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Research Article

ANALYSIS OF PHYSICO-CHEMICAL PARAMETERS OF DIESEL OIL CONTAMINATED SOIL COLLECTED FROM BARMER

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ABSTRACT
Barmer is an emerging city in the field of crude oil production in Rajasthan. Now, Barmer harbors a number of hydrocarbon contaminated sites. In this study an attempt has been made to check out the changes associated with such contamination in the soil and microbial profiles. Three such sites were assessed in this investigation. Soil samples were analyzed for their
Physico-chemical activities viz; pH, Electrical conductivity, Total dissolved solids, Carbonate, Bi-carbonate, Calcium carbonate, Chloride, available Nitrogen, C/N ratio, soil moisture content, water holding capacity, soil organic matter, soil organic carbon and presence of heavy metals. These Physico-chemical parameters play an important role in bioremediation of diesel hydrocarbons compounds. These parameters were compared with that of normal soil samples from the same area. Contaminated soil samples were more acidic than their uncontaminated counterparts. Water holding capacity was recorded maximum in the normal soil. This observation is attributed to the presence of oily hydrocarbons which forms a coat over the soil particles. All the contaminated soil samples were found to have very high bicarbonate and chloride content but no soluble carbonates were detected. All these soil profile characterization were determined using standard microbiological procedures.

Key Words: *Barmer, Hydrocarbon, Microbial, Physico-chemical*

INTRODUCTION
Bioremediation, when properly managed, is an environmentally sound and cost-effective method of treating soils containing organic chemicals. Bioremediation may then enable appropriate reuse of the treated soil and minimize disposal of waste soil to landfill, while providing for adequate protection of human health and the environment. Material, they are a vital component of an interconnected ecosystem that influences every landscape. For example, the variability of soil properties across a landscape can influence habitat types which then shape the distribution of different animal species. It has even been suggested that as a fundamental land resource, soil productivity has influenced the economy and development of many countries and, hence, "the advancement of the modern world" (Coleman and Crossley, 1996). But when the soils are degraded, such as through poor agricultural practices, it has been shown that entire civilizations can collapse (Vogt *et al.*, 2010). Today, knowing the importance of our soils, we place value on monitoring them for any changing soil conditions (e.g. soil degradation). It is therefore essential that there are effective and sensitive tools developed to monitor and evaluate soil properties in order to better understand their potential effects on productivity. Traditional soil analysis techniques require time intensive methods which become limiting when applied at regional or global scales (Cecillon *et al.*, 2009).The aim of amendments is to improve the fertility status of such soils and to enhance the rate of oil degradation, thus minimizing the potential for contamination of groundwater and improving crop production (Amadi, 1992). Crude oil pollution tends to change the physical and chemical properties of soil, thus indirectly affecting the growth and development of plants (Frankenberger and Johanson, 1982). This is concluded that crude oil pollution becomes continuously injurious and adversely affects soil conditions and crop growth (Baker, 1970). Oil spillage often results to the destruction of soil properties, microorganisms as well as plant communities (Plice, 1948) (Rowell, 1977). The inhibition of

root growth due to acidity, which was caused by crude oil contamination and also demonstrated that growth and development of plants are adversely affected by crude oil pollution.

MATERIALS AND METHODS

Sample Collection

In the present study, diesel oil contaminated soil samples were collected randomly from three different sites and one normal soil sample of Barmer district, Rajasthan, India.

The soil in the sample area was chronically polluted with diesel and engine oil. Soil samples were collected in the month of July 2012. The top and sub-soil samples were collected from upto a depth of 6-8 cm from vicinity of garages in Barmer with a sterile spatula into sterile bags by using simple sampling technique and returned to the laboratory for further testings as soon as possible. The samples were named as BS-1, BS-2, BS-3 for contaminated soil samples and NS for normal soil.

Physico-chemical Characterization of Soil

Physico-chemical parameters like pH of the soil samples were recorded with the help of standardized pH meter. Electrical Conductivity and Total dissolved solids of the soil samples were analyzed by water analyzer kit. Carbonate, Calcium carbonate, Bi- carbonate and Chloride content of the soil samples were determined by titrimetric methods by (Pandey and Sharma, 2003). Water holding capacity was evaluated by flooding the soils with water, the weight of flooded soil was determined and after 24 hours of oven drying at 100 ^{0}C temperature amount of soil remained was determined and the percentage of water evaporated was calculated. Moisture content was determined similarly. Soil organic matter and soil organic carbon content was determined by titrimetric methods (Walkley and Black, 1934). Available nitrogen and C/N ratio were determined by using standard titrimetric procedures (Subbaish and Asija, 1956). Concentration of Zinc, Copper, Manganese, Iron, Phosphorus, Magnesium were analyzed by Atomic Absorption Spectroscopy.

RESULTS AND DISCUSSION

Micro-organisms are the nature's original recyclers, converting toxic organic compounds to harmless products often Co_2 and water. Ever since it has been discovered that microbes have the ability to transform or degrade xenobiotics. Micro-organisms to utilize hydrocarbons to satisfy their cell growth and energy needs. Micro-organisms are equipped with metabolic machinery to use diesel hydrocarbons products as a Carbon and energy sources. Successful bioremediation methods upon having the right microbe at right place with right environmental factors for degradation to occur. Physico-Chemical parameters of the soil play a vital role in success of bioremediation. In this study outcome is to determine the qualities of contaminated and normal soils and with the help of that qualities to determine the capabilities of micro-organisms to remediate the diesel hydrocarbons and engine oil.

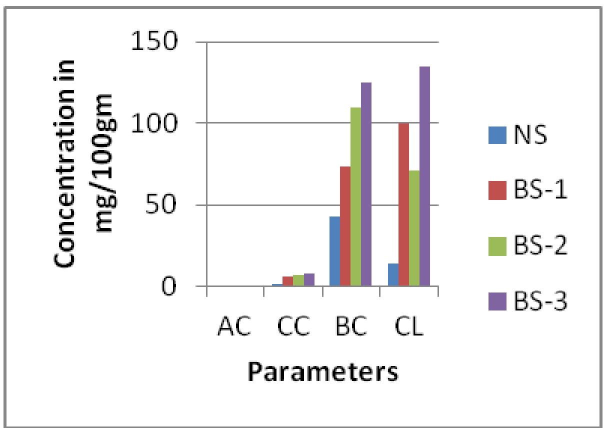
Contaminated soil samples were more acidic than their normal soil samples. BS-2 is more acidic in comparison to BS-1 and BS-3. Electrical conductivity of the contaminated soil samples have maximum than normal soil, BS-3 had maximum electrical conductivity than BS-1 and BS-2. Total dissolved solids had maximum in contaminated soil than normal soil. Presence and concentration of available carbonates influences the soil properties in many respects. Contaminated soil samples have shown striking results and many times repeated experiments demonstrated total absence of carbonates in all contaminated soil samples but in minute quantity available carbonate is present in normal soil (0.12 mg/100gm soil). $CaCo_3$ concentration was observed maximum in contaminated soil than normal soil. BS-3 was reported to have the maximum calcium carbonate content (7.6 mg/100gm soil) while BS-1 had minimum (5.9 mg/100gm soil) and BS-2 had (6.7 mg/100gm soil). Calcium carbonate was recorded in normal soil (1.6 mg/100gm soil). Contaminated soil samples had very high bi-carbonate content as comparison to normal soil. BS-3 had maximum bicarbonate (125.05mg/100gm soil) and BS-1 had minimum (73.2mg/100gm soil) while in normal soil had minimum bicarbonate content (42.7mg/100gm soil) in comparison to contaminated soil.

Table 1: Physico-Chemical properties of crude oil contaminated soil and normal soil of Barmer

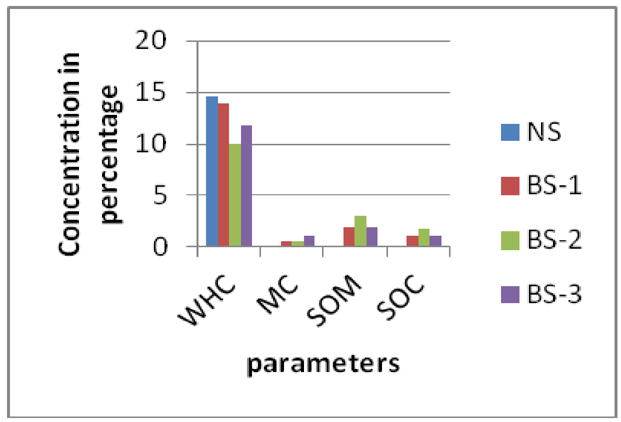
Parameters	Unit	Normal soil NS	Sample 1 BS-1	Sample 2 BS-2	Sample 3 BS-3
pH	-	8.1	7.9	7.7	7.8
Electrical Conductivity (EC)	mS	0.637	1.565	1.624	1.825
Total dissolved solids (TDS)	ppt	0.373	1.258	1.219	1.545
Available Carbonate	mg/100gm	0.12	-	-	-
Calcium Carbonate	mg/100gm	1.6	5.9	6.7	7.6
Bi- Carbonate	mg/100gm	42.7	73.2	109.8	125.05
Chloride	mg/100gm	14.2	99.4	71	134.9
Water holding capacity	%	14.61	13.86	9.95	11.81
Moisture Content	%	0.06	0.55	0.52	1.11
Soil Organic Matter	%	0.18	1.91	3.10	1.88
Soil Organic Carbon	%	0.10	1.11	1.8	1.09
Available Nitrogen	mg/kg	105	749	597	10
C/N Ratio	-	1:1	35:1	35:1	28:1

Table 2: Micronutrients present in Normal and Crude oil contaminated soil of Barmer

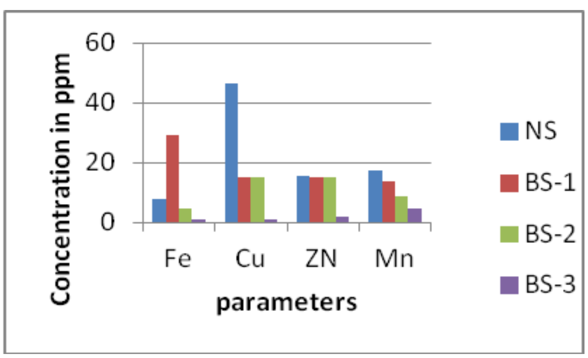
Micronutrients	Unit	Normal soil NS	Sample-1 BS-1	Sample-2 BS-2	Sample-3 BS-3
Iron	ppm	7.68	29.0	4.46	0.94
Copper	ppm	46.40	15.1	14.88	0.84
Zinc	ppm	15.4	15.1	14.88	1.92
Manganese	ppm	17.54	13.84	8.78	4.76
Magnesium	mg/kg	1440	1520	800	1760
Potassium	mg/kg	79	159	377	353
Lead	mg/kg	21	83	199	59



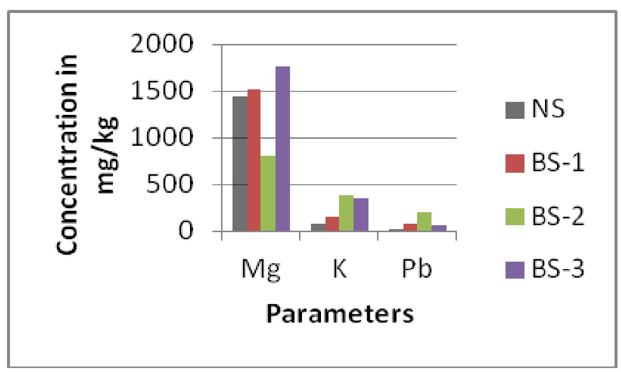
Graph 1: Comparative graph between Normal and Contaminated soil against available carbon, calcium carbonate, bi-carbonate and chloride



Graph 2: Comparative graph between Normal and Contaminated soil against water holding capacity, moisture content, soil organic matter and soil organic carbon



Graph 3: Comparative graph between Normal and contaminated soil against iron, copper, zinc and manganese present in soil



Graph 4: Comparative graph between Normal and contaminated soil against magnesium, potassium and lead present in soil

Contaminated soil had many times more chloride as compared to normal soil. BS-3 has reported maximum chloride content (134.9mg/100gm soil) while BS-2 had minimum (71mg/100gm soil) comparatively contaminated soil normal soil was reported minor chloride content (14.2mg/100gm soil). Maximum water holding capacity was recorded in normal soil (14.61%) among BS-2 had minimum (9.95%) water holding capacity while BS-1 had highest water holding capacity. Micro-organisms require moisture for growth and functioning. Moisture affects diffusion of water and soluble nutrients into and out of the microbial cells. Moisture content recorded maximum in contaminated soil BS-3 had maximum (1.11%) and BS-2 had minimum (0.52%) while in normal soil had (0.06%) moisture content. Hydrocarbon contaminated sites receive continuous inputs of carbon and hydrogen. Continuous carbon inputs enhanced the level of organic carbon and organic matter in the affected sites. Very high carbon content was recorded in the contaminated sites as compared to normal soil. BS-2 was recorded maximum organic matter (3.10%) and normal soil was recorded to have less organic matter content (0.18%). Soil organic carbon is maximum in contaminated soil and very less quantity in normal soil. Nitrogen content in the contaminated soil samples was very low as compared to normal soil. The C/N ratio in the contaminated soil was very high as compared to normal soil. Presence and concentration of micronutrients in soil influences its microbial status. Potash, phosphate, potassium, zinc, manganese, magnesium, iron, copper were estimated in all soil samples.

REFERENCES

Amadi A (1992). A double control approach to assessing the effect of remediation of pre planting oil pollution on maize growth. *Delta Agricultural Journal of Nigeria* **1** 1-6.

Baker MJ (1970). The effect of oils on plants. *Environmental Pollution* **1** 27-44.

Cecillon L, Barhes BG, Gomez C, Ertlen D, Genot V, Hedde M, Stevens A and Brun JJ (2009). Assessment and monitoring of soil quality using near-infrared reflectance spectroscopy (NIRS). *European Journal of Soil Science* **60** 770–784.

Coleman DC and Crossley DA (1996). *Fundamentals of Soil Ecology,* Academic Press: San Diego, CA, USA.

Jr Frankenberger TW and Johanson JR (1982). Influence of crude oil and refined petroleum on soil dehydrogenase activity. *Journal of Environmental Quality* **11**(4) 612-617.

Pandey J and Sharma MS (2003). Analysis of soil, in environmental Science: Practical and field Manual, Yash Publishing House 37-53.

Plice JM (1948). Some effects of crude petroleum on soil fertility. *Soil Science Society of America, Proceedings* **13** 413-416.

Rowell JM (1977). The Effect of Crude Oil Spills on Soil. A Review of Literature. In: *The Reclamation of Agricultural Soils after Oil Spills, Part 1,* edited by Toogood JA (Edmonton, Canada) 1-33.

Subbaish BV and Asija GL (1956). A rapid procedure for the determination of available nitrogen in soils. *Current Science* **25** 259-260.

Vogt KA, Weynand-Patel T, Shelton M, Vogt DJ, Gordon JC, Mukumoto C, Suntana AS and Roads AP (2010). *Sustainability Unpacked: Food, Energy and Water for Resilient Environments and Societies*; Earthscan: London, UK.

Walkley A and Black IA (1934). An examination of the determination method for determining soil organic matter and a proposed modification method of the chromic acid titration method, *Soil Science* **34** 29-38.