Assessment of Impacts Paper Industrial Effluent on ground water quality

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Abstract— **Water is an essential component for the survival of the eco systems and all the living organisms on the earth. Due to agricultural activities, rapid industrialization and growth in urban population, the water sources are being contaminated by anthropogenic activities. Keeping in view the rapid industrialization in East Godavari region, it is proposed to characterize the effluent water generated from the paper industry and ground water collected from the surrounding areas of the industry to assess the impact of paper industrial effluent on ground water quality .The present work is focused on characterization of effluent and ground water collected physiological parameters viz.,pH, EC,TDS,TH, TA, Chloride, Sulphate, Nitrate, Phosphate, Na, K,Ca,Mg for assessing the chemical contamination of water. Irrigation parameters like, Percent sodium, SAR, RSC, KR and MH are determined to verify the suitability of water for irrigation purposes. Further the waters are characterized for metal ions like Li,Be,Al,V,Cr,Mn,Fe,Co,Ni,Cu,Zn,As,Se,Rb,Sr,Ag, Cd, Cs, Ba,Pb to assess the metal toxicity. The waters are also characterized for Microbial species. The research results revealed that higher values of TDS, TA and TH in some water samples indicate the presence of soluble solids and alkalinity of water. Higher values of TH in some samples indicate the encrustation nature of waters which make the waters unsuitable for drinking and domestic purposes. Presence of pathogenic bacteria like E.coli, Enterobacter, Pseudomonas, Klebsiella and Basillus indicate the microbial contamination of water and hence these waters can cause waterborne diseases, if consumed for drinking purposes. It is suggested that these waters are to be treated by using the available treatment methods to remove the chemical contamination and to subject the waters for disinfection methods to remove the microbial contamination befour use for drinking or domestic purposes.**

Index Terms— **Groundwater, Characterization, Parameters, Bacteria, Contamination.**

I. INTRODUCTION

Water is one of the most important compounds for the ecosystem and all the living organisms on the earth need water for their survival and growth. Earth is the only planet having about 70 % of water. Due to enhancedpopulation growth industrialization and utilization of fertilizers in the agriculture sector and anthropogenic activity. Water is highly polluted with hazardouscontaminants. The pulp and paper industry due to its chemical process has major impact on the environment.

The potential pollutants generated from the pulp and paper mill can be classified into four categories –liquid effluents, air pollutants, solid wastes and noise pollution[1,2]

The paper industry has been categorized as one of the most polluting industries due to discharge of huge volumes of highly colored and toxic effluent in the environment creating pollution of soil, air and water[3]. Most of the paper and pulp industries discharge their insufficiently treated waste water into nearby water sources which can cause serious problems for aquatic life[4]. This waste water generated from paper industry is rich in dissolved solids such as chlorides and sulphates of Na, Ca and varying amounts of suspended organic materials. In addition the effluents also contain some trace metals like Hg, Pb, and Cr etc. The effluents discharge into the water systems make the water unfit for irrigation and potable use and create health hazards. However, despite being a useful source of plant nutrients viz,N, P, K, Ca the paper mill effluent often contains huge amounts ofvarious organic and inorganic materials as well as toxic trace elements which may accumulate in soils in excess quantities under long term use. Subsequently, these toxic elements can cause serious problems to human beings and animals by entering into the food chains. Untreated industrial effluents contain huge amountsof Cd, Pb, Zn, Cu, Mn and Fe which can enhance the concentration of metal ions in irrigated surface soils[5].

Keeping in view the existence of paper mills in East Godavari District of Andhra Pradesh India it is necessary that the quality of drinking water should be checked at regular time interval as there is possibility of contamination of water sources by the released effluents so that the quality of water will be contaminated and can cause health hazardous to the public who consume these waters for drinking purposes

Experimental: The ground water samples were collected in East, West, North and South directions around the Paper industry by considering the industry as nucleus at a distance of 0-1 km,2-3 km and 3-5 km and the details of sampling locations which their coordinates are presented in table-1

Polythene containers were employed for sampling and preserved for analysis by following the standard procedures[6].The samples were analysed for physicochemical parameters which include pH , Electrical conductivity (EC) , Total Dissolved solids (TDS), Total Alkalinity (TA), Total hardness (TH), Ca^{2+} and Mg^{2+}, Na^{+}, K^{+}, Chloride, Sulphate and Phosphate. pH determined by pH meter (Global-DPH 505, India-Model) and Conductivity measured by the digital Conductivity meter (Global-DCM-900-Model). TDS is determined from the relation TDS = Electrical conductivity (EC) ×0.64. Chloride, TH, TA and Chloride are estimated by titrimetry. Fluoride, Sulphate, Nitrate and Phosphate by Spectrophotometer (Model-167, Systronics), Na^{+} and K^{+} by Flame Photometer (Model-125, Systronics).The irrigation parameters determined for the waters include Percent Sodium (%Na), Sodium Adsorption Ratio (SAR), Residual Sodium Carbonate (RSC), Kelly's Ratio (KR), Magnesium Hazard (MH) and the parameters are determined by the following relation

Percent Sodium (%Na) = $\frac{Na^{+}X100}{Ca^{2+}+Mg^{2+}+Na^{+}+K^{+}}$ (meq/l)

Sodium Adsorption Ratio (SAR) = $\frac{Na^{+}}{\sqrt{\frac{Ca^{2+}+Mg^{2+}}{2}}}$ (meq/l)

Residual Sodium Carbonate (RSC) = $(CO_3^{-2-}\ HCO_3^{-}) - (Ca^{2+}+Mg^{2+})$ (meq/l)

Kelly's Ratio (KR) = $\frac{Na^{+}}{Ca^{2+}+Mg^{2+}}$

Magnesium Hazard (MH) = $\frac{Mg^{2+}}{Ca^{2+}+Mg^{2+}}X100$

Metal ions: The representative Ground water samples were prepared and analyzed for metal ions viz., Be, Al, Cr, Mn, Fe, Co, Ni, Cu, Zn, As, Ag, Cd, Ba and Pb by Inductive coupled Plasma Mass Spectrometry (ICP-MS) technique (Model-7700 Make- Agilent Technologies). Samples are diluted with milli equivalent water, maintain conductance less than 1000 µs/cm and acidified with 100µL of supra pure HNO_3. Rh used as Internal Standard (ISTD) and the samples were processed as per the manual instructions of the instrument and introduced in to the instrument for analysis.

Microbial Analysis: The ground water samples collected in sterilized containers (E.K. Lipp., et al., 2001)[7] are immediately processed for analysis for determining the MPN count and for detecting the bacterial spps. The Most Probable Number (MPN) technique has been employed for the enumeration for the *Coliform* count in water samples (K. Obiri. Danso& Jones K, 1999a, K. Obiri. Danso& Jones K, 1999b)[8,9] which involved the presumptive test using lactose broth and Nutrient Agar, confirmatory test using Eosin Methylene Blue (EMB) agar. Pure colonies isolated were subjected to grams stain, motility, Indole, Methyl red, Voges-Proskuer tests, Citrate utilization test, Urease test, Catalase and Oxidase test. (SohaniSmruthi and IqbalSanjeeda, 2012)[10]

Table-1: Details of Sampling Locations distance from the source

Sl.no	Location	Source	Distance	GPS-Coordinates	
				Latitude	Longitude
P-1	Puragattu,Nearricemill	BW	E(0-1km)	E-81^0 58' 051''	N-16^0 51' 450''
P-2	Puaragattu,Ramatemple	BW	E (2-3km)	E-81^0 58' 205''	N-16^0 51' 194''
P-3	Puragattu,Main road	OW	E (3-5km)	E-81^0 58' 387''	N-16^0 51' 321''
P-4	Near to paper mill main gate	OW	W (0-1km)	E-81^0 56' 630''	N-16^0 51' 795''
P-5	Mandapeta bus stand	OW	W (2-3km)	E-81^0 56' 314''	N-16^0 51' 658''
P-6	Mandapeta,NearSaibrundavan	OW	W (3-5km)	E-81^0 55' 934''	N-16^0 51' 729''
P-7	Maradibaka,Main road	BW	N (0-1km)	E-81^0 57' 055''	N-16^0 51' 919''
P-8	Maradibaka,Ametkarstreet	BW	N (2-3km)	E-81^0 57' 065''	N-16^0 52' 021''
P-9	Mandapeta near main road	OW	N (3-5km)	E-81^0 57' 386''	N-16^0 52' 216''
P-10	Near rice mill	BW	S (0-1km)	E-81^0 55' 634''	N-16^0 51' 649''
P-11	Maradibaka,Indirammacolony	OW	S (2-3km)	E-81^0 55' 029''	N-16^0 51' 567''
P-12	Maradibaka,Brick industry	OW	S (3-5km)	E-81^0 57' 442''	N-16^0 51' 401''

OW=Open well BW= Bore well. E-East-West, N-North, S-South

Fig-1: Maps showing the Study Area

The analytical data related to physicochemical parameters are presented in Table-2&3.

Table-2: Physicochemical characteristics of Paper Industry effluent and ground water

S.No	pH	EC µmhos/cm	TDS (mg/l)	TA (mg/l)	TH (mg/l)	Ca^{2+} mg/l	Mg^{2+} mg/l
Effluent	8.7	996	637.44	500	1400	360	120
P-1	7.4	564	360.96	90	180	48	14.64
P-2	7.6	906	579.84	110	110	20	14.64
P-3	7.5	796	509.44	120	170	44	14.64
P-4	7.5	682	436.48	120	190	60	9.76
P-5	7.8	312	199.68	100	110	28	9.76
P-6	7.1	1830	1171.2	200	280	64	29.28
P-7	7.5	680	435.2	110	210	48	21.96
P-8	7.3	664	424.96	100	140	48	4.88
P-9	7.4	358	229.12	60	90	20	9.76
P-10	7.7	567	362.88	90	130	28	14.64
P-11	7.8	578	369.92	110	180	24	29.28
P-12	7.7	683	437.12	100	70	12	9.76

Table-3: Physicochemical characteristics of Paper industrial effluent and ground water

S.No	Na+ (mg/l)	K+ (mg/l)	Chloride (mg/l)	Nitrate (mg/l)	Sulphate (mg/l)	Phosphate (mg/l)
Effluent	115.25	7.53	269.42	3.18	108.2	20.9
P-1	18.57	0.92	21.27	2.79	48	0.5
P-2	82.45	2.54	38.99	6.94	174	1.3
P-3	47.86	17.21	17.72	3.15	69	1.4
P-4	22.57	0.65	7.09	2.21	23	1.7
P-5	51.93	3.4	7.09	13.6	17	1.2
P-6	101.69	102.31	99.26	9.83	258	1.5
P-7	26.29	1.85	10.63	4.86	23	2
P-8	24.94	1.07	10.63	1.2	13	1.3
P-9	19.03	1.91	7.09	3.31	41	3.9
P-10	35.96	1.03	7.09	6.36	37	2
P-11	34.96	1.16	7.09	4.15	122	1.5
P-12	88.56	1.67	17.72	6.55	143	2.6

Table: 4 Irrigation Parameters

S.No	%Na (meq/l)	SAR (meq/l)	RSC (meq/l)	Kelly's Ratio(KR)	MH
Effluent	15.2	1.34	BDL	0.18	35.16
P-1	18.34	0.60	BDL	0.23	32.80
P-2	61.58	3.44	0.03	1.65	53.94
P-3	35.32	1.60	BDL	0.62	34.74
P-4	20.53	0.71	BDL	0.26	20.65
P-5	49.89	2.16	BDL	1.04	35.80
P-6	35.14	2.66	BDL	0.80	42.26
P-7	21.38	0.79	BDL	0.27	42.26
P-8	27.79	0.92	BDL	0.39	13.99
P-9	31.14	0.88	BDL	0.46	43.85
P-10	37.57	1.38	BDL	0.61	45.55
P-11	29.85	1.14	BDL	0.43	66.12
P-12	73.01	4.63	0.62	2.79	56.55

Table-5: Metal ion concentration of Sago Industrial effluent and ground Waters

Sample Code	Li (ppm)	Be (ppm)	Al (ppm)	V (ppm)	Cr (ppm)	Mn (ppm)	Fe (ppm)	Co (ppm)	Ni (ppm)	Cu (ppm)
P-Ef	0.007011	BDL	0.303172	0.020493	0.04359	0.008024	0.19813	0.000619	0.028405	0.069716
P-1	0.593	BDL	4.093	1.635	0.044	0.485	2.768	0.011	0.094	BDL
P-2	0.004549	BDL	0.003203	0.036785	0.000059	0.000235	0.002104	0.000017	0.000098	BDL
P-3	BDL	0.001592	BDL	0.001754	0.025831	0.000039	0.000181	0.000927	0.000026	0.000096
P-4	0.000714	BDL	0.229674	0.00869	0.000523	0.045827	0.30069	0.000295	0.000427	0.000495
P-5	0.000665	BDL	0.005117	0.001298	0.000375	0.000305	0.005944	0.000016	0.000645	BDL
P-6	0.006884	BDL	0.002388	0.032498	0.000256	0.002768	0.001967	0.000112	0.000342	BDL
P-7	0.001269	0.000022	0.008559	0.003286	0.000096	1.147487	0.009521	0.000273	0.000747	BDL
P-8	0.000941	BDL	0.016531	0.007353	0.000087	0.00247	0.023871	0.000045	0.000091	BDL
P-9	0.000556	BDL	0.009228	0.004201	0.000061	0.334197	0.01515	0.000225	0.000449	BDL
P-10	0.001171	BDL	0.004929	0.02229	0.000067	0.021684	0.009475	0.000074	0.000275	BDL
P-11	BDL	0.00847	0.03584	0.00004	0.001215	0.006673	0.000011	0.00019	BDL	0.002004
P-12	BDL	0.00218	0.000011	0.005518	0.042109	0.000069	0.000476	0.005566	0.000014	0.000103

Table-6: Metal ion concentration of Paper Industrial effluent and ground Waters

Zn (ppm)	As (ppm)	Se (ppm)	Rb (ppm)	Sr (ppm)	Ag (ppm)	Cd (ppm)	Cs (ppm)	Ba (ppm)	Pb (ppm)
0.064691	0.001782	BDL	0.000898	0.07725	0.000044	0.001382	0.000148	0.093938	0.009716
1.579	0.098	0.157	0.36	175.252	BDL	0.19	0.001	53.405	BDL
0.000714	0.000867	0.000636	0.000047	0.020019	BDL	0.000004	0.000001	0.003955	BDL
BDL	0.000156	0.000497	0.000221	0.000619	0.05429	BDL	0.000003	0.000001	0.00753
0.002015	0.00029	0.000301	0.001089	0.180818	BDL	0.000001	0.000014	0.051807	BDL
0.003264	0.000095	0.000564	0.000712	0.371529	BDL	0.000003	0.000024	0.061344	BDL
0.006297	0.000917	0.001676	0.014128	0.444289	BDL	0.0002	0.000002	0.062233	BDL
0.123369	0.000212	0.000074	0.001496	0.228184	BDL	0.000007	0.000002	0.04219	BDL
0.000654	0.000099	0.000341	0.000506	0.175867	BDL	BDL	0.000002	0.040365	0.000019
0.003377	0.00012	0.000061	0.000378	0.133866	BDL	0.000006	0.000001	0.023806	BDL
0.052628	0.000614	0.000178	0.000275	0.170784	BDL	0.000003	0.000001	0.013635	BDL
0.000516	0.000301	0.000381	0.136493	BDL	0.000002	0.000001	0.008224	BDL	BDL
BDL	0.000852	0.001735	0.000242	0.000338	0.00001	BDL	0.000003	0.000001	0.005153

Table-7: Bacterial species identified in Ground water and Paper industrial effluent

Sample code	MPN Count/ 100ml	No.of Bacterial Colonies	Bacterial colony morphology on EMB	Gram Stain	Motility	Biochemical Tests							*Bacteria identified*
						Indole	MR	VP	Citrate	CA	OX	UR	
P1	120	2	Metallic Sheen	-ve	Motile	+ve	+ve	-ve	-ve	+ve	-ve	-ve	***E.Coli***
			Purple Centered	-ve	Motile	-ve	-ve	+ve	+ve	+ve	-ve	-ve	***Enterobacter***
P2	1600	2	Purple Centered	-ve	Motile	-ve	-ve	+ve	+ve	+ve	-ve	-ve	***Enterobacter***
			Light Pink	-ve	Motile	-ve	+ve	-ve	-ve	+ve	-ve	+ve	***Proteus***
P3	<2	1	Purple Centered	-ve	Motile	-ve	-ve	+ve	+ve	+ve	-ve	-ve	***Enterobacter***
P4	23	1	Colorless	-ve	Motile	-ve	-ve	-ve	-ve	-ve	+ve	-ve	***Pseudomonas***
P5	<2	1	Purple Centered	-ve	Motile	-ve	-ve	+ve	+ve	+ve	-ve	-ve	***Enterobacter***
P6	23	2	Purple Centered	-ve	Motile	-ve	-ve	+ve	+ve	+ve	-ve	-ve	***Enterobacter***
			Light Pink	-ve	Motile	-ve	+ve	-ve	-ve	+ve	-ve	+ve	***Proteus***
P7	8	2	Metallic Sheen	-ve	Motile	+ve	+ve	-ve	-ve	+ve	-ve	-ve	***E.Coli***
			Purple Centered	-ve	Motile	-ve	-ve	+ve	+ve	+ve	-ve	-ve	***Enterobacter***
P8	220	3	Metallic Sheen	-ve	Motile	+ve	+ve	-ve	-ve	+ve	-ve	-ve	***E.Coli***
			Purple Centered	-ve	Motile	-ve	-ve	+ve	+ve	+ve	-ve	-ve	***Enterobacter***
			Pink Mucoid	-ve	Motile	-ve	-ve	+ve	+ve	+ve	-ve	-ve	***Klebsiella***
P9	2	2	Purple Centered	-ve	Motile	-ve	-ve	+ve	+ve	+ve	-ve	-ve	***Enterobacter***
			Pink Mucoid	-ve	Motile	-ve	-ve	+ve	+ve	+ve	-ve	-ve	***Klebsiella***
P10	920	1	Colorless	-ve	Motile	-ve	-ve	-ve	-ve	-ve	+ve	-ve	***Pseudomonas***
P11	<2	1	Purple Centered	-ve	Motile	-ve	-ve	+ve	+ve	+ve	-ve	-ve	***Enterobacter***
P12	11	1	Metallic Sheen	-ve	Motile	+ve	+ve	-ve	-ve	+ve	-ve	-ve	***E.Coli***
PAP-EF	>1800	3	Pink Mucoid	-ve	Motile	-ve	-ve	+ve	+ve	+ve	-ve	-ve	***Klebsiella***
			Colorless	-ve	Motile	-ve	-ve	-ve	-ve	-ve	+ve	-ve	***Pseudomonas***
			Purple Centered	-ve	Motile	-ve	-ve	+ve	+ve	+ve	-ve	-ve	***Enterobacter***

The photographs of bacterial species present in ground water are shown in Figures from2 (a) to 2(l) and Paper industrial effluent is shown in figures from 3(a) to 3(c) respectively

Bacterial species present in Ground water

2 (a) *E.Coli, Enterobacter,*

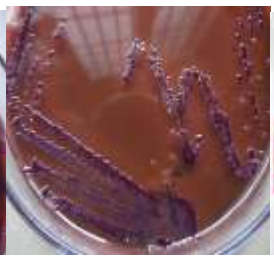
2 (b) *Enterobacter,Proteus*

2 (c) *Enterobacter*

2 (d) *Pseudomonas*

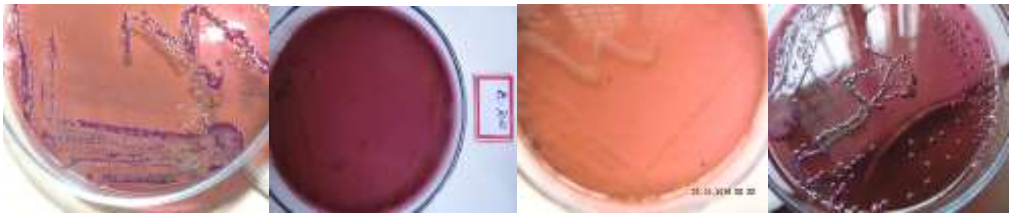
2(e) *Enterobacter*

2(f) *Enterobacter,Proteus*



2(g) *E.Coli, Enterobacter*

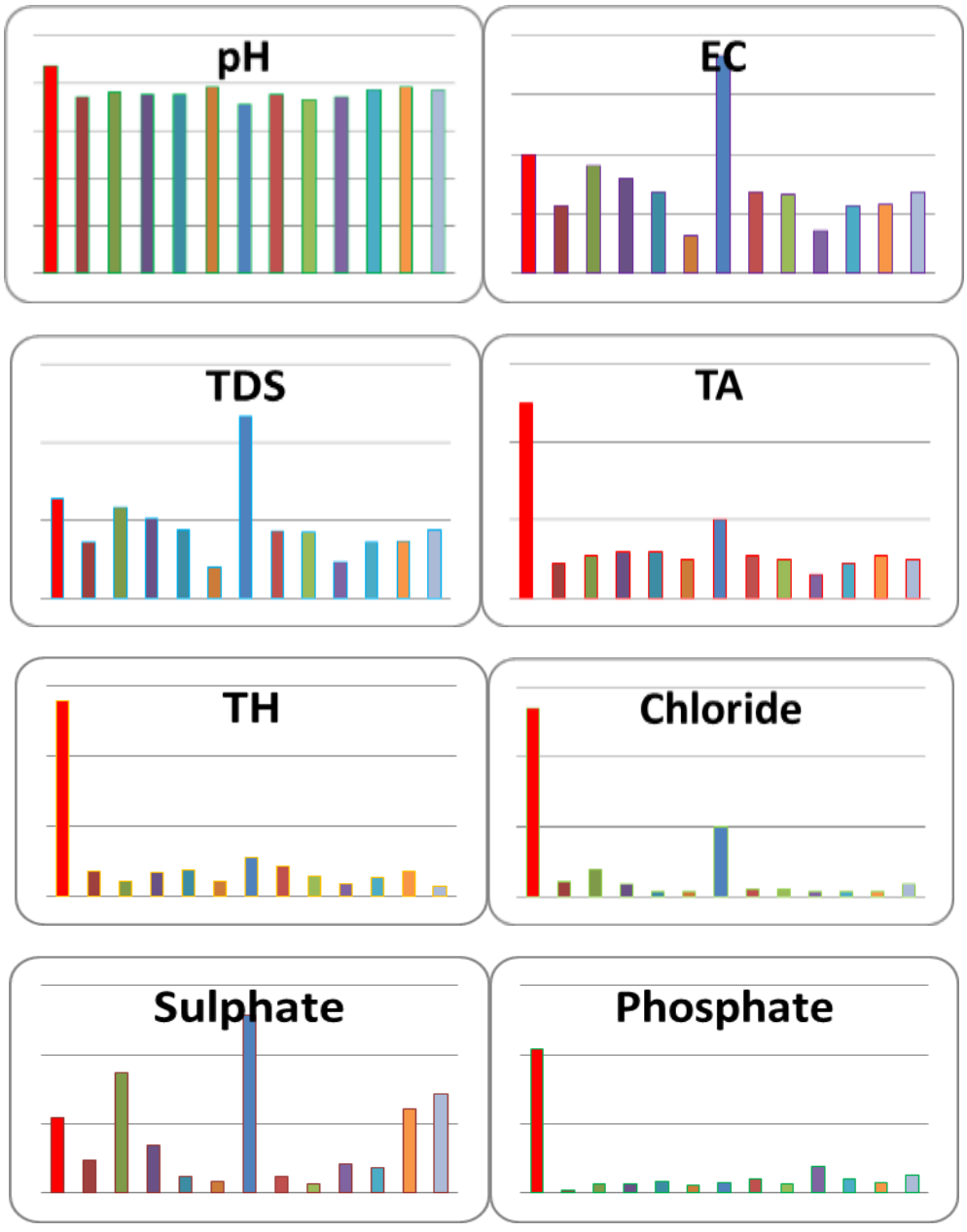
2(h) *E.Coli, Enterobacter,Klebsiella*

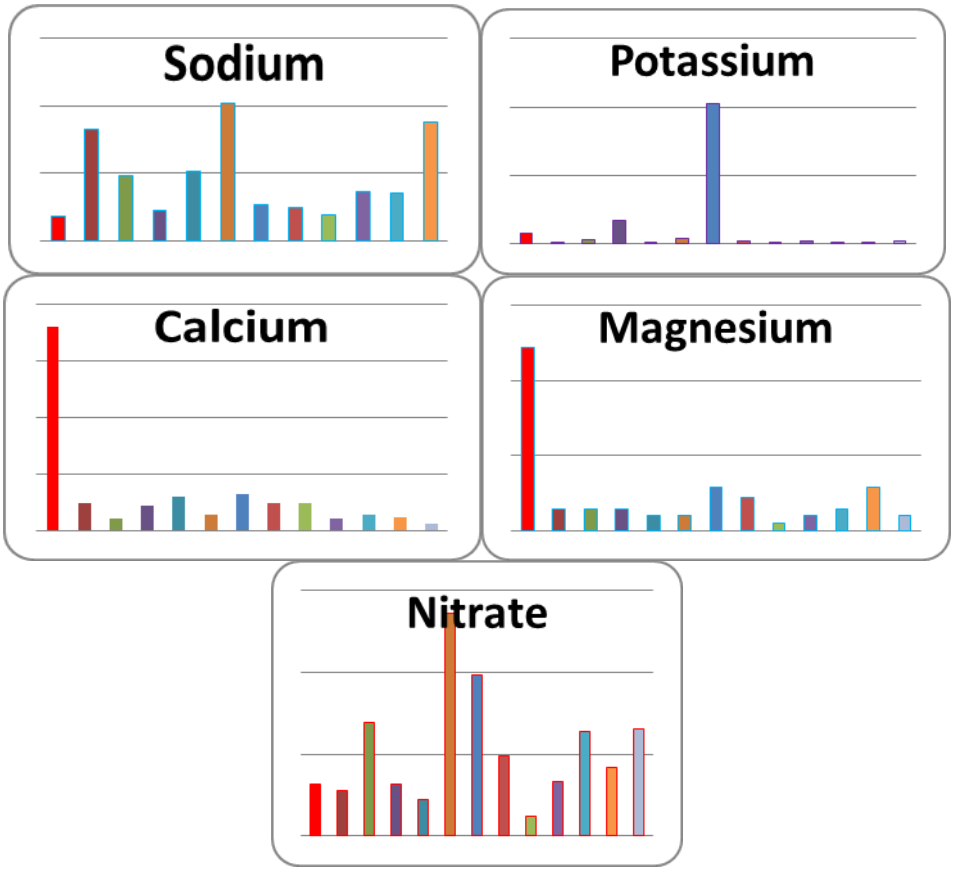


2(i) *Enterobacter,Klebsiella* 2(j) *Pseudomonas* 2(k) *Enterobacter* 2(l) *E.Coli,*

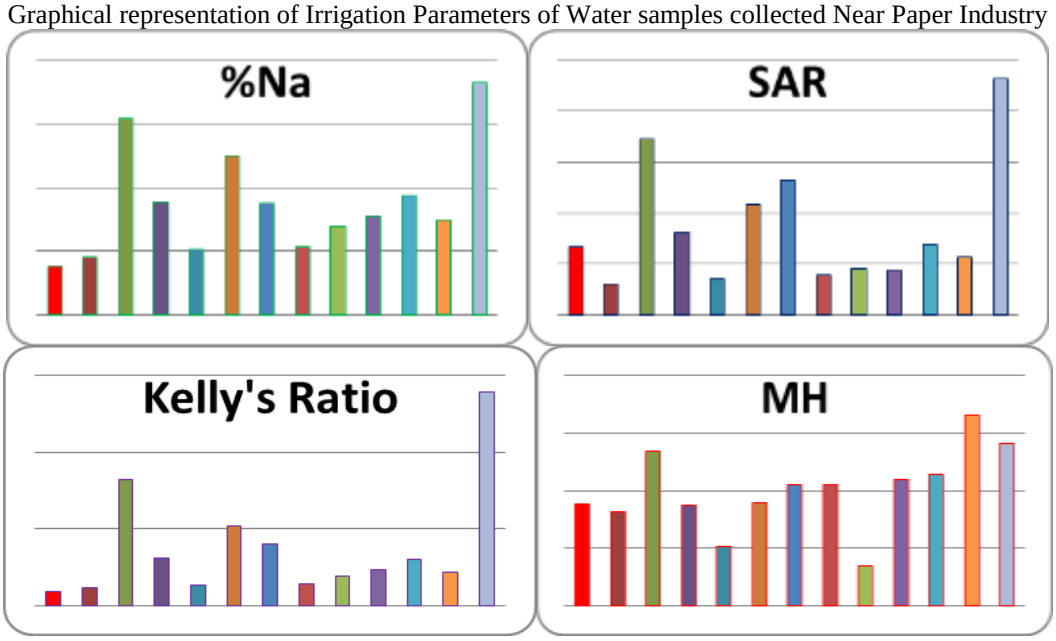
3(a) ***Klebsiellaspp*** 3(b) *Pseudomonas* 3(c) *Enterobacter*

Figures showing the graphical representations of Physical Parameters of Water samples collected Near Paper Industry





Graphical representation of Irrigation Parameters of Water samples collected Near Paper Industry



II. Results & Discussion:

pH: The pH of effluent is 8.7 while the pH of ground waters around the industry varies from 7.1-7.8 which is within the permissible limit. It indicates this impact of effluent is absent on the ground water quality in terms of pH

EC: The EC of effluent is 996 µmhos/cm,while the EC ranges from 312-1830 µmhos/cm.Ec of ground water samples P-2,P-6 and P-11 are at higher indicating the saline nature of waters.

TDS: TDS of effluent is 637.44 mg/L while TDS of ground waters range from 362.88-1171.2 mg/L.TDS of water samples P-2,P-3,P-6 crossed the permissible limit of 500 mg/.Indicating the presence of soluble solids in waters which can changes the taste of the water and hence then unsuitable for drinking purposes.

TA: TA of effluent is 500 mg/L while TA of ground waters range from 60-200 mg/L.TA of all water samples are within the permissible limit of 200 mg/L.

TH: TH of effluent is 1400 mg/L while it ranges from 70-280 mg/L. The permissible limit of TH of waters is 300 mg/L.TH of water samples are within the permissible limit .In these cases the impact of effluent water is absent on ground water quality.

Ca^{2+}: Calcium ion concentration in effluent is 360 mg/L while the ranges from 12-64 mg/L.The permissible limit of Ca^{2+} ion concentration is 75 mg/L .Since the concentration of Ca^{+2} ion is within the permissible limit. The impact of effluent on ground water quality is absent

Mg^{2+}: Mg^{2+} ion concentration in Effluent is 120 mg/L .Mg^{2+} ion concentration of ground waters ranges from 4.88-29.88 mg/L.Mg^{2+} ion concentration in waters within the permissible limit (30 mg/L) which indicates the absence of effluent impact in ground water.

Na^{+}: Sodium ion concentration of effluent is 115.25 mg/L.It ranges from 19.03-101.69 mg/L ground water and the concentration levels are within the permissible limit (200 mg/L) of WHO standards.

K^{+}: Potassium ion concentration of effluent is 7.53 mg/L.It ranges from 0.65-102.31 mg/L.All the values of concentration of Potassium in except in sample-6 is within the permissible limit (12 mg/L)of WHO standards while it exceed the permissible limit in water sample-6

Chloride: Chloride ion concentration of effluent is 269.42 mg/L while it ranges from 7.09-99.26 mg/L.In case of ground water samples chloride ion concentration is within the permissible limit .The impact of effluent on ground water quality is absent

Nitrate: Nitrate ion concentration of effluent is 3.18 mg/L while it ranges from 1.20-9.83 mg/L in ground waters. The permissible limit of nitrate in drinking water is 45 mg/L. All the values of nitrate ion concentration in ground water are within the permissible limit indicate the absence of effluent influence on ground waters.

Sulphate: The sulphate ion concentration of effluent is 108.2mg/L The permissible limit of sulphate ion concentration in water is 250 mg/L its concentration ranges from 13-258 mg/L.Sulphate ion concentration in sample -6 crossed the permissible limit indicating the discharge of effluent in to the ground water source in that location. In other samples sulphate ion concentration is within the permissible limit.

Phosphate: Phosphate ion concentration in effluent is 20.9 mg/L while it ranges from 0.5-3.9 mg/L in ground waters .Phosphate ion concentration in all ground waters is on the lower side indicating the impact of effluent on ground water in terms of phosphate.

%Na: Percent sodium of effluent is 15.20 meq/L while it ranges from 18.34-73.01 meq/Waters with % sodium value more than 60 meq/L are not suitable for irrigation purposes %Na of samples P-2 and P-12 crossed the limit of 60 meq/L and are unsuitable for irrigation purposes. Since % Na of effluent is comparatively lower than the %Na of ground water and hence it has no effluence on ground water quality.

SAR: SAR of effluent is 1.34meq/L while it ranges from 0.60-63 meq/L. All the values are within the permissible limit of 26 meq/l of irrigation standards and are suitable for irrigation purposes

RSC:RSC of effluent is at BDL while it is 0.03 meq/L and 0.62 meq/L ,in samples P-2 and P-12 RSC is within the permissible limit of 1.5 of irrigation standards and in other ground water samples it is at BDL.Lower values of RSC indicate the suitability of waters for irrigation purposes.

KR: Kelly's ratio of effluent is 0.18 while it ranges from 0.27-2.79 in ground water samples. Waters with KR value up to 1 are suitable for irrigation purposes. In case of waters P-2-P-5 and P-12, KR exceeded the permissible limit of 1 and hence these waters are unsuitable for irrigation purposes. Other water samples with KR value less than 1 are suitable for irrigation purposes

MH: Waters with MH less than 50 are suitable for irrigation purposes .MH of effluent is 35.16 while MH of ground waters range from 13.99-66.12. In case of sample P-2, P-11 and P-12, MH exceeded the permissible limit and hence unsuitable for irrigation purposes whereas in the remaining waters MH is lover than 50 and are suitable for irrigation purposes. Higher value of MH deplete the quality of soil and hence the crop yield will be reduced in the location of the industry area

Metal ions: The metal ion concentration of Li,Be,Al,V,Cr,Mn,Fe,Co,Ni,Cu,Zn,As, Li,Be,Al,V, Cr,Mn,Fe,Co,Ni,Cu,Zn,As,Se,Rb,Sr,Ag,Cd,Cs,Ba and Pb are on the lower side of the permissible limit of drinking water standards indicating the waters are free from Metal toxicity.

MPN Count & Bacterial species: The effluent is found to contain MPN count and other pathogenic bacterial species like *Klebsiella, Pseudomonas, Enterobacteand,Proteus* are found water samples P-1,P-2,P-4,P-6,P-7,P-8,P-10,P-12 are found to contain MPN count indicating the bacterial contamination of waters .In addition,the water samples P-1 and P-7 are found to contain *E.coli* and *Enterobacter*, P-2 contains *Enterobacter,and proteus*;P-6 with Enterobacter,and proteus ,P-8 with E coli, Enterobacter and klebsiella; P-9 with *Enterobacter and klebsiella* P-10 with while *Enterobacter,and klebsiella* P-10 with *Pseudomonas* and P-12 with *E.coli*.The results indicate the impact of effluent and ground water quality in terms of microbial contamination.

III. CONCLUSIONS:

pH values indicated the slight alkaline nature of waters.TDS in limited no of water samples exceeded the permissible limit indicating the presence of soluble solids in waters. Total alkalinity and total hardness Ca^{2+},Mg^{2+} ion concentrations are within the permissible limits of drinking water standards.Chloride,Nitrate and Phosphate ion concentrations are within the permissible limit indicating non corrosive nature waters and the and the absence of discharge of agriculture runoffs in to the ground waters.Sulphate in only one sample crossed the permissible limit conformed the discharge of industrial effluent into waters in that location of the study area . The values of irrigation parameters %Na and KR and MH crossed the permissible limit of irrigation standards in samples P-12 and P-2,P-5 and P-12 respectively indicating their unsuitability for irrigation purposes . MH crossed the limit in sample P-2 and P-12 indicating the depletion of quality of soil in the location of the study area which in turn reduces the yield of the crop in those locations. Lower metal ion concentration in water indicates the absence of metal toxicity of waters. Presence of MPN count and pathogenic bacteria species like *E-coli, Enterobacter, Pseudomonas, Proteus and Klebsiella* indicate the bacterial contamination of waters.

The research results revealed the presence of soluble solids in waters and microbial contamination .The waters are to be treated by the available treatment techniques like water filtration and nano filtration to remove the soluble solids. The waters are to be subjected to disinfection method to remove

the microbial contamination before consuming. The waters for use otherwise the waters can cause water born diseases and the health of the public will be effected.

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