

Study of Co-Relationship between the Soil pH and Organic Carbon

Dharmendra Kr. Singh^a, Sonam Bharti^b, Bidisha Ganguly^b

^a Dept. of Chemistry, P.K.R.M. College, Dhanbad, VBU Hazaribag, Jharkhand, India

^b Dept. of Environmental Science, P.K.R.M. College, Dhanbad, VBU Hazaribag, Jharkhand, India

Abstract- Organic carbon is an essential part for carbon sequestering in soil and also balancing carbon dioxide concentration in the atmosphere. Soil organic carbon indicates the soil quality such as organic matter and water holding capacity etc. Soil pH help in solubilizing mineral nutrient helping sustain agricultural process. This research paper mainly focuses on study area near mining zone and know the soil quality status with the help of these two parameters.

Keyword: pH, organic carbon, co-relationship, organic matter and water holding capacity.

Introduction- Soil plays essential role for survival of life by the help of crop production. It also helps in balancing the nutrient cycle on earth and it can reduce the risks of global warming. Now a days soil quality deteriorates due to anthropogenic activities, such as mining etc. Due to mining activities soil quality i.e., physical and chemical parameters alter as result the crop production will decrease. This research paper mainly focuses on physical parameter of soil which help to indicate in early stage of soil deteriorate.

Soil pH is an essential parameter help for knowing soil quality such as biogeochemical process, fertility. Importance of soil pH supporting in regulating nutrient availability in soil indirectly helps in vegetation, primary productivity, microbial survival process (1). Soil pH depend upon the various factors such as topography, origin of rock, time scale and seasonal variation etc (2). Low pH value reduces absorption rate of nitrogen availability because it reduces activities of leguminous bacteria for nitrogen fixation (3).

Analysis of pH helps to know hydrogen ion and hydroxyl ion concentration and activity of soil water system. It acts as an indicator of acidic, alkaline or neutral nature of soil (4).

Another important parameter is organic carbon. It helps in regulating carbon cycle which has essential role in global climate change, for it indicates succession process of different species on terrestrial ecosystem and maintains carbon sequestration process(5). If soil pH is in favourable condition, crop nutrient uptake by crops will be enhanced and increase the crop root system helping in maintaining of organic carbon in soil. Properties like aggregation, compaction, energy flow, surface sealing, microbial activity, water infiltration enhance if the organic carbon is in standard level. Organic carbon indicates organic matter in soil (6,7).

Study Area - Dhanbad is known as the coal mining capital placed in Jharkhand, India. Mostly, red soil which is lethargic in nature is found in Dhanbad. Dhanbad has humid subtropical climate and consists dry deciduous forest (8).

The soil quality is not so good for agricultural purpose due to anthropogenic activity. Samples were collected from Digwadih, Dhanbad near mining area. Three soil samples were collected from the plot for analysis of physical parameter (pH and Organic Carbon). Sampling was done to check quality of cultivation. Random systematic sampling was done for collection of soil sample during summer season (9).



Fig: Map of Dhanbad

Material and Methodology: pH- For soil sample taken 1:2.5 (w/v) ratio of soil and water. Weigh 10-gram air dry soil into beaker. Add 25 ml of double distilled water and swirl with glass rod thoroughly for 5 minutes and keep it for 30 minutes. After 30 minute rest turn on the pH meter and allow it to warm up for 15 minutes. standardize the glass electrode using buffer solution of pH 7, pH 4 and pH 9. After calibration, dip electrode in soil solution and wait for 30 second.

Organic carbon (Walkley & Black method)- Weigh 1.0g air dried soil sample (0.2mm) into 500ml Erlenmeyer flask. Add 10 ml of 0.167 M $K_2Cr_2O_7$ and swirl the flask gently to disperse the soil in the solution and 20 ml conc. H_2SO_4 , the swirl the flask for 1 minute and minimize heat loss, allow the flask to stand on an insulated sheet for 30 minutes in a fume hood. Then add slowly 200ml of distilled water to the flask and 10 ml of 85% H_3PO_4 . Add 1ml of diphenylamine sulfonate indicator. Colour changes to deep violet-blue. Take 0.5 M $FeSO_4$ solution in 50 ml burette and titrate it till the end point i.e., the colour changes sharply to brilliant green (11).

Results- The results after the analysis process of sample are given below. The soil sample was analysed by pH meter and organic carbon measured by titration process. The value of both physical parameters is given in table below:

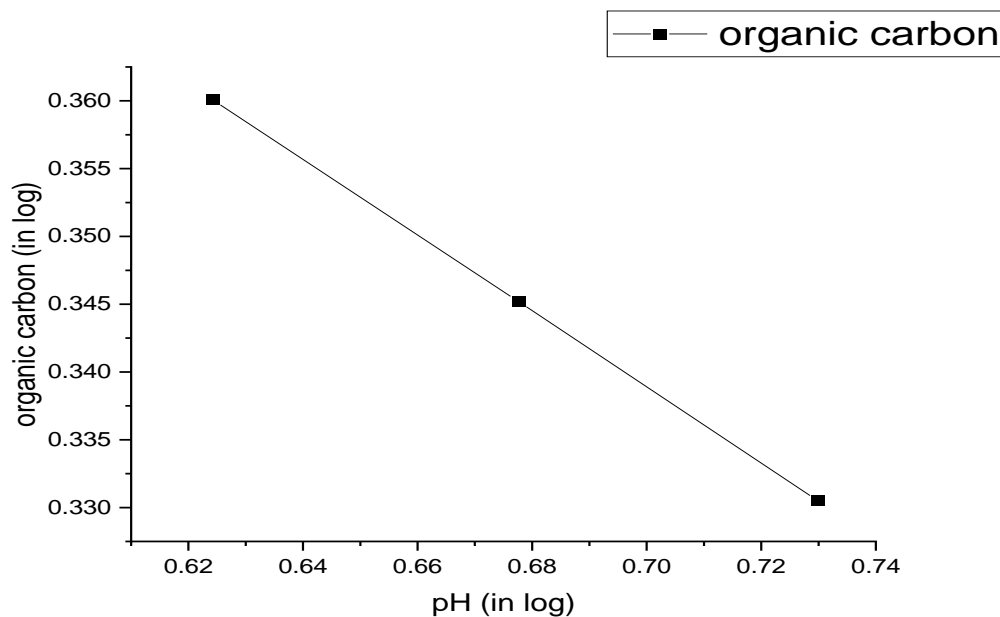
Table 1- pH and Organic value given in log value given below:

Sl. No	pH (in log value)	OC (in log value)
--------	-------------------	-------------------

1.	0.6242	0.5037
2.	0.6776	0.3324
3.	0.7299	0.2000

Table 2. pH value in log and derived value of organic carbon given below

Sl.no	pH (x)	OC(y)
1.	0.6242	0.36008
2.	0.6776	0.3452
3.	0.7299	0.3305



Graph1- show relationship between pH (x axis) and organic carbon (y axis)

Organic Carbon = $-0.2804 \log \text{pH} + 0.5351$ eq. (1)

The regression equation of organic carbon shows the significant negative co- relationship between the pH and organic carbon in the experimental soil sample (12,13).

Discussion- The pH value of soil sample is 0.6242 (log) minimum and maximum 0.7299 (log). and organic carbon is minimum 0.2000 (log) and maximum 0.5037 (log). Regression value is -0.981. soil sample is acidic in nature due to mining activity. organic carbon availability is leached out. This sample needs addition of lime for proper cultivation.

Acknowledgment: Authors are thankful to Dept. of Chemistry & Environmental Sc. for giving permission to carry out experiment and other assistance.

Reference

1. Coventry, D. R., & Evans, J. (1989). Symbiotic nitrogen fixation and soil acidity. Soil acidity and plant growth., 103-137.
2. Troeh, F. R., & Thompson, L. M. (2005). Soils and soil fertility (Vol. 489). Oxford: Blackwell.
3. Cornfield, A. H. (1952). An apparatus for the macro-determination of organic carbon in agricultural materials, using the van slyke-floch digestion mixture. Journal of the Science of Food and Agriculture, 3(4), 154-156.
4. Shaw, B. H., Mechenich, C., & Klessig, L. L. (2004). Understanding lake data. University of Wisconsin--Extension, Cooperative Extension.
5. Post, W. M., & Kwon, K. C. (2000). Soil carbon sequestration and land-use change: processes and potential. Global change biology, 6(3), 317-327.
6. Graber, E. R., Fine, P., & Levy, G. J. (2006). Soil stabilization in semiarid and arid land agriculture. Journal of Materials in Civil Engineering, 18(2), 190-205.
7. Sethuraman, G., & Naidu, S. (2008). International Encyclopaedia of Agricultural Science and Technology: Organic Farming (Vol. 7). Mittal Publications.
8. Kemper, W. D. (1993). Effects of soil properties on precipitation use efficiency. Irrigation Science, 14, 65-73.
9. Pande, G., Sinha, A., & Agrawal, S. (2015). Impacts of leachate percolation on ground water quality: A case study of Dhanbad city. Global Nest J, 17(1), 162-174.
10. Harnpicharnchai, K., Chaiear, N., & Charerntanyarak, L. (2013). Residues of organophosphate pesticides used in vegetable cultivation in ambient air, surface water and soil in Bueng Niam Subdistrict, Khon Kaen, Thailand. The Southeast Asian journal of tropical medicine and public health, 44(6), 1088-97.
11. Meersmans, J., Van Wesemael, B., & Van Molle, M. (2009). Determining soil organic carbon for agricultural soils: a comparison between the Walkley & Black and the dry combustion methods (north Belgium). Soil Use and Management, 25(4), 346-353.
12. Zhou, W., Han, G., Liu, M., & Li, X. (2019). Effects of soil pH and texture on soil carbon and nitrogen in soil profiles under different land uses in Mun River Basin, Northeast Thailand. PeerJ, 7, e7880.
13. Xu, H., Demetriades, A., Reimann, C., Jiménez, J. J., Filser, J., Zhang, C., & GEMAS Project Team. (2019). Identification of the co-existence of low total organic carbon contents and low pH values in agricultural soil in north-central Europe using hot spot analysis based on GEMAS project data. Science of the Total Environment, 678, 94-104.