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Impact of Industrial Effluents in the Physico-Chemical Parameters of Ground Water in India: A Survey

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Abstract: ***A Significant number of today's ground water contamination problems from man's activities is one of the major source of groundwater contamination mainly due to various types of industries as they were disposes waste water effluents without treatment to the ground water bodies. This research work was carried to investigate the contamination level of groundwater by determination of physical and chemical properties of groundwater. It was observed that the groundwater quality is deteriorated because of higher concentration of acidic and alkaline, ions and higher concentration of various salts. Thus the ground water of study area was not useful for the drinking purpose. The industrial effluents also content high concentration of various salts, carbonates, bicarbonates, pH, and conductivity. Thus the result suggested that effluents discharged from the various industries showed variable characteristics and potential threat to the ground water contamination. This paper provides a brief survey on different parameters compared from Thane-Belau, Mira and SangliKupwad Industrial Area MIDC India.***
Keywords:- Industrial Effluent, physic-chemical parameter, water characteristics, ground water analysis.

I. INTRODUCTION

During the past few decades Indian industries have significantly grow, which has contributed to high economic growth but simultaneously it has also given rise to severe environmental pollution. Consequently, the water quality is seriously affected which is far lower in comparison to the international standards. Waste water from manufacturing or chemical processing industries contributes to water pollution. Industrial waste water usually contains specific and readily identifiable Chemical compounds. It is found that one-third of the total water pollution comes in the form of effluent discharge, solid wastes and other Hazardous wastes. Out of this a large portion can be traced to the processing of industrial chemicals and to the food products industry. The surface water is the main source of Industries for waste disposal. Untreated treated effluents have increase the level of surface water pollution. Strict guidelines are given by Central Pollution Control Board (CPCB) but still the environmental situation is far from satisfactory. Different norms and guidelines are given for all the industries depending upon their pollution potentials. Most major industries have treatment facilities for industrial effluents.

But this is not the case with small scale industries, which cannot afford enormous investments in pollution control equipment as their profit margin is very slender. As a result in India there are sufficient evidences available related with the mismanagement of industrial wastes [4-5]. Most of these defaulting industries are petrochemical industries, sugar mills, distilleries, leather processing industries, paper mill, agrochemicals and pesticides manufacturing industries and pharmaceutical industries. Consequently, at the end of each time period the pollution problem takes menacing concern. The problem of water pollution has become still worse due to toxic heavy metals [12]. The increasing trend in concentration of heavy metals in the environment has attracted considerable attention amongst ecologists globally during the last decades and has also begun to cause concern in most of the major metropolitan cities. Untreated or allegedly treated industrial effluents and sewage water contains variable amounts of heavy metals such as arsenic, lead, nickel, copper, mercury, zinc and chromium[12, 13], which have the potential to contaminate crops growing under such irrigation.

II. BRIEF SURVEY BASED ON AREA

A. Dhulia Maharashtra

The study was carried at Dhule MIDC area. The industrial area is spread over 284.41 hectares of land consisting of large and medium scale industries like engineering units, steel processing industries, chemical units, pharmaceutical units, textile industries etc. The study area lies between latitude 20^0 38' to 21^0 61' N & longitude 73^0 50' to 75^0 11' E. Dhule climate is a local steppe climate, in Dhule there is little rainfall throughout the year. This study was initiated to evaluate the various industrial effluents for

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physic-chemical characteristics at the discharge point and assess the quality of ground water in the surrounding area to know if the industrial effluents had any effect on the contamination of such water used for drinking or irrigation purposes.

1) *Sampling of effluent and underground water:* The effluents and water samples were collected from different areas like Venkatesh chemical , Supreme metals, R. M. Chemical (detergent) , rolex engineering (Electro plating), Kiran tiles, rubber industry. During the same period ground water samples also collected from different tube wells and dug wells from nearby villages of study area. The samples were collected in clean plastic container of 1 L. volume in such way that no bubbles were formed in the containers. A total of 19 samples including 6 from industrial effluents and remaining are the ground water samples from tube wells and dug wells.
2) *Chemical analysis:* Industrial Effluents and ground water of the surrounding area were analyzed for various important characteristics such as pH, electrical conductivity (APHA, 1998), calcium, magnesium, sodium, potassium ,carbonate, bicarbonate, chlorides, sulphate, sodium absorption ratio (SAR), residual sodium carbonate(RSC) and heavy metals concentration such as zinc, copper, ferrous, manganese (APHA, 1998).
3) . *DhuleResults and Discussion :* To evaluate the pollution load in the industrial effluents and in ground water of Dhule Industrial Estate, the samples were analyzed for different physic-chemical parameters and results were compared with values of National Environmental Quality Standards (NEQS, 2000) for industrial effluents similarly values of ground water were compared with the standards

Table 1:Physico-Chemical Characteristics of Industrial Sample

Parameter	Units	S1	S2	S3	S4	S5	S6
PH.	-	3.5	9.7	6.5	12	13	1.1
Conductivity	mhos/cm	1.0	1.0	1.001	1.807	1.0	1.0
Calcium	meq/lit	0.0	6.4	0.0	5.4	3.0	0.0
Magnesium	meq/lit	0.0	0.0	0.0	5.4	5.0	0.0
Sodium	meq/lit	3.88	1.72	9.66	1.7	2.1	2.1
Potassium	meq/lit	0.07	0.07	0.04	0.06	0.03	0.05
Carbonate	meq/lit	0.0	66.0	00	12	86	00
Bicarbonate	meq/lit	00	91	24	4.4	4.7	0.0
Chlorides	meq/lit	52	117.6	50	34	70	38
Sulphate	meq/lit	51.05	26.64	70.51	97.86	192.88	35.85
Sodium Abso. Ratio	-	0.0	2.4	0.0	2.04	1.02	00
Residual Sodium Carbonate	-	2.85	155.2	20.31	14.66	103.8	2.15

Table 2: Physico-Chemical Characteristics of Ground Water Sample

Parameter	Units	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11
PH.	-	6.6	8.4	6.6	9.5	7.9	7.4	7.5	7.7	7.8	7.5	4.7
Conductivity	mhos/cm	1.0	1.0	1.0	0.88	1.0	1.35	0.51	1.08	0.62	1.0	1.0
Calcium	meq/lit	5.2	6.2	9.0	11.4	3.8	10.6	5.6	5.8	8.2	7	12.8
Magnesium	meq/lit	3.0	12.2	3.2	00	11.4	6.4	00	00	3.0	1.0	00
Sodium	meq/lit	0.86	1.02	0.42	1.27	0.72	1.5	2.10	0.59	0.79	0.37	1.05
Potassium	meq/lit	0.04	0.06	0.05	0.02	0.02	0.02	0.02	0.04	0.01	0.03	0.09
Carbonate	meq/lit	12	00	00	00	00	00	00	00	00	00	00
Bicarbonate	meq/lit	12.2	3.4	4.0	13.4	11	8.4	11	00	00	00	00
Chlorides	meq/lit	2.4	0.0	3.0	98.4	2.0	0.0	18	2.0	2.4	2.0	0.0
Sulphate	meq/lit	17.50	16.08	21.34	99.11	2.94	10.19	-21.2	6.5	9.60	6.5	13.88
Sodium	-	2.75	2.38	6.61	5.02	2.21	4.21	1.93	4.94	4.58	4.94	6.16

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Abso. Ratio												
Residual Sodium Carbonate	-	83.3	2.32	3.54	12.11	10.26	6.81	8.89	0.50	0.80	0.50	-1.80

Of World Health Organization (WHO,1981) and United State Environmental Protection Agency (US-EPA,1998) for drinking water. The results obtained on characteristics of effluents and ground water from tube well, dug well are presented and discuss.The physico-chemical characteristics of the industrial effluents and ground water show that have great variability. The physico-chemical characteristics of all samples differed substantially from one another with respect to chemical characteristics.

The water quality analysis of different samples have been carried out for pH, conductivity, calcium , potassium, carbonates, bicarbonates, chlorides, sulphates, zinc, copper, ferrous, manganese.

The pH of the industrial effluents ranged from 1.1-13 and electrical conductivity (EC) from 1.0-1.807 m mhos/cm, the calcium and potassium ranged from 3.0-6.4 mg/L. the carbonates and bicarbonates ranged from 66.0-86 mg/L and 0.03-0.07 mg/L respectively. The chlorides and sulphate ranged from 34-117.6 mg/L and 26.64-192.88 mg/L respectively as shown in Table No.1. Also the heavy metals like zinc ranged from 0.21-0.92 ppm. the copper concentration ranged from 0.02-0.23 ppm. The manganese concentration ranged from 3.95-9.25 ppm. also ferrous ranged from 0.01-0.27 ppm as shown in Table No.3. All the concentration of the effluents show a wide variation.

Table 3:Heavy metal concentration in Industrial Effluents

Parameter	Zinc	Copper	Ferrous	Manganese
Unit	ppm	ppm	ppm	ppm
S1	1.08	0.26	0.14	13.52
S2	0.58	0.27	0.02	3.26
S3	0.97	0.12	0.28	6.23
S4	0.74	0.23	0.23	6.23
S5	1.06	0.31	0.06	4.82
S6	0.82	0.12	0.16	6.23

Table 4:Heavy metal Concentration in Ground water sample from near by area of Dhule MIDC

Parameter	Zinc	Copper	Ferrous	Manganese
Unit	ppm	ppm	ppm	ppm
S1	0.51	0.17	0.26	7.41
S2	0.21	0.06	0.01	4.16
S3	0.42	0.02	0.23	6.15
S4	0.42	0.02	0.23	5.09
S5	0.74	0.23	0.09	4.82
S6	0.43	0.06	0.2	4.9
S7	0.48	0.13	0.14	3.95
S8	0.21	0.02	0.31	9.25
S9	0.92	0.03	0.07	5.36
S10	0.34	0.03	0.19	8.42
S11	0.57	0.14	0.27	5.12

The ground water samples were collected from adjoining area of Dhule MIDC area such as Laling, Mohadi, Avadhan village and other nearby areas , it also shown great variation in physico- chemical properties. The pH of ground water samples ranged from 4.7-9.5 and EC from 0.51 – 1.35m mhos/cm, also the calcium and potassium ranged from 2.6-12.8 meq/lit and 1.0 to 13.4 meq/lit respectively. The carbonates and bicarbonates ranged from 0.0-12 meq/lit and 1.0-13.4 meq/lit respectively, the chloride and

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sulphate ranged from 2.0-98.4 meq/lit and -21.2-99.11 respectively as shown in Table No.2. Also heavy metal concentration in ground water sample such as zinc ranged from 0.21- 0.92ppm, copper ranged from 0.02-0.23ppm , ferrous ranged from 0.01-0.31ppm and manganese ranged from 3.95-9.25ppm. as shown in table no.4. all the concentration of heavy metal of ground water samples shows wide variations.

B. Sangli-Miraj Kupwad Industrial Area

1) *Methodology: The* groundwater samples are collected in polyethylene bottles from 17 respective bore-well stations in study area. The bottle was rinsed before the sampling after collection the bottles are labeled on field. 8 samples collected from Kupawad industrial area and 9 samples collected from Miraj industrial area and named KBW1, KBW2, KBW3, KBW4, KBW5, KBW6, KBW7, KBW8,and MBW1, MBW2, MBW3, MBW1, MBW4, MBW5, MBW6, MBW7, MBW8, MBW9. After sampling analysis is done for the following parameters pH, EC, TDS, magnesium, sodium, potassium, carbonates, chlorides, sulphates, nitrate, chlorine, DS, copper, ferrous, cadmium, mercury, lead, arsenic and total hardness as per the standard procedure. The results were compared with WHO (world health organization) and BIS (Bureau of Indian standards). The statistical analysis has been carried out which consist of correlation and Regression between each parameters.
2) *pH :-* pH is an important for water sampling, the pH value of respective samples was 6.6 to 7.74 well within the desired standard limit .
3) *Electrical conductivity (EC):-* It gives a measure of dissolved solid present in water. The EC values of few station points KBW4, MBW2 and MBW8 was above the limit indicating that dissolved salt were present in the water samples.
4) *Total Dissolved solid (TDS):-* All the samples are within prescribed limits.
5) *Magnesium:* Observed range of magnesium content is within standard limit.
6) Sodium: - Sodium concentration was found to be above the prescribed limits for stations KBW2, KBW3, MBW4 and MBW8 which more than 200mg/lit.
7) *Potassium:* - Potassium concentration of respective samples ranges from 0 to 10.14mg/lit, which is well within the prescribed limit.
8) *Sulphate:* - Sulphate content observed during test is between 0-122.8 mg/lit within desired standard limits.
9) *Nitrate:* - It is observed that, at few stations, content of Nitrate is more than required standard limits. The content value and station are KBW2 with 85.12 mg/lit, MBW2 with 49.84 mg/lit and MBW8 have 68.32 mg/lit in water samples.
10) *Chlorides:* It is observed that Chloride concentration of respective samples ranged from 73.5-1753.5 mg/lit. There are total 7 stations whose chloride concentration are more than 250 mg/lit, which are KBW4, KBW8, MBW2, MBW5, MBW6, MBW7 and MBW8. The highest level chloride concentration is 1753.5 mg/lit at station MBW8.
11) *Dissolved Solids (DS):-* DS present in respective samples ranges between 810-1260mg/lit. The concentration of DS is more than standard limits of 500mg/lit. Ferrous: - Ferrous concentration of all stations within the standard limit of 2PPM, except KBW6 which is 5PPM.
12) *Cadmium:* - Cadmium is found at all stations within the standard limit of 0.003PPM, except KBW2 with 4.8PPM and MBW7 with 0.12PPM that concentration of these two stations is more than standard limits.
13) *Mercury:-* Mercury concentration few station such as KBW2 with 20.36PPM, KBW6 with 91.56PPM, MBW3 with 17.44PPM is more than the standard limits.[2]

D. Thane-BelapurMidc Area Maharashtra India

1) Methodology: All glassware, pipettes, burettes, etc. were first cleaned with tape water thoroughly and finally with de-ionized distilled water. The chemicals and reagents used for analysis were of analytical reagent (A.R.) grade. The procedure for calculating the different parameters were conducted in laboratory. All equipment's were checked and calibrated according to the manufacturer's specification. Determination of parameters like colour, odour, pH, Electrical Conductivity (EC), Dissolved Oxygen (DO), Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Total Alkalinity, Total Acidity, Chlorinity, Total Dissolved Solid (TDS) and Total Hardness were done by using standard methods (APHA, Trivedy, Manivaskam).

2) *Findings:* The results of the present investigation indicates that the industrial effluent having towards toxicity as they are above the permissible ranges. Presence of high concentration of heavy metal is alarming situation for the health of all organism presence in nearby area. Necessary measures especially biodegradation and bioremediation strategies are needed to be adopted for the treatment of effluent before discharge in the sea in order to secure the aquatic as well as human life.[3]

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III. CONCLUSION

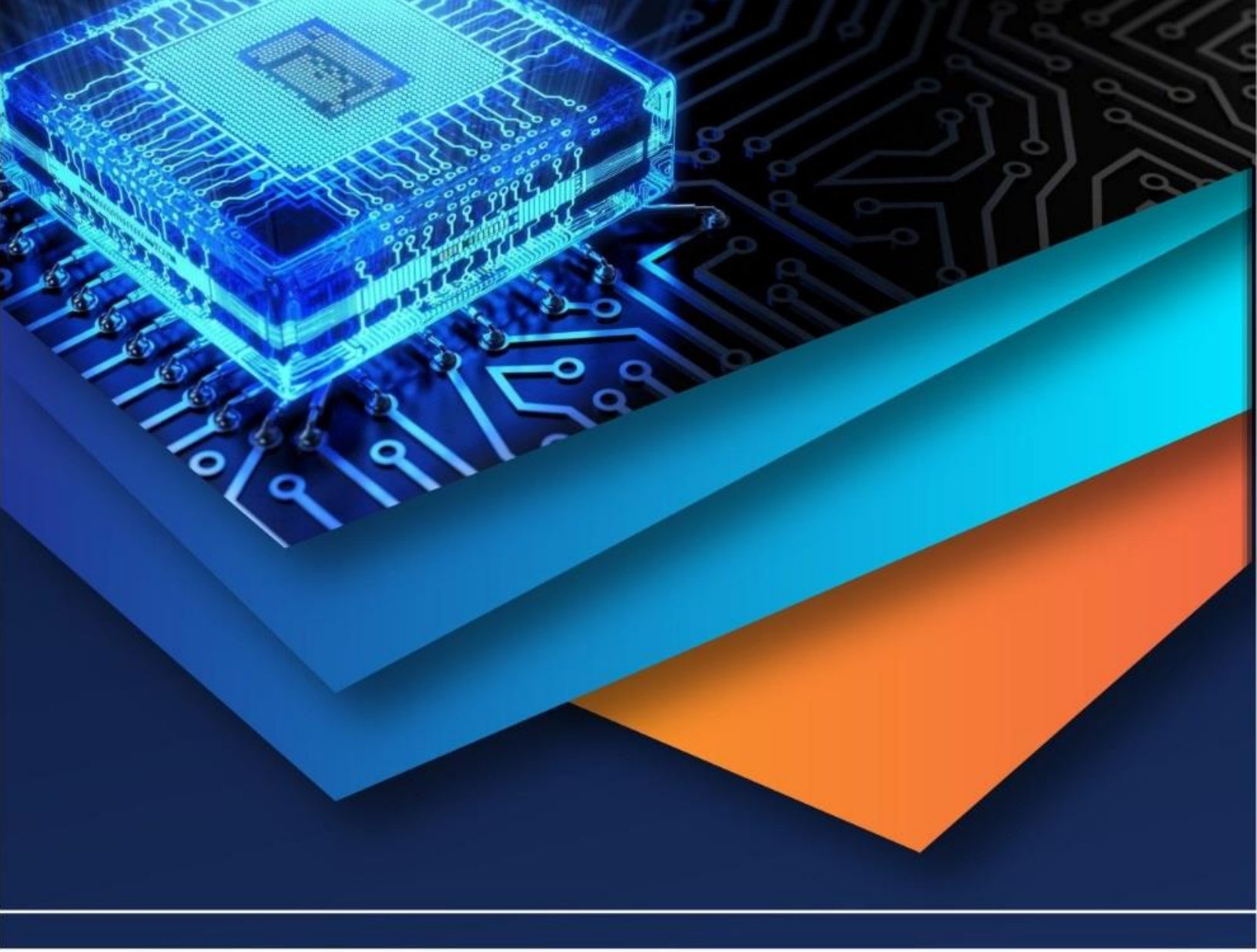
The characteristics of industrial effluents varied with the industries, as well as the characteristics of ground water in the surrounding area of different regions mentioned in survey, also varied .the pH of some effluents and ground water samples were beyond the limits and of the remaining within the permissible limit. The alkaline substances of some industrial effluents and ground water samples were within and remaining above the permissible limit comparing with the WHO and NEQS .the heavy metals of some industrial effluents and ground water samples were within and others above the permissible limit. The concentration of manganese was highest as compare with other metals. From above discussion, it can be said that the quality of ground water in the study area is polluted, it is directly affected to underground water bodies so the ground water of the study area is not useful for drinking and irrigation purpose.

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