



Effect of irrigation with Amalai paper mill effluent on the organic carbon and organic matter in the soil

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Abstract

The study was undertaken to investigate the Effect of irrigation with Amalai Paper Mill Effluent On the Organic Carbon and Organic Matter in the soil. The effluent sample from orient paper mill were analysed. For this soil samples were collected from four different places from within the area of Anuppur district. This was done so to have representative sample of all the soil types found within the area of Anuppur district. Organic matter content of the soil being a value multiplied by a similar factor to the organic carbon had similar values as the organic carbon with higher average values for site 4 and site 1 as compared to the values for site 2 and 3.

Keywords: irrigation; effluent; organic carbon; organic matter; soil

1. Introduction

Soil may be defined as a thin layer of earth's crust which serves as a natural medium for the growth of plants. It is the unconsolidated mineral matter that has been subjected to, and influenced by genetic and environmental factors – parent material, climate, organisms and topography all acting over a period of time. Soil differs from the parent material in the morphological, physical, chemical and biological properties. Also, soils differ among themselves in some or all the properties, depending on the differences in the genetic and environmental factors. Thus, some soils are red, some are black; some are deep and some are shallow; some are coarse-textured and some are fine-textured. They serve in varying degree as a reservoir of nutrients and water for crops, provide mechanical anchorage and favourable tilth. The components of soils are mineral material, organic matter, biota, water and air, the proportions of which vary and which together form a system for plant growth.

Paper industry is an agro based industry, effluents generating from this industry contain considerable amounts of organic and inorganic chemical components such as fibers, cellulosic wastes, wood dust, chlorine compounds, carbonates and bicarbonates (Mishra and Sunandashao, 1989) [1]. Paper mill effluent has health impacts such as diarrhea, vomiting, headache, nausea and eye irritation on humans (Akhan, 2008 and APHA, 1998) [2, 3]. Direct discharge of effluents from this industry may have profound influence on soil physico-chemical and biological properties. The treated paper industry effluent, used for crop irrigation showed serious changes in the chemistry of the soil. Presence of toxic pollutants affect aquatic system (Makris and Banerjee, 2002, and Owens, *et al.* 1994) [4, 5].

Khodabakhsh, (2013) [6] have recorded significant increase in electrical conductivity (salinity), organic carbon, soluble Ca and Mg, available soil phosphorus and potassium but the percentage of total neutralizing value (T.N.V) of soil decreased. Variation in physico-chemical properties of soil around industrial area and agricultural area has been reported by Sumithra, *et al.* (2013) [7].

Also, plots irrigated with wastewater showed important structural damage in sub surface zone where soil pore network collapsed.

2. Material and Methods

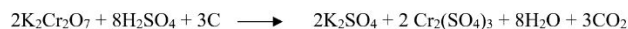
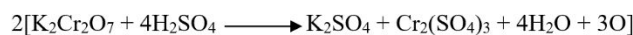
The study site lies between 23°6'0" N Latitude and 81°41'1" E Longitude in Anuppur district. The district is situated in the north eastern part of Madhya Pradesh. This District came into existence on 15th of August 2003 by re-organising Shahdol District. Anuppur District has total area of 3701 sq.km., extends 80 km from east to west and 70 km from north to south.

For this soil samples were collected from four different places from within the area of Anuppur district. This was done so to have representative sample of all the soil types found within the area of Anuppur district. Places of collection of the soil were given site number, as follows:

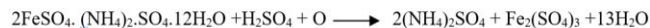
S. No.	Place	Site No.
1.	Pusprajgarh	S ₁
2.	Anuppur	S ₂
3.	Chachai	S ₃
4.	Amlai	S ₄

Soil samples were collected by the compositing method. Compositing is the mixing of sample units to form a single sample, which is used for Chemical Analysis (Tan, 1995) [8]. In compositing, the fundamental assumption is that analysis of the composited sample yields a valid estimate of the mean, which would be obtained by averaging the result of analysis from each of the sampling units contributing to the composite.

The organic matter content of soil is estimated from the organic carbon, determined by using Titrimetric determination (Walkley and Black, 1934) [9] method. The method is also known as "Wet-digestion method" involves a rapid titration procedure for the estimation of organic Carbon content of soil. Carbon was oxidized by K₂Cr₂O₇ followed by back titration, against a standard solution of ferrous ammonium sulphate.



Titration Procedure



1g soil was taken in a 500 mL conical flask. 10 mL of 1N $\text{K}_2\text{Cr}_2\text{O}_7$ solution was mixed and shaken. Then, added 20 mL of con. H_2SO_4 and swirl the flask 2 or 3 minute, allowed the flask to cool for 30 minutes. Poured 200 mL of distilled water, 10 mL of H_3PO_4 (85%) or 0.5 gm of NaF and 1 mL (10 drops approximately) of diphenyl amine indicator were then added and swirled to mix well. The solution was titrated with 0.5N Ferrous Ammonium Sulphate solution on Auto-Titrator (Systronics-351) till the colour changed from blue violet to green. A blank solution made as described above (without soil sample) was titrated and the same process was repeated for all the soil samples.

Calculation

$$\% \text{ C of organic} = \frac{(\text{B}-\text{T}) \times 0.10 \times 0.003 \times 100}{\text{B} \times \text{mass of the soil sample}}$$

Where,

B = Titre value for the blank solution

T = Titre value with the solution containing the soil sample

$$\% \text{ of organic Matter} = \% \text{ Organic Carbon} \times 1.724$$

3. Results and Discussion

The results have been given in table 1. Organic matter of the soils of all the sites have been reported in table 2.

Table 1: Organic carbon in the soils.

S. No.	Months	S ₁	S ₂	S ₃	S ₄
1.	Jan.	0.56	0.26	0.24	0.61
2.	Feb.	0.59	0.28	0.25	0.60
3.	Mar.	0.61	0.30	0.25	0.60
4.	Apr.	0.60	0.31	0.27	0.63
5.	May.	0.60	0.30	0.26	0.60
6.	Jun.	0.59	0.23	0.28	0.62
7.	Jul.	0.55	0.21	0.27	0.61
8.	Aug.	0.58	0.23	0.30	0.61
9.	Sept.	0.55	0.24	0.29	0.62
10.	Oct.	0.58	0.24	0.30	0.64
11.	Nov.	0.56	0.25	0.28	0.69
12.	Dec.	0.62	0.26	0.28	0.63
Mean		0.58	0.26	0.27	0.62
SD		±0.02	±0.03	±0.02	±0.03

Organic carbon percent in the soil had almost three-fold variation from 0.24 to 0.69, between the months and sites. On the average site 4 and site 1 had almost double the values as compared to the values for site 2 and 3.

Table 2: Organic matter

S. No.	Months	S ₁	S ₂	S ₃	S ₄
1.	Jan.	0.97	0.45	0.42	1.05
2.	Feb.	1.02	0.48	0.43	1.03
3.	Mar.	1.05	0.52	0.43	1.03
4.	Apr.	1.04	0.54	0.47	1.09
5.	May.	1.04	0.52	0.45	1.03
6.	Jun.	1.02	0.40	0.48	1.05
7.	Jul.	0.95	0.36	0.47	1.09
8.	Aug.	1.00	0.40	0.52	1.05
9.	Sept.	0.95	0.42	0.56	1.07
10.	Oct.	1.00	0.42	0.52	1.10
11.	Nov.	0.97	0.43	0.48	1.19
12.	Dec.	1.07	0.45	0.48	1.09
Mean		1.01	0.45	0.48	1.07
SD		±0.04	±0.06	±0.04	±0.05

Organic matter content of the soil being a value multiplied by a similar factor to the organic carbon had similar values as the organic carbon with higher average values for site 4 and site 1 as compared to the values for site 2 and 3. A comparison of the present work, which was concentrated on the soil types of the study area has been worked out earlier also by Friedel *et al.* (2000) ^[10] and Gales, *et al.* (1966) ^[11]. They have done with the objective to establish a relationship between the soil types of these regions for the use of the farmers of this region. Attempt was also made so that the present study could be a small academic contribution in this field.

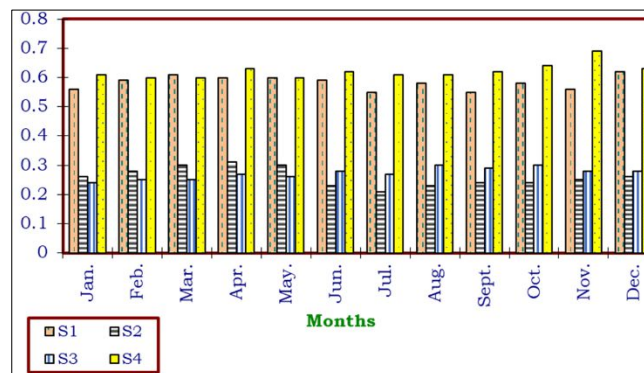


Fig 1: Organic carbon in the soils

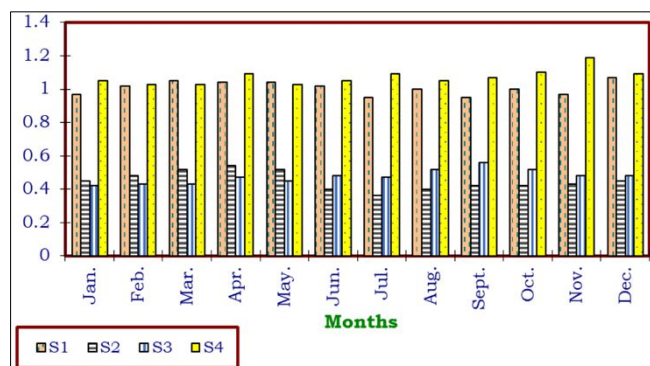


Fig 2: Organic matter

A perusal of the present study and earlier studies by Chhabra (1993) ^[12], Raghuvansh (2002) ^[13] and Trilochan (2004) ^[14] indicates that the soil types are almost the same in the chemical properties with the soil types of the Hill. But except for a few sites the physical properties including the appearance of the soil types of all these four sites namely Pushprajgarh, Anuppur, Chachai and Amlai are different. The probable reason of the similarities between the chemical properties is perhaps because in the Pushprajgarh and Anuppur almost all the soils have come from the hills due to rains and with the rivers/streams which flow from hill tops, down to the plains. The difference in the physical properties as well as in the appearance is probably due to the temperature and climatic differences in these regions.

4. Conclusion

Soil from the four places, viz: Pusprajgarh, Anuppur, Chachai and Amlai, exhibit, generally, differences for most of the studied. For some of the parameters the differences in properties were very wide while for some of the parameters the differences were very insignificant. The experiment was arranged with four, representative soil type of the district, so that one can predict the impact of the paper mill effluent, applied to the soil anywhere within the area of the district.

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