401-600	> 600
Sulphur (kg/ha)	10	11-20	21-30	31-40	> 40
Zinc (mg/kg)	0.30	0.31-0.60	0.61-1.20	> 1.20	-
Iron(mg/kg)	0.30	4.50	4.51-9.6	> 9.6	-
Boron(mg/kg)	-	0.50	0.50-1.00	> 1.00	-

Table 2: Physicoshemical properties of mine soil in Proposed coal mine area
EC- Electrical conductivity, OC- Organic Carbon, Zn- Zinc, B-Boron

Samples	pH	EC(%)	OC(%)	Zn(mg/kg)	B(mg/kg)
S1	6.80	0.09	1.20	0.10	0.18
S2	6.80	0.26	1.50	0.60	0.12
S3	7.08	0.14	1.35	2.16	0.08
S4	7.10	0.16	1.35	2.88	0.04
S5	7.30	0.18	1.65	0.20	0.04

Table 3: Nutritional properties (Available nutrients)of mine soil in proposed coal mine area

Samples	Nitrogen (kg/ha)	Phosphorous (kg/ha)	Potassium (kg/ha)	Sulphur (mg/kg)	Iron (mg/kg)
S1	360	38.4	741.4	17.0	32.2
S2	413	38.8	425.0	10.4	21.2
S3	385	39.3	645.4	4.29	12.3
S4	385	39.3	739.2	6.75	10.3

S5	456	38.7	761.6	8.39	9.4

Conclusion: We can conclude that soil nutrients (Soil moisture, pH, total nitrogen, potassium, sodium, total phosphorus, lime, magnesium, alkalinity, bulk density, organic carbon, chloride and iron Electrical conductivity) of mined soil differ from the native soil significantly. The value of Fe is higher than the normal range in most of samples of soil which could be due to poor drainage. The biological reclamation if not done with in shelf life (period up to which the soil will maintain its fertility status to support plant growth), the nutrient released by microbiological activity are lost due to leaching and erosion, the nutrient cycle is broken down, and the soil ultimately becomes unproductive. It has been also found that mining not only effects soil fertility but it also cause health problems in the adjacent localities like schools. Monitoring of micronutrients in the soils should be done periodically as it can be an efficient way to assess the qualitative and quantitative abundances of the metal concentration.

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References:

1. *Shraddha P.Mangukiya, Jignesh C. Dabhi, I.R.Gadhvi,* A Systematic Checklist of Marine Mollusca At the Coast ; Life Sciences international Research Journal , ISSN 2347-8691, Volume 2 Issue 1 (2015), Pg 391-394
2. Chavhan, D. M. and Wagh, G.S., Physicochemical and microbiological analysis of soil around Lonand City and adjoining area of MIDC. Int. J. of Life Sci. Vol.1 (1)(2013):67-70
3. Kaur , H. and Gupta, Alka L., Analytical Chemistry, Pragati Edition, Meerut, 2013;pp 200-223
4. Doran, J.W. and Zeiss, M.R Appl. Soil Ecology, (2000):15: 3-11.
5. Sayyed, M. R. G. and Wagh, G. S.: An assessment of groundwater quality for agricultural use: a case study from solid waste disposal site SE of Pune, India. Proceedings of the International Academy of Ecology and Environmental Sciences, (2011)1(3-4):195-201
6. Satyanarayana Pv, Chamundeswari N, Krishnam Raju S, Vasanta Bhanu K, Ravi Kumar B, Girija Rani M, Ramana Rao Pv ,Vishnuvardhan K, MTU 1121 (MTU Ii 178-34-1-1-2), A New Elite Rice Variety; Life Sciences International Research Journal , ISSN 2347-8691, Volume 1 Issue 1 (2014): Pg 348-352
7. Olsen, S.R., Cole, C.V. Watambe F.S. and Dean, L.A.: Estimation of available phosphorus in soil by extraction with $NaHCO_3$, U.S.D.A. Ciraza (Quoted from, Method of soil Analysis, C.A. Black 2nd ed.) 1165 Am. Soc. Agron, Inc. Medision Wisconsin, USA(1954).
8. American Public Helath Association (APHA), American Water works Association and Water Pollution control Federation: Standards Methods for the examination of water and waste water (Ed. A.D.Eaton Clesceri, L.S., Greenberg, A.E. and Trussel, R.R.) (19th Ed.), APHA, Washington D.C. (1955)
9. Vogel's, A text book of Quantitative Analysis Including Elemntary Instrumental Analysis 5th Ed. The English language book society and Langman.C (2003)
10. Black CA , Methods of soil analysis, parts 1 and 2. American Society of Agronomy, Madison.(1965)
11. Agrawal M, Singh J, Jha A K & Singh J S., Coal-based environmental problems in a low rainfall tropical region. 27-57. In: R.F. Keefer & K.S. Sajwan (eds.). Trace Elements in Coal Combustion Residues. Lewis Publishers, Boca Raton. (1993).
12. Banerjee S K, Mishra T K, Singh A K & Jain A., Impact of plantation on ecosystem development in disturbed coal mine overburden spoils. J. Trop. For. Sci. 16(3) (2004), pp 294-307.
13. Rai A K, Paul B & Singh G., A study on the Bulk density and its effect on the growth of selected grasses in coal mine overburden dumps, Jharkhand, India International journal of environmental sciences, (2011), 4(6).
14. Pederson T A, Rogowski A S & Pennock R., Physical characteristics of some mine spoils. Soil Science Society American Journal, l44, (1988), pp 131-140.
15. Ghose, K. Mrinal, Effect of open cast mining on soil fertility, Journal of Scientific & Industrial Research Vol.63, December 2004, pp1006-1009

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