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A GENUINE FOCUS ON THE DISTRIBUTION OF SALTS AND ORGANIC MATTER CONTENT IN THE SURROUNDING SOILS OF GUWAHATI REFINERY OF KAMRUP DISTRICT, ASSAM, INDIA

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ABSTRACT

The research work was done to test the soil fertility status in the soil of outskirts of Guwahati refinery of Kamrup district. The district lies between 25.46 and 26.49 north latitude and between 90.48 & 91.50 east Longitude and covers an area of 4, 34, 500 ha. A total of nineteen soil samples colllected from various directions out side the refinery have been analyzed and studied separately. Mainly surface soils were collected as these may highly be polluted. This paper presents preliminary results of the testing of soil samples. Sample data were subjected to statistical treatment using Gaussian distribution statistic and correlation analysis. The result shows an increase in content of calcium, magnesium, total phosphorus, phosphate, sulphate and electrical conductivity in soil, surrounding refinery. Increase of all this parameters may change the status of the soil fertility and pollute the environment.

Key word: Soil, Refinery area, Fertility, Mineral element, Gaussian distribution statistic, Correlation analysis

INTRODUCTION

Soil quality means soil functioning at its potential in an ecosystem with respect to maintenance of biodiversity, water quality, nutrient cycling and biomass production[1]. But the matter of fact is that soil quality can be measured by some indicators and by comparing these indicators with some standard set of optimum change values. In the present study, we just focus on the monitoring of various salts mixed in the soil and their relation with the fertility of the soil around the refinery area. Because in the industry like refinery, various types of chemicals are discharged during industrial work. Effluents always comes in contact with the surroundings soil causing degradation of soil quality and toxicity introduced into

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the soil by the effluent may resist for years[1] and it can be very harmful for surrounding area and for the environment.

Study area

The study area, Kamrup district is situated in the Eastern part of India and on the middle of Assam The district lies between 25.46 and 26.49 North latitude and between 90.48 & 91.50 East longitude and covers an area of 4, 34, 500 ha. Guwahati refinery covers an area of 147 acre with its three process unit, a captive power plant, crude and product storage, product blending, dispatch and other off facilities. Guwahati refinery is the main industrial point in the Kamrup district of Assam. It was set up with technical assistance offered by the People's Republic of Romania and was designed to process 0.75 mmtpa of crude oil produced from oil field. A large number of people have been residing in this area since long ago. So there is always a major threat from the refinery to the surrounding people. It was inaugurated by Pt. Jawaharlal Nehru, the first Prime Minister of India on 1st January, 1962. With a capacity of 1 million metric tones per annum, Guwahati refinery receives a mix of oil and ONGC crude oil produced from Assam oil field through a 430 km long and 16 diameter trunk pipelines.

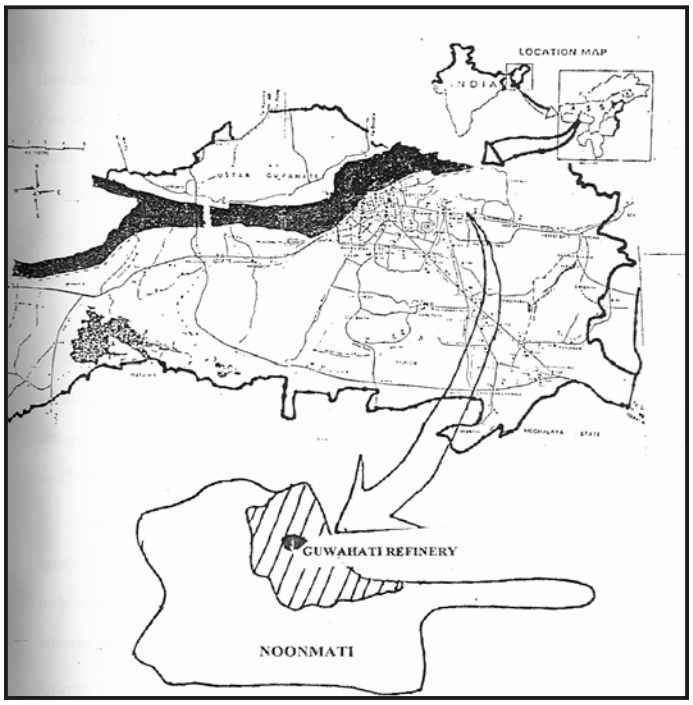

Fig. 1: Location map of study area (Guwahati Refinery, Noonmati)

Sampling information

Nineteen soil samples were collected around the refinery during June to December, 2008, where no regular tests have been performed (Table 1).

Table 1: Samples

Sampling locations	Sample's No.
Outside of the east boundary	1-5
Outside of the north boundary	6-10
Outside of the south boundary	11- 15
Outside of the west boundary	16- 19

EXPERIMENTAL

Material and methods

Nineteen samples were collected from different directions around the refinery area. Most of the samples were collected within the hundred meter range of boundary wall. Samples were collected in pre-monsoon area season. The distance between the two samples is about half kilometer. Mainly, surface soil was collected for analysis (0-30 cm). First, the samples were air dried and then crashed by a mortar. Then aluminum sieve of 450 micron was used to displace the rocks from the soil samples. For determination of physicochemical parameters, analytical grade chemicals and standard methods.[2-4]

RESULTS AND DISCUSSION

According to analysis, most of the samples were alkaline and some of the samples were acidic also. Mainly eastern side of the refinery area is slightly acidic, which may be attributed to discharge of industrial wastes into the soil.

Bulk density of most of the samples was high as compared to the controlled value (0.92 g cm^{-3}). This may be due to high organic matter content in the soil. Another attribution of high organic matter is due to the mixing up organic wastes discharge during industrial work of nearby carbon company. Most of the samples have organic matter above 6 %, which is extremely high according to ICAR rating, 1997. Highest organic matter was found with

the value of 7.34 %, which is extremely high. So as per the investigation, Carbon Company and refinery effluents may be the main source for this abnormally high organic matter.

Table 2: Values of different parameters of soil

pH	Conductivity (mS/cm)	Phosphate (ppm)	Total phosphorus (ppm)	Sulphate (mg/kg)	Organic matter (%)	Calcium (meq/100g)	Magnesium (meq/100g)
6.24	0.6	19	307	270.6	6.15	1.7	0.24
6.34	0.2	3	112	301.5	6.51	------	-----
6.56	1.2	21	132	171	5.68	2.5	0.62
6.03	1.2	516	3370	403.3	6.3	2.26	1.13
6.34	0.6	24	148	196	6.82	3.35	1.58
6.07	---	275	1600	53.4	7.34	2.5	2.36
6.24	0.6	41	336	792	7.24	9.7	3.04
7.39	3	118	293	245	7.24	7.98	0.84
7.35	2.8	1.7	89	226	3.93	4.64	2.32
7.19	4.8	19.7	164	605.1	6.5	2.79	2.56
6.95	4.4	365	431	596	6.93	7.78	4.64
7.05	2.4	4.8	189	643	6.102	6.83	3.4
7.31	4	---	138	33	6.93	8.38	6.56
7.37	3.6	116	219	431	6.82	5.98	5.2
7.23	10.4	45	163	1097	6.04	5.03	5.12
7.22	3	137	211	437	6.102	6.03	0.16
4.34	12.2	157.7	493	772	6.51	1.99	1.6
7.47	3.6	35	82	282	6.206	5.13	2.44
6.99	3.4	89.2	286	276	6.62	4.5	3.56

Conductivity of most of the samples were extremely high, which is attributed to the availability of cations and anions present in those areas. High conductivity may be due to the leakage of ironically rich effluent containing large amount of chemicals used in different processing units[5,6]. Highest value of conductivity was found to be 12.2 ms cm^{-1}. which is quite a large value.

Phosphorus content in all the samples were very high. Soil phosphatase, the enzyme that transforms organic P to inorganic P is mostly of plant and microbial origin and consists of alkaline and acid phosphatases[7]. High organic matter may be responsible for high value of phosphorous. Phosphorus absorption in mineral soils has been extensively studied but P sorption behavior in organic-rich soils is less known[8]. Mostly value of organic phosphorus is more than inorganic phosphorus. Lowest value of phosphorus was found to be 82 ppm and highest value of total phosphorus was 3370 ppm, which is extremely high.

While concerning about distribution of calcium and magnesium salts around refinery area, it was found that calcium and magnesium contents also show high values according to ICAR rating. This may be due to the high alkalinity of most of the soil samples, which come in contact of oil rich effluent discharged during the industrial work. Sulphate was also found in excess amount in most of the soil samples around refinery area. It has been observed that the effluent collected from the Panipat oil refinery had increased pH, EC, Ca^{2+}, Mg^{2+}, alkalinity, Cl^{-}, SO_4^{2-}, P and organic contents in soil during all intervals of time except bulk density and specific gravity[9].

Discussion of statistical analysis

Sample data were subjected to statistical treatment using no Gaussian distribution statistic and correlation analysis.

Table 3: Statistical analysis of values

Statistical data of parameter	Conducti-vity	Phosphate	Total phosphorous	Organic matter	Calcium	Magnesium	Sulphate
Standard deviation	3.207	141.67	779.8	0.757	2.46637	1.84	1324.43
Kurtosis	3.181	3.194	11.83	6.003	-1.00138	-0.388	17.145

Cont…

Statistical data of parameter	Conducti-vity	Phosphate	Total phosphorous	Organic matter	Calcium	Magnesium	Sulphate
Minimum	0.2	1.7	82	3.93	1.7	0.24	33
Maximum	12.2	516	3370	7.34	8.38	6.56	1097
Skewness	1.77	1.864	3.368	-1.95	0.37095	0.573	4.0622
Median	3	43	211	6.51	4.835	2.4	301.5

From statistical analysis, it was found that positive value of kurtosis of conductivity, total phosphorus, organic matter and sulphate show a sharp distribution around the refinery but negative value of kurtosis of calcium and magnesium show flat distribution around the refinery.

In case of skewness, it was found that only organic matter shows negative value which means that it gives a distribution with a significant long left tail. But all other parameters show positive value of skewness, which gives a distribution with significant long right tail.

Discussion of coefficient of correlation

Most of the parameters show positive correlation. With both; calcium and magnesium, total phosphorus show negative correlation i.e. with increasing content of phosphorus in soil, magnesium and calcium contents in soil decrease. But with sulphate, both calcium and magnesium show positive correlation. It is also clear from correlation value between total phosphorus and SO_4^{2-} in the soil, which shown negative correlation. It is clear that excess concentration of phosphorus in the soil increases the probability of presence of comparatively low content of Ca^{2+}, Mg^{2+} and SO_4^{2-} in the soil, but while concerning about the correlation of organic matter with Ca^{2+}, Mg^{2+}, SO_4^{2-} and total phosphorus, it was found that all the parameters show positive correlation with the organic matter except conductivity. But above all, only correlation between Ca^{2+}, Mg^{2+} and SO_4^{2-}, conductivity are significant.

Determination of soluble salts

Soluble salts were measured by electrical conductivity of soil extract[10]. To determine the salts in ppm, it is necessary to multiply the mS/cm with 640 as given in the Table 4. As given in the Table 5 it was found that in most of the location salt solubility is high where

soils are alkaline in nature except in the four locations. So we can correlate positively soil pH with salt solubility.

Table 4: Coefficient of correlation between different parameters of soil

	Ca^{2+}	Mg^{2+}	Total phosphorus	SO_4^{2-}	Conductivity	Organic matter
Ca^{2+}	1					
Mg^{2+}	0.51	1				
Total phosphorus	-0.31	-0.214	1			
SO_4^{2-}	0.18	0.2185	-0.07999	1		
Conductivity	-0.01	0.313	-0.17886	0.6277	1	
Organic matter	0.27	0.2078	0.14496	0.0116	-0.0673	1

Table 5: Soluble salts (from soil test interpretation guide)

Remarks	Conductivity	ppm
	mS/cm	salt
Low	<1.0	<640
Medium	1.0-2.0	640-1280
High	>2.0	>1280

Table 6: Interpretation of solubility of salts in different location around the refinery

pH	Conductivity	Soluble salts(ppm salts)	Remarks
6.24	0.6	384	Low
6.34	0.2	128	Low
6.56	1.2	768	medium
6.03	1.2	768	medium
6.34	0.6	384	Low
6.07	0.6	384	Low

Cont…

pH	Conductivity	Soluble salts(ppm salts)	Remarks
6.24	0.6	384	Low
7.39	3	1920	High
7.35	2.8	1792	High
7.19	4.8	3072	High
6.95	4.4	2816	High
7.05	2.4	1536	High
7.31	4	2560	High
7.37	3.6	2304	High
7.23	10.4	6656	High
7.22	3	1920	High
4.34	12.2	7808	High
7.47	3.6	2304	High
6.99	3.4	2176	High

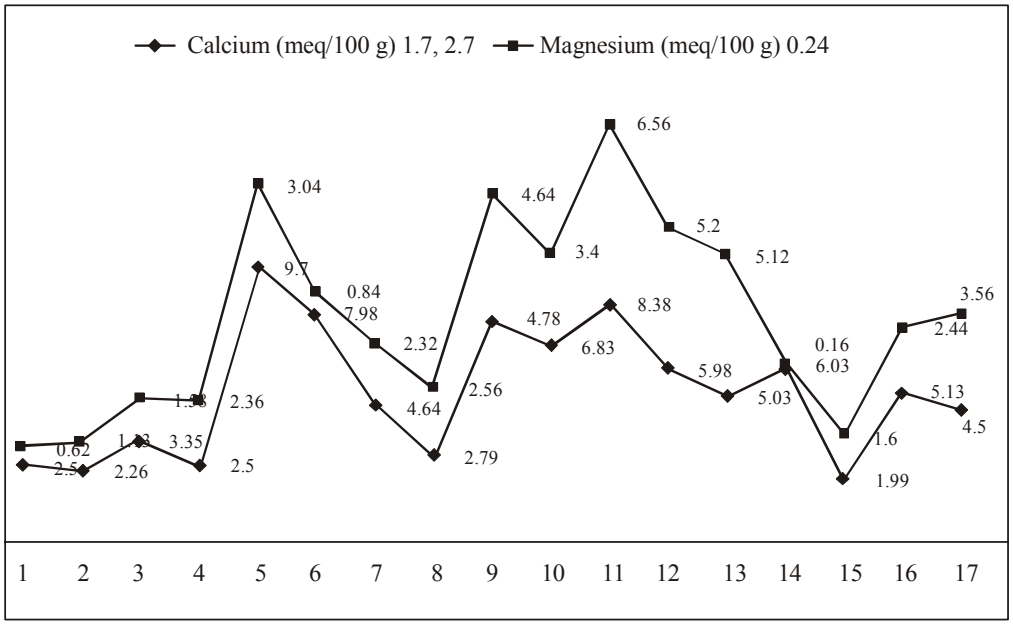

Fig. 1: Distribution of Ca/Mg ratio in the soil around refinery area

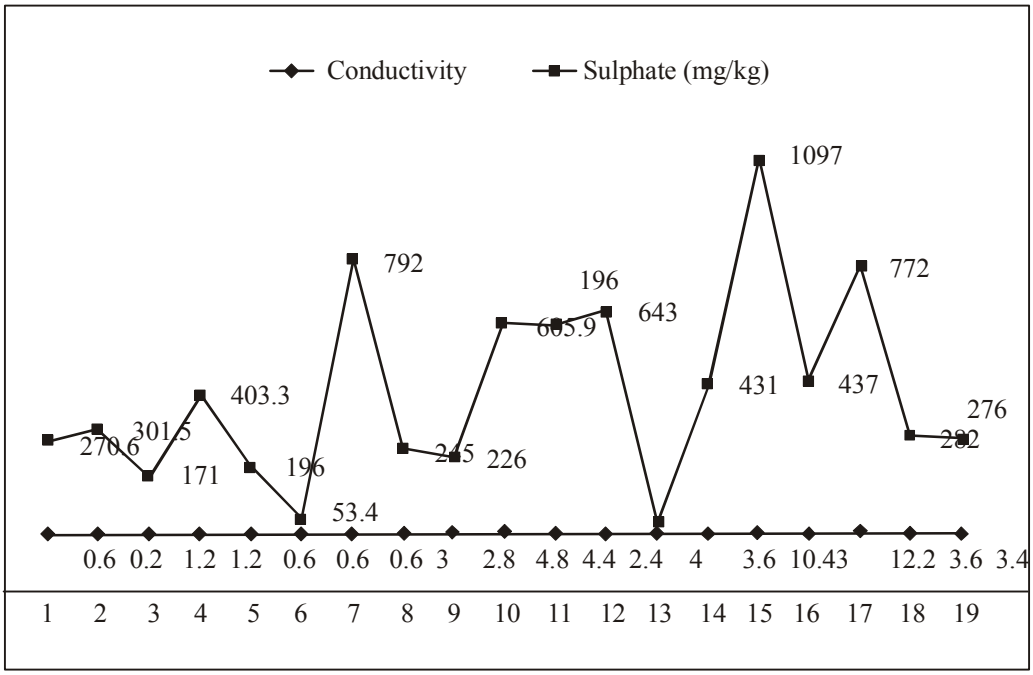

Fig. 2 : Corelation between conductivity and sulphate

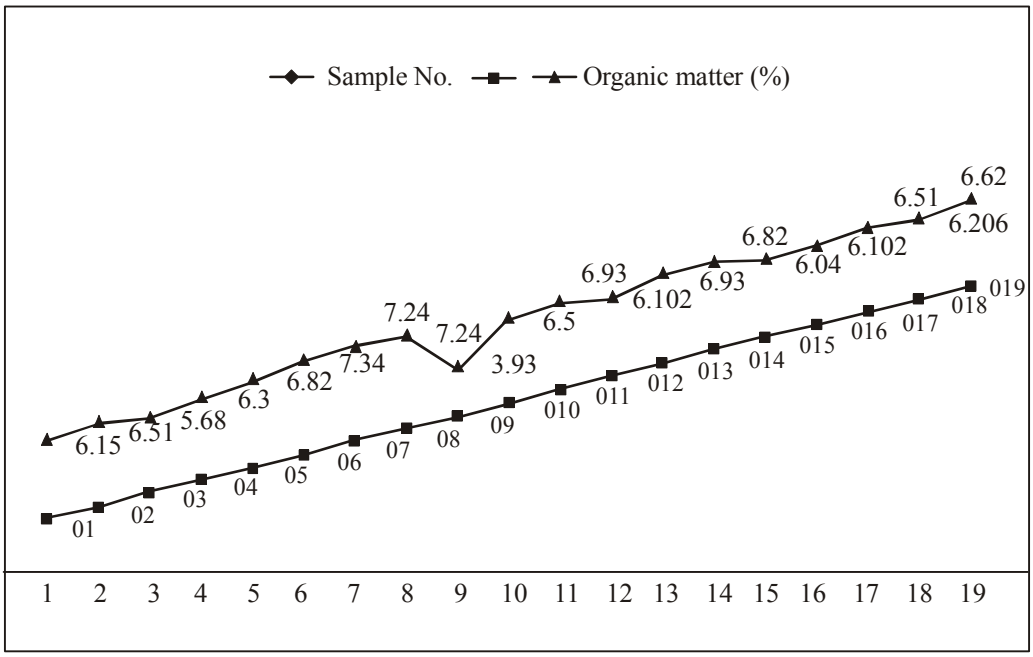

Fig. 3. : Distribution of organic matter in various location

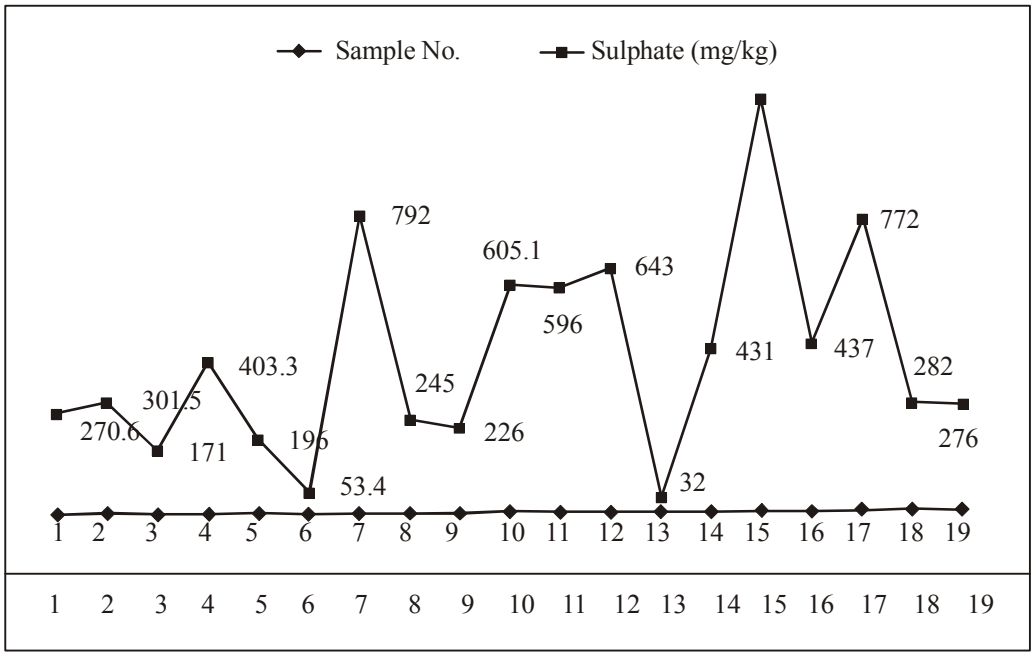

Fig. 4 : Distribution of sulphate in various location

CONCLUSION

The analysis reveals that there is hardly any harmful effect in the surrounding soils of refinery as most of soil samples exhibit high solubility of salts. Presence of high organic matter indicates that surrounding soil of the refinery is highly fertile. Therefore, there is a positive aspect of soil fertility of surrounding refinery, where soil always come in contact with oil rich effluent. From statistical analysis, it is also revealed that standard deviation, significant kurtosis and skewness are high, which indicate that the soluble ions in the soils of the study area exhibit unsymmetrical distribution with a long asymmetric tail extending either towards higher or lower values with respect to the median. So present research reveals that the distribution of soluble salts in the soils around the refinery is widely off normal.

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