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Assessment Of Industrial Units Discharge Effluent Influence On Ground Water Excellence In East Godavari Area

D.Rama Rao[1],G.Elishababu[2], M.V.K.Mehar[3] ,D.Karunakar[4],
[1] *Department of Chemistry, P.R.Govt College (A) Kakinada*
[2] *Departments of EducatonAdikaviNannyy University Rajamahendravaram*
[3]*Department of Physics Govt Degree collegeAalamuruEgdt*
[4]*Department of Chmistry Tara Govt College Saggareddy*
Corresponding Author: D.Rama Rao

Abstract: *Ground Water is an necessary 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 are determined to verify the suitability of water for irrigation purposes.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 Basillusindicate 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.*

Key words: *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.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 different industial unites 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 industrial unites 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

Fig-1: Maps showing the Study Area

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

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

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

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

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

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

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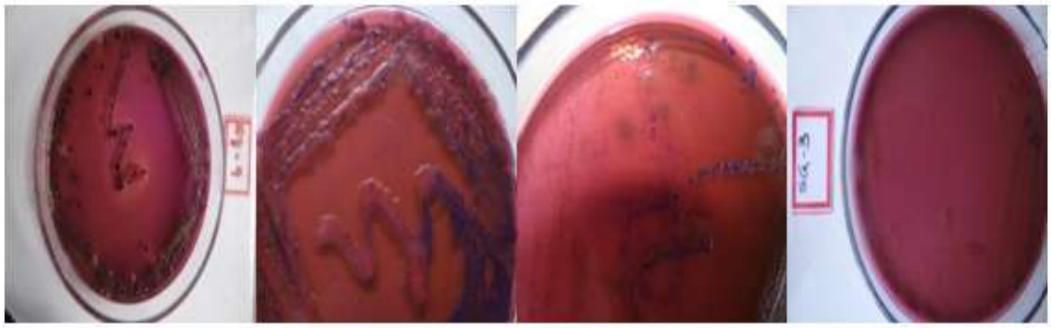
Microbial Analysis: The ground water samples collected in sterilized containers (E.K. Lipp., et al., 2001)[7] are immediately processed for analysis for determining the MPN count and for detecting the bacterial spps. The Most Probable Number (MPN) technique has been employed for the enumeration for the *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].
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	1996	537.94	500	1100	460	320
GW-1	7.8	764	360.96	90	180	48	14.64
GW-2	7.6	906	579.84	170	150	20	14.64
GW-3	8.2	796	50.48	220	170	50	14.64
GW-4	7.5	682	436.48	120	190	60	9.76
GW-5	7.8	3120	289.68	100	110	28	9.76
GW-6	7.1	1830	1171.2	200	280	64	29.28
GW-7	8.5	680	435.2	110	310	98	21.96
GW-8	7.3	664	424.96	100	240	48	4.88
GW-9	7.4	3580	389.15	60	90	20	9.76
GW-10	7.7	967	368.8	90	138	28	19.64
GW-11	7.8	588	363.12	110	280	24	29.28
GW-11	7.9	363	437.12	100	70	12	9.76

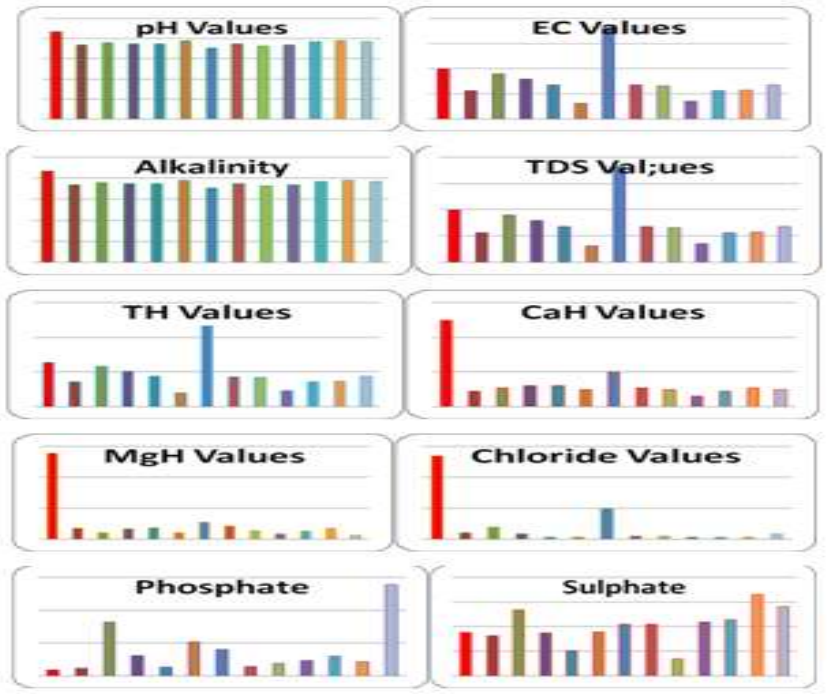
The photographs of bacterial species present in ground water are shown in Figures from2 (a) to 2(d Bacterial species present in Ground water



2 (a) 2 (b) 2 (c) 2 (d)

Enterobacter, Proteus EnterobacterPseudomonas

Figures showing the graphical representations of Physical Parameters of Water samples collected Near Industrial unites



II. Results & Discussion

4.3.2 Results and Discussion (Physicochemical Parameters)

pH: The pH of effluent is 8.7 while the pH of ground waters around the industry varies from 7.1-8.7 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 1996 µmhos/cm,while the EC ranges from 312-3580 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 60-220 mg/L.TA of all water samples are within the permissible limit of 200 mg/While sample no 3 is slightly high.

TH: TH of effluent is 1100 mg/L while it ranges from 70-310 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 460 mg/L while the ranges from 12-98 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 but slight variation in sample no 7.

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.

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.

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,andproteus ,P-8 with E coli, Enterobacter and klebsiella; P-9 with *Enterobacter and klebsiella* P-10 with while *Enterobacter,andklebsiella* 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. 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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