Water quality Index Assessment of the Groundwater of Industrial area and absorption by Polymer Composites

Dasari Sravani[1*], Dr. S. Aruna Kumari[2], K.Mruduladevi[2]

[1]Associate professor of Chemistry, Aditya College of Engineering and Technology, Surampalem, India

[2]Associate professor of Chemistry, Aditya Engineering College, Surampalem, India

DOI: https://doi.org/10.47772/IJRISS.2023.70586

Received: 28 April 2023; Revised: 09 May 2023; Accepted: 12 May 2023; Published: 13 June 2023

ABSTRACT:

Introduction: Water play a pivtol role in the existence in the human life. water quality index is assessing the overall quality of water based on location, time and some parameters of water. water quality index is important tool for assessing the quality water on the surface. Water quality index assessing is the important parameter helps in improving the quality of drinking and ground water. Due to anthropogenic activites the quality of ground and drinking water is decreased.

Objective: The main objective of research is to find the water quality index of the ground water and bore water in selected industrial area of the Kakinada and analyse the water quality index of it and absorption of ions by polymer composites for desalination and water treatment.

Methodology: the water quality inex is calculated based on icmr standards.

Results: The research results revealed that the sampling sites S-1,S-2 and S-3 is water quality index is less than 100 which is treated the poor quality of drinking water. The S-4,S-5,-6,S-7S-8,S-9,S-10,S-11,S-12 the water quality index is greater than 100 which is not suitable for drinking water.

Conclusion: The water quality index observed at various stations shows that some places are not fits for drinking S-1,S-2 and S-3 are below 100 are very poor and S4-S12 sites are more polluted and unfit for drinking. The ground water is need to protected from pollution and govt need to take necessary measures to improve the quality of ground water and cyclodextrin polymer composites effective composite for removal of hardness and desalination.

Key words: Water, WQI, ground water, drinking water, polymer composites.

INTRODUCTION

Water is part of source for human existence in the earth crust. water plays as crucial role in the domestic, industrial, agriculture and commercial industries. Water quality index is important parameter for assessing the quality of the drinking water and industrial water. Due to urbanization and industrialisation the quality of water is reduced.

Water quality index is parameter used to measure changes in quality of water in a particular area and make comparisons from different location of Kakinada. This index allows for a general analysis of quality of water in many area and extent of pollution in the ground water environment and also helps govt to take

measures for improving the quality of ground and drinking water. Groundwater quality is impacted by natural processes such as irrigation, urbanisation, industrialization, mining, and processes like precipitation, evaporation, ion exchange, and mineral dissolution (8).To meet their domestic needs, people who live close to industrial areas depend on the quality of the water. The only parameter that evaluates the total quality of the water is the water quality index.

The objective of research is to analysis the water quality index parameter for measuring difference in water sample and suggest the measures to increasing the quality of the water and the uasage of the advanced polymer composites for water treatment and desalination.

Polymer composites are made up of two or more natural organic and inorganic materials with high mechanical strength, flexibility, chemical stability and high surface area. These materials are very effective **in treatment of water for industrial and domestic applications**. Among many composites materials the cyclodextrin and amino hyper branched polymer cotton fibres are more effective for dye removal.(11)

Study area

Figure 1. study location of the map[17]

The water is collected from different areas of the industrial region and rural areas of the Kakinada. the coastal region of Kakinada is hub of industries where the usage of water is more for industries ,drinking and domestic purpose.

The samples at different location are collected in a cleaned the water bottles and store at room temperature for carrying the analysis. To evaluate the water quality at the various stations, many parameters are analysed. The water quality index is the best parameter for assessing the purity of water is fits for drinking. The bureau of indian standards are used to assess the water WQI(8)

METHODOLOGY:

All the water samples are collected at particular area and analysed the important parameters. The water quality which is assessed with various parameter like PH, temperature, Electrical conductivity, Total dissolved solids, Turbidity, total hardness, Total Alkalinity, Ca^{2+},Mg^{2+},Cl- and Dissolved oxygen with help of Conductivity meter, PH meter, Turbidity meter, Total hardness, Ca^{2+}, Mg^{2+}, Cl- is analysed by titrimetric method. Cholride ions are measured by titration with silver nitrate solution.

RESULTS

Table-1:The physiochemical analysis of water in different sites and the data is cited from (16)

Sample	PH	TEMP	EC Ms	TDS ppt/ppm	Turbidity NTU	T.H ppm	T.A ppm	Ca2+ ppm	Mg2+ ppm	C l- ppm	D.o ppm
S-1 TMBW	7.21	29	3.84	152ppm	0.05	400	601.5	172.3	55.33	514.84	4.60
S-2 TMMW	7.4	29.2	2.31	872ppm	0.15	395	545	106.2	70.17	304.9	4.93
S-3 KMBW	7.3	28.7	0.903	335ppm	1.93	325	590	82.16	59.01	24.99	3.19
S-4 kMMW	6.4	29.1	0.424	150ppm	0.35	175	167.5	30.06	35.22	14.99	4.94
S-5 PDBW	9.01	29.3	3.29	121ppm	0.02	325	750	104.81	53.50	25.99	5.02
S-6 PDMW	7.20	29.1	0.892	315ppm	0.05	265	250	60.72	49.64	74.97	5.56
S-7 YDWW	7.66	29.1	3.36	145ppm	0.28	555	865	148.2	98.85	454.8	4.67
S-8 YDMW	7.50	28.9	0.554	181ppm	0.15	245	255	60.12	44.92	99.96	4.09
S-9 KDWW	7.20	29.1	1.42	406ppm	0.04	330	445	86.1	59.26	49.98	4.61
S-10 VKBW	9.20	29.1	1.23	118ppm	0.04	730	229	370.74	87.30	524.8	4.32
S-11 PNBW	7.92	28.9	7.45	319ppm	0.65	225	432	102	98.4	4.52	4.28
S-12 PNMW	7.62	29.1	1.444	641ppm	0.06	234	540	112	84.5	5.23	3.76

For evaluating the quality of the water, a water quality index was established for each and every month. It helps in analysing the quality of water and suggests changes need to taken in drinking and domestic water.

Eight significant physio-chemical parameters were taken into account using the Central Public Health Environmental Engineering Organization (CPHEEO), 1991, and Indian Council of Medical Research (ICMR), 1975 standards.

Eight crucial factors were taken into consideration when calculating WQI: pH, dissolved oxygen (DO), total dissolved solids (TDS), electrical conductivity (EC), total alkalinity (Alk), total hardness (Har-T), calcium (Ca), and magnesium (Mg).

These factors most significantly impact river quality.

ISSN No. 2454-6186 | DOI: 10.47772/IJRISS |Volume VII Issue V May 2023

The following are the steps for calculating the water quality index: Weight factor (3.1) Higher legal limit factors are less damaging since they can impair river water quality when present in very high concentrations.

Therefore, a factor's weight and its allowable limitations have an inverse relationship.

Consequently, Wi = k/Xi or Wi = 1/Xi where k is the proportionality constant.

Wi is the weighting factor.

Xi = the maximum allowable limits as determined by the Public Health Environmental Engineering Organization and the Indian Council of Medical Research K values were calculated as follows: k = 1. 8i = 1. (1/ Xi) Where 8i=1 (1/Xi) = 1/Xi (pH), 1/Xi (DO), 1/Xi (EC), 1/Xi (TDS), 1/Xi (Alk), 1/Xi (Hart), 1/Xi (Ca), and 1/Xi (Mg) (1)

Table-2 water quality standards represents the icmr stands and unit weights are represented.

Water quality factors	Icmr stds Xi	Unit weights Wi
PH	6.5-8.5	0.218176
EC	300	0.00618
Tds	500	0.003708
TH	300	0.00618
DO	5	0.37089
Ca2+	75	0.02472
Mg2+	30	0.0618
Cl-	250	0.007416

Table -3 Qi rating table of water sample

	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12
PH	4.0	8.0	6.0	12.40	4.20	4.0	12.0	10.0	4.0	4.40	1.84	1.24
EC	46.8	76.9	9.99	14	106	29.6	110	18.9	47.3	41	248.9	48
Tds	0.05	174.4	67	30	0.004	63	0.029	36.2	81.2	0.03	63.8	128.2
TH	133.3	131.6	108.3	58.3	108.3	88.3	185	81.6	110	243.3	375	78
DO	104.1	100.7	118.5	118.8	349.9	94.1	103.4	109.4	108.9	107.8	82.7	223.9
Ca2+	229.7	141.6	109.54	40	139.7	80.9	197.6	80.1	114.8	493.8	136	149.3
Mg2+	184.3	233.3	196.7	117.3	178.3	165.4	329.5	149.7	197.5	291	329	281.6
Cl-	205.9	121.9	83	46.96	86.63	249.9	181.92	333.2	19.99	209.6	1.8	2.09

ISSN No. 2454-6186 | DOI: 10.47772/IJRISS |Volume VII Issue V May 2023

PH: PH is crucial for the quality of drinking water. The drinking water's pH ranges from 6.5 to 7.to 8.5 which is slightly acidic in nature.Qi rating is S-1,S-5,S-6,S-9,S-10,S-11 and S-12 are acidic in nature and sites in S-2,S-4,S-7,S-8 are alkaline nature.

EC: Ec represents the conductivity of ions in water. Ec varies from 300 mhos/cm. Qi rating is higher levels are observed in S-11 site next to s-5 and s-7 are detected. the lower levels of Qi rating are analysed in S-4and S-9.Average levels of conductivity are observed in S-1,S-2,S-3 and S-10,S-12 sites.

TDS: Total dissolved solids are observed in water samples. TDS varies from 500 ppm. Qi rating of water samples observed in the sites S-2 and S-12 are high, where as least are detected in samples S-1,S-5,S-7,S-10

TH: The Total hardness of water in the parameters are observed as 300 ppm for ground and drinking water respectively. The total hardness of water from S-12,S-11,S-1 respectively. The least hardness of water is observed in S-4 observed.

DO: The dissolved oxygen is found to be standard value 5.in current samples of qi rating is high is observed as S-5 and S-11.

Ca^{2+} : The calcium content was found to be highest amount in S-10 and S-1 but other station observed as average S-3,S-2,S-5,S-7,S-9,S-11,S-12.the least amount of calcium content was observed in S-4,S-6,S-8 sites.

Mg^{2+}: The magnesium content is higher weight in S-11,S-12,S-10,S-2,S-7 and average weight of magnesium in S-1,S-3,S-4,S-5,S-6,S-7

Chloride ions: the chloride content is maximum weight is S-7,S-10,S-9,S-1 and average weight of chloride ions S-2,S-6,S-5 and leas weight of content in S-3,S-11,S-12.

Table-4 WQI rating table of water sample of different location sites

	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12
PH	8.72	17.44	13.08	270.32	91.56	8.72	26.6	21.8	8.72	95.92	40.1	27.03
EC	0.28	4.61	0.59	0.84	6.36	1.77	6.6	1.13	2.83	2.46	14.9	2.88
Tds	0.0015	5.232	2.01	0.9	0.0012	1.89	0.0887	1.086	2.43	0.0009	1.914	3.846
TH	7.99	7.89	6.498	3.498	6.49	5.29	11.1	4.89	6.6	14.5	22.5	4.68
DO	38.5	37.52	43.84	129.46	129.46	94.1	103.4	109.4	108.9	107.8	82.7	223.9
Ca^{2+}	4.59	2.83	2.19	0.96	2.79	1.61	3.95	2.17	2.15	9.87	2.72	2.98
Mg^{2+}	11.05	13.99	11.8	7.02	10.6	9.92	19.77	8.98	11.85	17.46	19.74	16.89
Cl-	1.43	0.84	0.58	0.32	0.6	1.7	1.2	2.3	0.13	1.4	0.01	0.14

the graphical representation of WQI rating of different parameter in different sites collected sample water from Fig A to Fig H

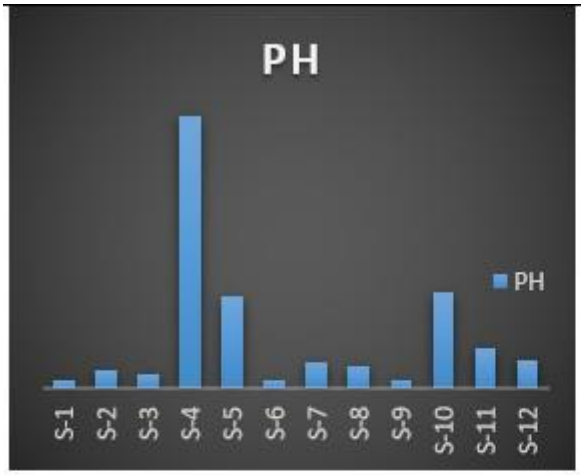

Fig A

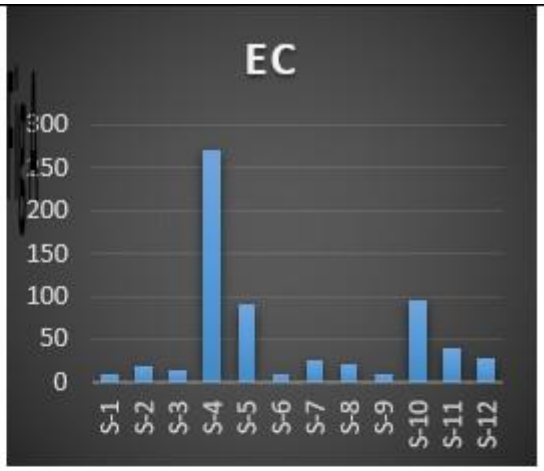

Fig B

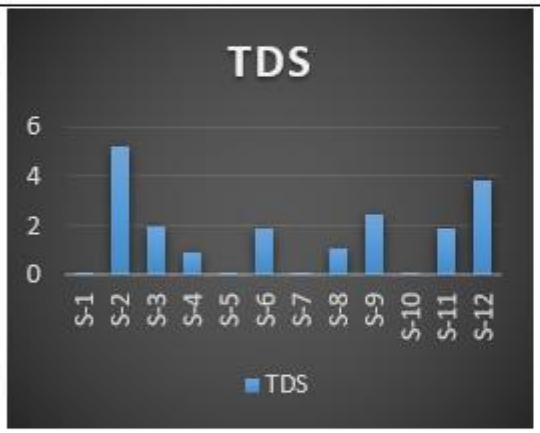

Fig C

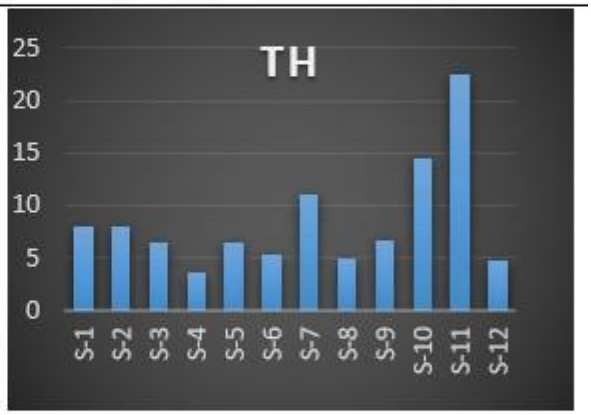

Fig D

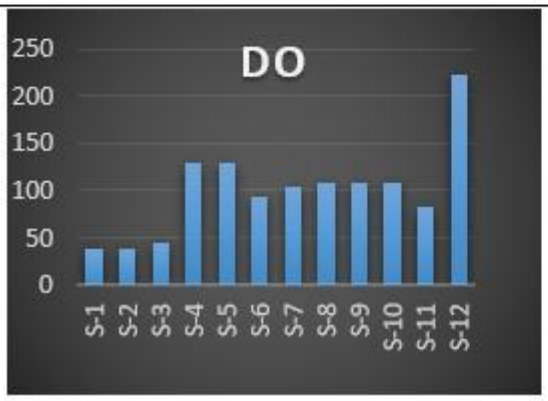

Fig E

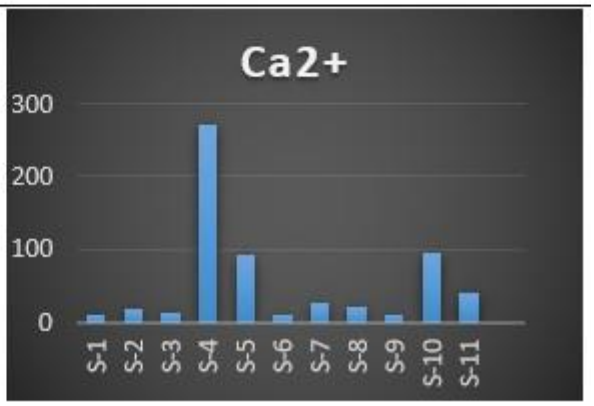

Fig F

5. Total quality index of different sites are reperesented in TABLE-5

Sample	Station	WQI
S1	**TMBW**	72.5
S2	**TMMW**	90.32
S3	**KMBW**	80.54
S4	**KMMW**	419

S5	**PDBW**	247.8
S6	**PDMW**	125
S7	**YDWW**	172.7
S8	**YDMW**	151.7
S9	**PDMW**	143.6
S10	**VKBW**	137.6
S11	**PNBW**	184.5
S12	**PNMW**	281.3

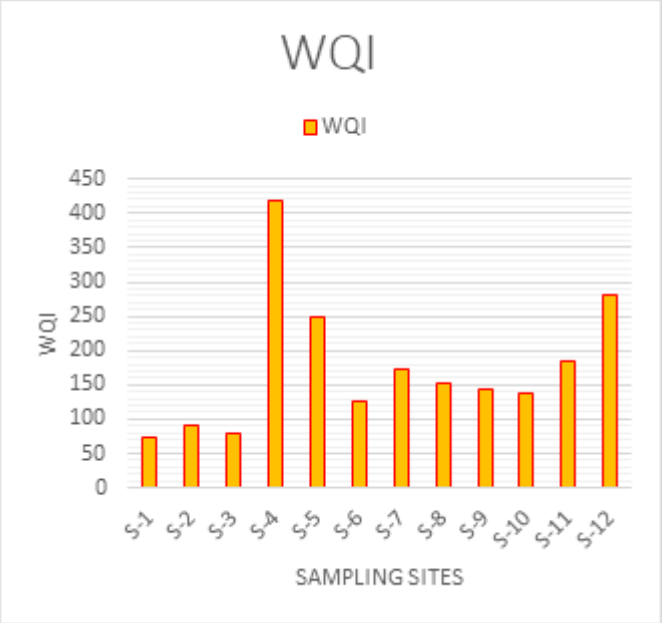

Fig 2: The Graph representation of Water quality index in the various sites.

The WQI observed at less S-1 site is 72.5,S-2 as 90.5,S-3 site as 80.5, S-4 as 419,S-5 as 247.8,S-6 as 125 S-7 as 172.7,S-8 as 151.7,S-9 as 143.7,S-10 as 137.6,S-11 as 184.5 and S-12 as 281.2.

Table 6: Status of water quality based on WQI. (4)

S.NO	WQI rating	Quality
1	0-25	Excellent
2	26-50	Good
3	51-75	Poor
4	76-100	Very Poor
5	100 and above	Unsuitable for drinking

DISCUSSIONS:

The water quality index is highest in KMMW,PNMW and KMMW areas which makes not suitable for the drinking. The sampling sites of PDMW,YDWW,YDMW,PDMW,VKBW and PNBW are also high that is why it is not suitable for drinking. The sampling sites S-1,S-2 and S-3 is water quality index is less than

100 which is treated the poor quality of drinking water. The S-4,S-5,S-6,S-7,S-8,S-9,S-10,S-11,S-12 the water quality index is greater than 100 which is not suitable for drinking water. The ground water observed in Nigeria is good quality(6).several lastest methods are developed for assessing the quality of water quality index in which best method is additive regression give best results.(10).Geographical information system is another method for assessing the quality of water index.(9).

Polymer composites are most effective materials for removal of hardness and salts from water. there are different types of polymer composites present in removal of salts such as polymer clay composite, polymer based activated carbon composites, polymer graphene composites and polymer based adsorbents for dye removal.

Polymer clay composite polymer: clay are low cost natural materials used for purification of micropolluants. clay composites draws attention that in water treatment because of wide pores, wide surface area, with high stiffness and stability and regeneration is easier.

Polymer based activated carbon composites: Activated carbon is powdery solid made up of graphite structure.it is also one of the important material for purification of water and desalination because it is low cost and easily produced from the agro wastes.

Polymer graphene CNT composites: CNT due to high surface area making as effective in water purification and removal of salts and disadvantage of low adsorption capacity.

Polymer based adsorbents for dye removal: artificial synthesized dye material are not effective than natural synthesized polymer composites. Because of their remarkable physiochemical characteristics and voids, cyclodextrin-based composites are particularly effective at removing metals. (13-14)

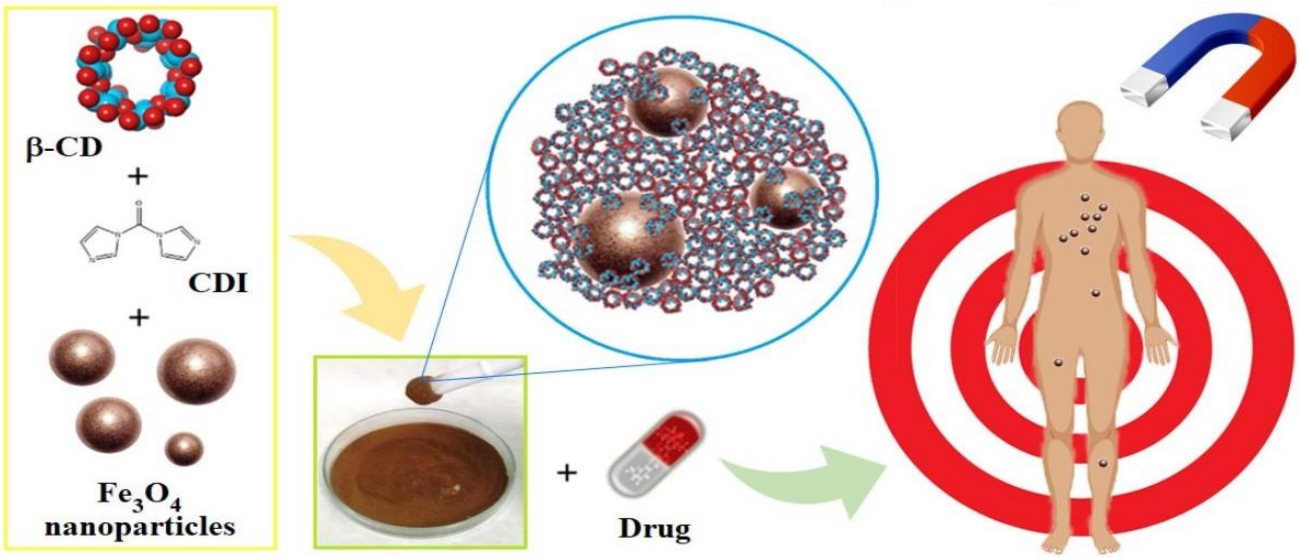

Fig 3 the above figure is obtained from source(15)

Abbreviations: WQI: water quality index, Qi: quality rating, PH:PH scale, EC: Electric conductivity, Tds: Total dissolved solids, DO: Dissolved oxygen, TH: Total hardness,Ca^{2+}:calcium ions,Mg^{2+}:magnesium ions, Cl-:chloride ions.

CONCLUSION:

The research results reveals that the water quality index observed at various stations shows that some places are not fits for drinking S-1,S-2 and S-3 are below 100 are very poor and S4-S12 sites are more polluted

and unfit for drinking.the water in the ground water is need to protected from pollution.so that people can effectively make use of water resources for the domestic purposes, agriculture and drinking purpose and the beta cyclodextrin is effective polymer composite for removal of salts and purification of water.

Declaration of interest: The authors declare there is no conflict of interest in submitted manuscript.

ACKNOWLEDGEMENTS:

I extend my sincere gratitude towards My guide, Coguide and My Aditya Educational Instistutions and Aditya college of Engineering and Technology in carrying out my research work.

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