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Physico-Chemical, Correlation and Linear Regression Analysis of Small Industry Area Soil Samples (Winter Season)

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Abstract

The soil samples were collected from various locations in an industrial area. Mineral and chemical compounds are present in the soil samples. The soil is used for the agriculture, industrial and environmental activities etc. Soil Pollution is in the form of physical, chemical and biological ways the present study is carried out from the industrial area soil and analyzed by physico-chemical method. Results are discussed.

Keywords: Soil, industry, winter season and physico-chemical properties

1. Introduction

Soil is one of the important and valuable resources in Nature**.** All living things are directly dependent on soil for their day to day needs and 95% of human food is derived from the earth. Planning for healthy and productive soil is critical to human survival. Soil is a natural body made up of layers (soil horizons) of mineral constituents that differ from the parent materials in their morphological, physical, chemical and mineralogical properties. Soil is made up of broken rock particles that have been altered by chemical and mechanical processes such as weathering and erosion. Sewage sludge, industrial factory residues and intensive fertilisations are the most likely sources of soil, water and plant pollution. In many parts of the world, including India, the use of industrial wastewater in suburban areas is common practice.

2. Physico Chemical Analysis of Soil Samples

The Physico-chemical parameters like pH**,** electrical conductivity, Total dissolved solids (TDS), Total alkalinity (TA), Total hardness (TH), Turbidity (TUR), calcium (Ca^{2+}), magnesium (Mg^{2+}), sodium (Na^{+}), potassium (K^{-}), chloride (Cl^{-}), fluoride (F^{-}), sulphate (SO_4^{-}), phosphate (PO_4^{-}), nitrate (NO_3^{-}) and Carbonate (CO_3^{2-}) contents of soil samples were estimated.

i). pH: The soil samples values are 7.9 to 8.7. The higher value of 8.7 has been observed in samples, respectively. The lower value of 7.9 has been observed in sample WS_{15} for winter seasons. All the values are within the permissible limit.

ii). Electrical Conductivity (EC): The electrical conductivity of soil in four seasons ranges from 1.16 to 1.27µs/cm, respectively. The higher value of 1.27µs/cm has been observed for. All the values are within the permissible limit.

iii). Total Dissolved Solids (TDS): Total dissolved solids refer to all minerals, salts, and non-volatile inorganic impurities. In 2012, the BIS established a TDS upper limit of 500-2000 mg/l.TDS levels above a certain threshold can cause kidney dysfunction, such as stone formation and calcium deposition in the renal system. The TDS in the current study ranges from 500 to 2000 mg/l. The higher value of 850mg/l has been observed for WS_9 sample at site-3 of the winter season. All the values are within the Acceptable limit.

iv). Total Alkalinity (TA): A combined property of water is its carbonate and hydroxide content. In other words, its ability to neutralize acids can be described. The maximum permissible limit as prescribed by BIS is 600 mg/l.

The higher value of 254 mg/l has been observed for the WS_8 sample at site-3 of the winter season. A lower value of 214 mg/l has been observed for the WS_{13} sample at site-5 of the winter season. All the values are within the permissible limit.

v). Total Hardness (TH): The minimum value of 120 mg/l has been observed in the WS_1 sample at site-1 of the winter season. All the values are within the permissible limit.

vi). Turbidity (TUR): The minimum value of turbidity has been observed throughout the year. All the values are within the permissible limit.

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vii). Calcium (Ca^{2+}): Calcium is an important nutrient required by organism. All the values are within the permissible limit.

viii). Magnesium (Mg^{2+}): Calcium and magnesium are directly related to hardness. All the values are within the permissible limit.

Table 1: Physico-chemical analysis of soil samples at winter season (WS_1-WS_{15})

Samples		Parameters															
		pH	EC	TDS	TA	TH	TUR	Ca^{2+}	Mg^{2+}	Na^{+}	K^{+}	Cl^{-}	F^{-}	SO_4^{-}	PO_4^{-}	NO_3^{-}	CO_3^{2-}
Site-1	WS_1	8.4	1.26	844	240	126	1.5	20.01	11	40.02	3.03	240	1.5	105	6.4	1.8	150
	WS_2	8.7	1.25	837	224	128	1.0	20.03	11	41.06	3.08	236	1.0	100	6.3	2.1	164
	WS_3	8.5	1.19	797	220	120	1.1	20.00	11	50.04	2.00	230	0.5	60	6.2	1.9	152
Site-2	WS_4	8.6	1.26	844	242	126	1.6	22.04	12	51.07	2.05	262	1.5	120	6.0	2.0	182
	WS_5	8.0	1.27	850	232	134	1.7	22.07	12	52.06	3.03	250	1.0	125	5.8	2.2	204
	WS_6	8.2	1.21	810	250	124	1.8	20.06	11	44.06	4.06	252	0.5	100	4.8	1.8	196
Site-3	WS_7	8.8	1.26	844	232	136	1.2	22.05	12	52.02	3.07	232	1.0	65	5.6	2.0	170
	WS_8	8.1	1.20	804	254	130	1.4	21.06	11	42.05	5.04	250	1.0	55	5.9	1.5	144
	WS_9	8.4	1.27	850	234	120	1.1	21.04	11	44.06	6.01	236	1.5	65	5.5	2.4	192
Site-4	WS_{10}	8.5	1.26	844	236	132	1.0	21.00	11	55.06	5.02	214	1.5	90	6.0	2.5	150
	WS_{11}	8.2	1.20	804	234	134	1.6	21.05	11	40.07	5.06	210	0.5	95	5.7	3.0	148
	WS_{12}	8.7	1.22	817	222	120	1.4	22.03	12	51.05	4.09	236	1.0	50	5.6	1.4	156
Site-5	WS_{13}	8.6	1.20	804	214	130	1.3	22.06	12	41.05	4.02	248	1.5	100	5.4	2.5	162
	WS_{14}	8.1	1.16	777	236	136	1.1	21.08	11	44.06	5.03	232	1.5	200	6.2	2.5	170
	WS_{15}	7.9	1.26	844	232	126	1.8	21.00	11	40.06	5.06	252	1.0	120	6.2	1.7	152
BIS (2012)		6.5-8.5	300	500-2000	200-600	200-600	1-5	75-200	30-100	200-250	12	250-1000	1-1.5	200-400	1-5	150-350	200-600

ix). Sodium (Na^{+}): Sodium in groundwater may be a result of the release of soluble products during the weathering of rocks and minerals. All the values are within the permissible limit.

x). Potassium (K^{+}): Potassium is an essential nutrient; it has an important role in the growth of plants. The lower value of 2.00 mg/l has been observed in winter season sample WS_3 at site-3. All the values are within the permissible limit.

xi). Chloride (Cl^{-}): Almost all bodies of water contain chloride. Even table salt contains more than 50% chloride. Excess chloride causes the séance to have a bitter taste, as well as a laxative effect, as well as heart and kidney disease. The lower value of 210 mg/l has been observed in the winter season sample WS_{11} at site-4. All the values are within the permissible limit.

xii). Fluoride (F^{-}): There are numerous minerals that are found as fluoride salts, which make them soluble. It is necessary within a certain limit because beyond that it can cause fluorosis and porous bones. The fluoride values are 0.5 to 1.5 mg/l respectively.

xiii). Sulphate (SO_4^{-}): In comparison to chloride, sulphate has very little effect on the taste of water (Dietrich and Burlingame 2015). The higher value of 200 mg/l has been observed in the winter season sample WS_{14} at site-5. All the values are within the permissible limit.

xiv). Phosphate (PO_4^{-}): All the values are within the permissible limit.

xv). Nitrate (NO_3^{-}): The table shows the nitrate values are 1.4 to 2.5 mg/l respectively. Lower value of 1.4 mg/l has been observed in autumn in the season, and sample WS_{12} at site-4. All the values are within the permissible limit.

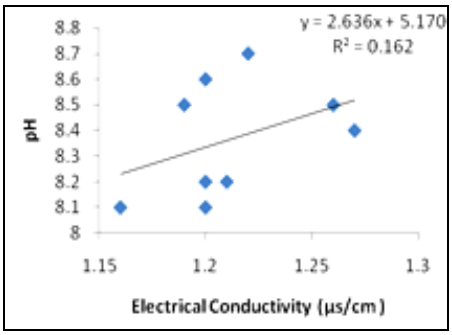
xvi). Carbonate (CO_3^{2-}): The table shows the carbonate values are 144 to 404 mg/l, respectively. The lower value of 144 mg/l has been observed in winter season sample WS_8 at site-3. All the values are within the permissible limit.

With the help of physico-chemical analysis, water parameters such as pH, EC, TDS, TA, TH, Ca, Mg, Na, K, F, SO_4, PO_4, NO_3 and CO_3-HCO_3 were measured. Variation of parameters value was observed due to change in water quality at different location. Water elemental concentrations vary less in the study area, even though deviations from acceptable levels are visible with a large increase in K values in the summer season, while in other regions it is below the desired level. Water physical properties are strongly related to water fertility. During the current investigation, irregular element distributions were observed, which could be attributed to changes in water quality caused by possible industrial pollution. Many useful inferences about the variation of chemical compositions have been drawn from the above results. Changes in land use and industrial discharge have also been linked in correlation studies. Correlation coefficients will aid in the selection of appropriate treatment to reduce pollution

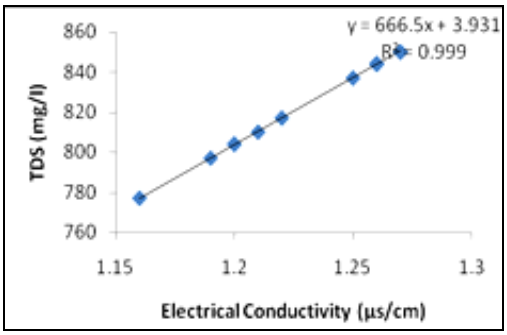
Table 2: Correlation matrix for soil samples parameters in winter season at (WS_1-WS_{15})

Parameters	pH	EC	TDS	TA	TH	TUR	Ca^{2+}	Mg^{2+}	Na^{+}	K^{+}	Cl^{-}	F^{-}	SO_4^{-}	PO_4^{-}	NO_3^{-}	CO_3^{2-}
pH	1.000															
Electrical Conductivity	0.167	1.000														
Total dissolved Solids	0.169	0.060	1.000													
Total Alkalinity	-0.454	0.058	0.058	1.000												
Total Hardness	-0.197	-0.101	-0.097	0.138	1.000											
Turbidity	-0.545	0.124	0.124	0.379	-0.042	1.000										
Calcium	0.156	0.158	0.160	-0.202	0.328	0.137	1.000									
Magnesium	0.417	0.219	0.220	-0.346	0.139	0.172	0.855	1.000								
Sodium	0.361	0.270	0.268	-0.091	0.039	-0.214	0.427	0.490	1.000							
Potassium	-0.437	-0.143	-0.144	0.227	0.107	-0.061	0.013	-0.434	-0.351	1.000						
Chloride	-0.189	0.183	0.182	0.246	-0.253	0.525	0.201	0.355	-0.119	-0.298	1.000					
Fluoride	0.184	0.300	0.303	-0.021	0.124	-0.331	0.320	0.189	0.062	0.159	0.155	1.000				
Sulphate	-0.448	-0.198	-0.199	0.103	0.479	0.141	0.008	-0.090	-0.189	0.047	0.138	0.330	1.000			
Phosphate	-0.053	0.110	0.115	-0.124	0.106	-0.294	-0.254	-0.277	-0.069	-0.233	-0.142	0.280	0.280	1.000		
Nitrate	-0.043	-0.123	-0.123	-0.213	0.504	-0.264	0.092	-0.112	-0.086	0.288	-0.563	0.157	0.370	-0.051	1.000	
Carbonate	-0.103	0.297	0.288	0.142	-0.027	0.234	0.228	0.331	0.256	-0.129	0.430	0.056	0.253	-0.492	0.098	1.000

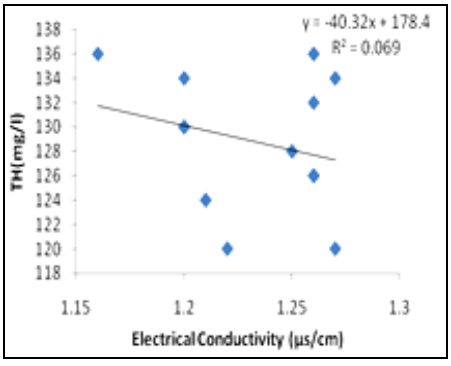
3. Linear Regression Analysis of Winter Season Soil Samples



(a)



(b)



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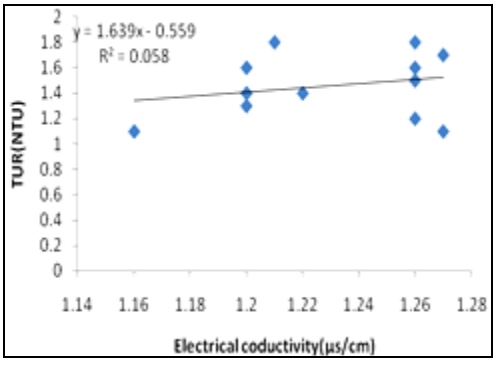

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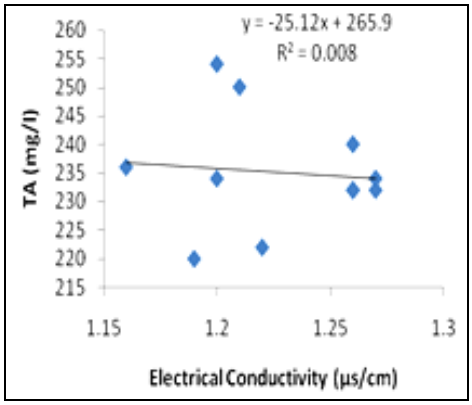

(e)

Fig 1(a, b, c, d e): Electrical conductivity vs pH, TDS, TH, Turbidity and TA

Regression analysis of the soil sample X axis is Electrical conductivity with Y axis pH, Total dissolved solids, Total Alkalinity, Total Hardness and Turbidity. The figures are given below, Figure1. Linear regression analysis of winter season soil samples shows the X axis is Electrical conductivity with Y axis pH, Total dissolved solids, Total Alkalinity, Total Hardness and Turbidity. The linear regression values is R^2= 0.162, 0.999, 0.008, 0.069 and 0.058. The winter season value is R^2 = 0.999(TDS) is significant level.

4. Conclusion

The aim of this study is to find out the industrial area soil. For this purpose, soil samples collected from industrial zone at Attur region. Soil samples collected from winter seasons in various site. In order to investigate the Physico-chemical analysis in each sample and to correlate the results with the extent of pollutions, the following spectral and physico-chemical studies are successfully carried out. All the above mentioned parameters and the minerals are within the permissible limit. The presence of magnesium, sodium and potassium is within the permissible limit, which increases cultivation.

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