MADHAV INSTITUTE OF TECHNOLOGY & SCIENCE

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Gwalior, Madhya Pradesh – 474005

Department of Civil Engineering

Madhav Institute of Technology & Science

2022

A MINOR-PROJECT REPORT

ON

"*Study of Heavy Metal Concentration in Gwalior Region*"

SUBMITTED BY: GROUP NO. 11

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1

CERTIFICATE

Madhav Institute of Technology & Science
Gwalior

This is to certify that the project entitled " **Study of Heavy Metal Concentration in Gwalior Region** " submitted by the students of group 11-(Gokul Nayma, Chetan Namdeo, Kushagra Mishra, Harsh Prajapati, Aditya Kourav) is in complete satisfaction of the necessity of the complies of Bachelor of Technology degree in Civil Engineering at Madhav Institute of Technology & Science, Gwalior is a genuine work completed by the students under my watch and direction.

To the best of my insight, the matter epitomized in the theory has not been submitted to any other college/Institute for the recompense of any Degree or Diploma

Under the Guidance of- Prof. Aditya Kumar Agarwal

26/5/2022

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2

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Unfortunately, the long list of acknowledgement, regardless of how extensive is constantly fragmented and lacking. To be sure this page of notice should never have the capacity to touch the generousness of the individuals who tendered their assistance to us.

As a matter of first importance, I wish to express my profound feeling of appreciation and obligation to **Prof. Aditya Kumar Agarwal**, Department of Civil Engineering – MITS, Gwalior for appointing me the undertaking " **Study of Heavy Metal Concentration in Gwalior Region**" and for his motivating direction, helpful feedback and significant proposal all through this venture. We also want to extend our appreciation to every one of our companions and senior understudies who have constantly empowered and bolstered us in doing this work. We want to thank all the individuals from Department of Civil Engineering who have dependably been agreeable with us.

Last however not the slightest we want to thank the writers of different examination articles and books that we alluded throughout this undertaking.

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ABSTRACT

Soils may become contaminated by the accumulation of heavy metals and metalloids through emissions from the rapidly expanding industrial areas, mine tailings, disposal of high metal wastes, leaded gasoline and paints, land application of fertilizers, The present project work deals with the assessment of pollution due to the untreated industrial waste water; collected from Banmore, Ghirongi and Malanpur Industrial area near Gwalior district. The study reveals that textile, soap, polymer, chemical, agriculture, pharmaceutical, dairy and food products industries are some of the major industries contributing to the pollution in the surrounding environment. Monthly Changes in physico-chemical parameters such as temperature, pH, total dissolved solids, total suspended solids, oil and grease, chlorides, chemical oxygen demand and biological oxygen demand for a period from July to November were assessed by standard analytical procedures. And then, the results were compared with BIS and found that some of the parameters showing that the level of pollution was above the permissible limits.

CONTENTS:

4

Problem Statement :-

What is minor project tries to solve problem.

Study of Heavy metal concentration in and around Gwalior shows the harmful effects of heavy metal concentration in human body, plants, and animals. This gives an overview about the problem and helps in finding sources of heavy metals and their effects.

1.INTRODUCTION

The discharge of urban sewage directly to rivers and lakes is among the principal causes of surface water contamination. Contaminated water resources threaten the water supply of cities and the ecological equilibrium of aquatic ecosystems. To minimize or avoid these negative impacts, the sewage needs to be treated.

the extent that is necessary to maintain the water quality. However, despite purifying municipal wastewater, making it suitable for discharge in receiving water bodies such as rivers and lakes, the sewage treatment process generates a large volume of sludge that needs to be destined appropriately and quickly to avoid its accumulation and consequently its transformation into environmental liabilities in wastewater treatment plants (WTPs).

The options for disposal of sewage sludge are varied. In general, they include: (i) land application, (ii) industrial reuse, (iii) disposal in landfills, (iv) incineration and (v) discharge to oceans. Land application and disposal in landfills are the most widely adopted disposal methods in various parts of the world. The application to land is considered the most attractive option, because the sewage sludge can improve soil conditions for agricultural production, since it is rich in organic matter and plant nutrients. However, there are undesirable constituents in its composition.

Heavy metals, such as cadmium (Cd), lead (Pb), among others, are the most concern undesirable constituents, since they may be toxic to microorganisms, plants, animals and humans in not very high concentrations. Therefore, soils amended with sewage sludge should be evaluated for heavy metal contamination in order to prevent its excessive entry into the food chain, thus reducing the risk of toxicity in living organisms posed by the method of disposal of sludge on land.

2. Heavy metals: An overview

HEAVY METAL	ORGANISM	ESSENTIALITY	TOXICITY
CADMIUM (Cd)	Animals	NO	Reduced weight gain
	Humans	NO	Kidney damage and fragile bones
	Plants	NO	Oxidative stress and reduced plant growth
CHROMIUM (Cr)	Animals	NO	Nil
	Humans	YES	Allergy and increased cancer risk Increased oxidative stress and reduced plant growtl
	Plants	NO	
COPPER(Cu)	Animals	YES	Lever damage and death
	Humans	YES	Heptic necrosis and kidney damage
	Plants	YES	Inter-venial chlorosis in younger leaves
IRON(Fe)	Animals	YES	Anorexia.diarrhea,metabolic acidosis and death
	Humans	YES	Vomiting,diarrhea,metabolic acidosis and Alzheime
	Plants	YES	Leaf bronzing and roots with black coating
LEAD(Pb)	Animals	NO	Appetite loss and anemia and body weight loss
	Humans	NO	Neurological problems and kidney damage
	Plants	NO	Chlorosis and root system darkening

HEAVY METAL	ORGANISM	ESSENTIALITY	TOXICITY
MANGNESE (Mn)	Animals	YES	Anemia and gastrointestinal lesions
	Humans	YES	Psychiatric disturbance and neurodegener, disorder
	Plants	YES	General chlorosis and necrotic leaf spots
MERCURY (Hg)	Animals	NO	Vomiting and bloody diarrhea and necrosis
	Humans	NO	Neurological disturbances and kidrey damage
	Plants	NO	Hypertrophic rootretarted plant growth
ZINC(Zn)	Animals	YES	Diarrhea,jaundice.kidney and abomasum damage
	Humans	YES	Diarrhea,nausea,vomiting.epigastric pain
	Plants	YES	Chlorosis deficiency and stunned plant growth

Table 1 Effects of Heavy Metals

Heavy metals comprise a class of not very well defined chemical elements. They have been commonly characterized as metals and metalloids (semimetals) with density higher than 5 g cm^{-3} associated with problems of environmental contamination and toxicity, although some of them are required in low concentrations for some organisms such as higher plants, animals and humans. However, this definition (attempt) has been criticized for its chemical and toxicological inadequacy and it has had no institutional support of IUPAC (International Union of Pure and Applied Chemistry). Despite the criticism, there is no more appropriate term to refer collectively to the elements known as heavy metals. Therefore, we use this terminology in this text and support its use in the definition introduced by Hawkes , according to which heavy metals comprise a block in the Periodic Table with all metals and metalloids in Groups 3 to 16 that are in periods 4 and greater. As some authors consider selenium (Se) it as a metalloid and therefore heavy metal , we also consider it as metalloid in this chapter, even though it is a non-metal. Thus, we expand the definition of Hawkes to include Se as a heavy metal, keeping in mind which this redefinition is simply operating, just to join in the same class specific chemical elements commonly associated to problems of environmental contamination and toxicity.

The relative importance of heavy metals toxicity was addressed by McLaughlin et al. in terms of food chain contamination. According to these authors, Cd is the metal with greatest potential to contaminate plants and subsequently to be transferred to animals and humans that eat these contaminated plants or part of them. This statement is based on the fact that (i) Cd poses animal and human health risks in plant tissue concentrations that are not generally phytotoxic and (ii) Cd concentrations in agricultural soils are increasing in many parts of world due to Cd inadvertent additions through the use of fertilizers, sewage sludge and soil amendments. Due to the high risk of contaminating the food chain, the risk of Cd to cause toxicity is considered to be high as well. Despite increased concern with Cd, the toxicity risk of other heavy metals should not be neglected.

The toxicity of heavy metals in living organisms is a phenomenon somewhat complex. Toxic effects of a metal depend on a number of factors that often include (i) rate, (ii) exposure time, (iii) tolerance of the organism and (iv) environmental conditions. In recent years, the effect of the interaction between heavy metals on the expression of toxicity has been considered very intensely. As a result of the interaction, a given metal may increase or decrease the negative effects of other metal in the organism.

3.SOURCES OF HEAVY METALS

Agricultural soils are receiving tremendous amount of pollutants from the various sources. Heavy metal contamination in agricultural soils may impart functional disorders of soils, retarded plant growth and even harm the health of humans through contamination of food chain. These heavy metals or metalloids do not undergo microbial and chemical degradation and persist in the soil for longer duration. This review emphasizes on the sources of heavy metals in soil and remediation technologies involved in their removal from the soil.

Both natural and anthropogenic inputs are correlated with the distribution of heavy metals in the soils. Natural sources include geological breakdown of parent rock materials, volcanic eruptions etc. Anthropogenic inputs like extensive use of agrochemicals (inorganic and organic) fertilizers, pesticides, waste water irrigation, sewage sludge supplementation, higher atmospheric depositions by industrial units and combustion of fossil fuels have led to elevated level of inorganic pollutants in the soils. Fungicides, phosphate fertilizers and inorganic fertilizers have variable levels of Pb, Cd, Cr, Ni, Zn etc depending upon their sources. The repeated use of phosphate fertilizers continuously making the agricultural soils enriched with heavy metals. Both natural and anthropogenic sources of heavy metals in the environment are illustrated in.
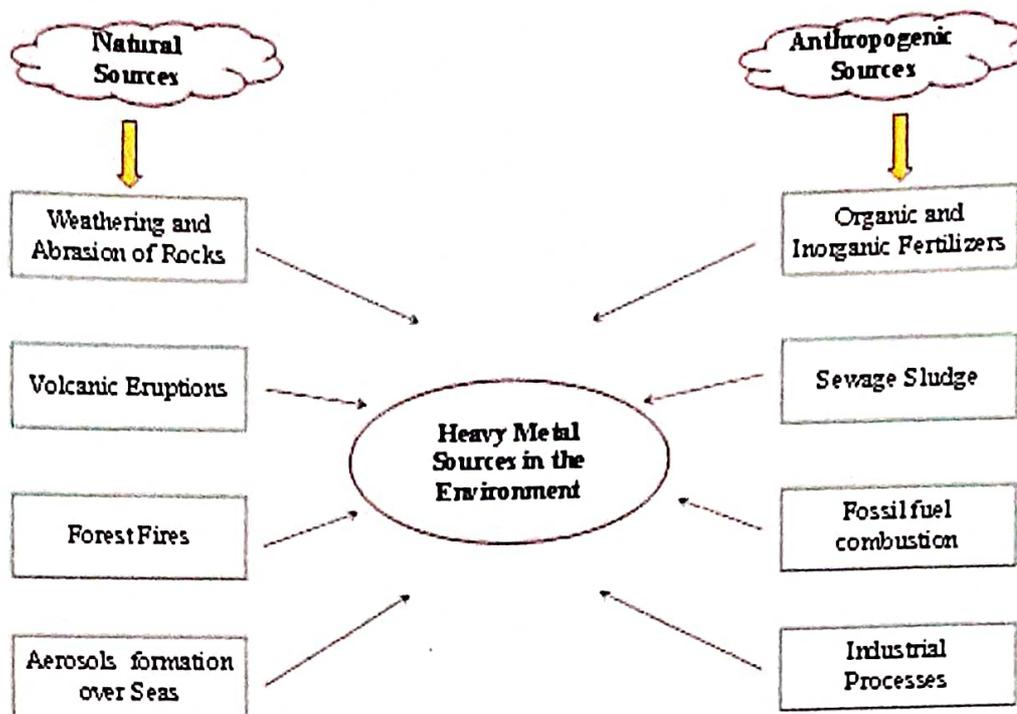
FIG.1 SOURCES OF HEAVY METALS

4.ASSESMENT OF EFFLUENT SAMPLES NEAR GWALIOR DISTRICT

The study assessed the industrial effluents quality of neighboring districts of Gwalior. A comparative study of effluents was carried out in different months and the samples are collected from the different sites in the prescribed manner. This study indicated that the level of pollution is increasing from July to November.

Especially TDS, COD observations are drawing the attention of the environmental activists. Various small scale and some major industries like alcoholic beverages, milk and milk products, food & food products, chemical and polymer in this area, release their inefficiently treated effluents openly which may contaminate water reservoir and raise serious abdominal health problems in humans as constipation, stone, stomach and intestinal ulcers, skin ailments and eyes irritation. Therefore, there is an urgent need to implant effluent treatment units in the industry itself to reduce environmental and health risks. The results of the investigations point out the need to implement common objectives, compatible policies and programmes for the improvement of waste water management
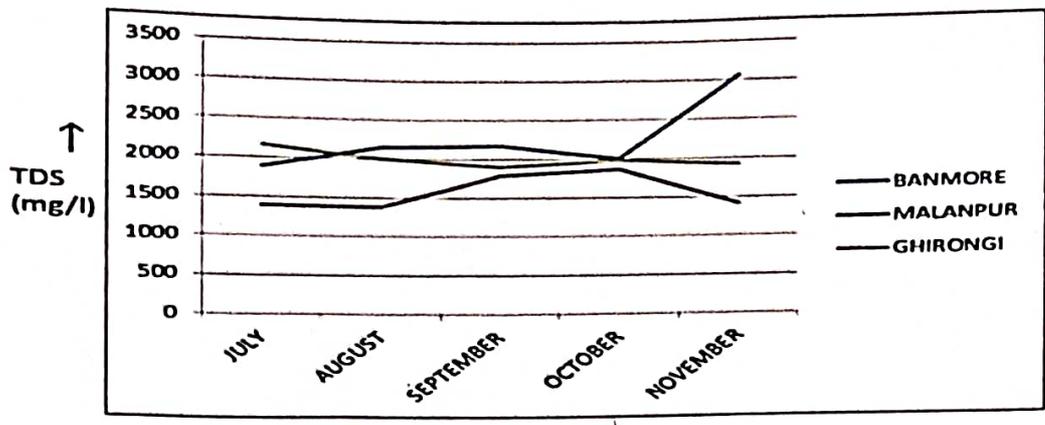
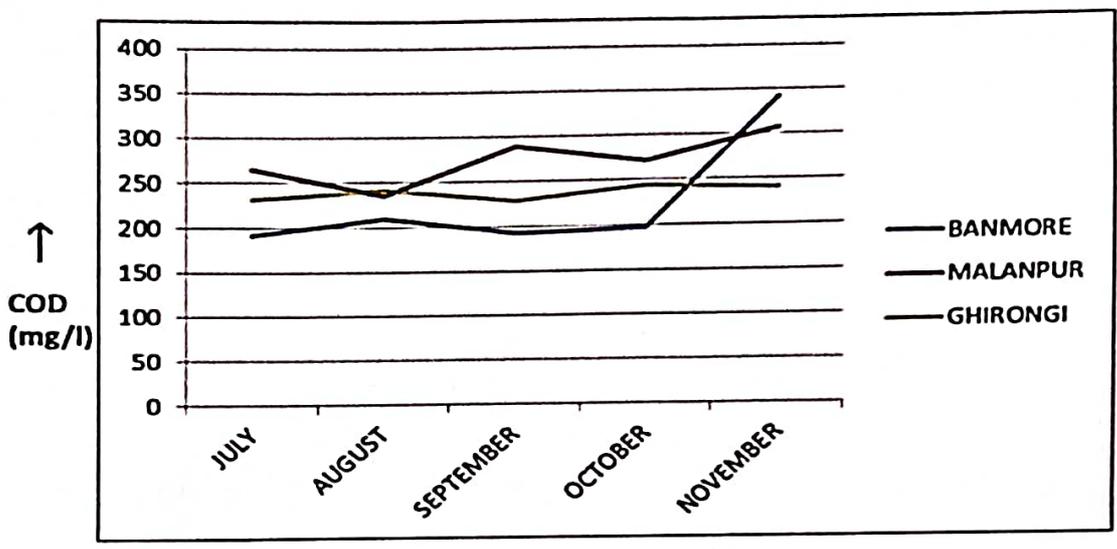Fig 2 Monthly Variation in Total Dissolved Solids(mg/L)
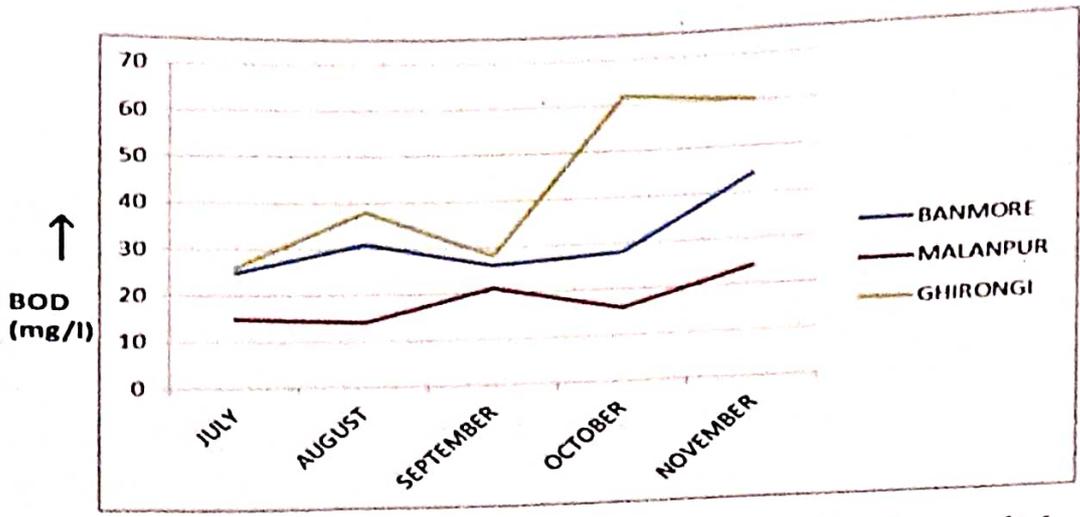

Fig 3 Monthly Variation in COD (mg/L)

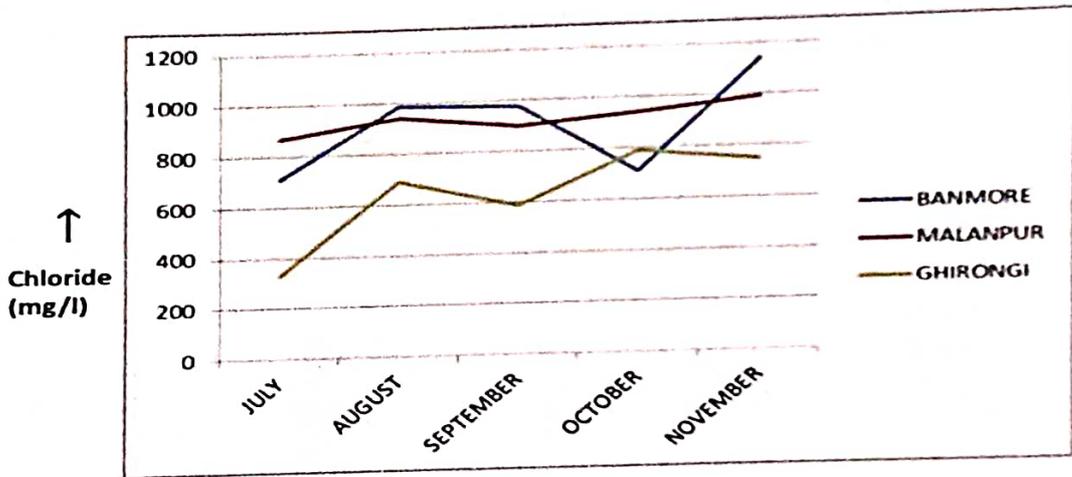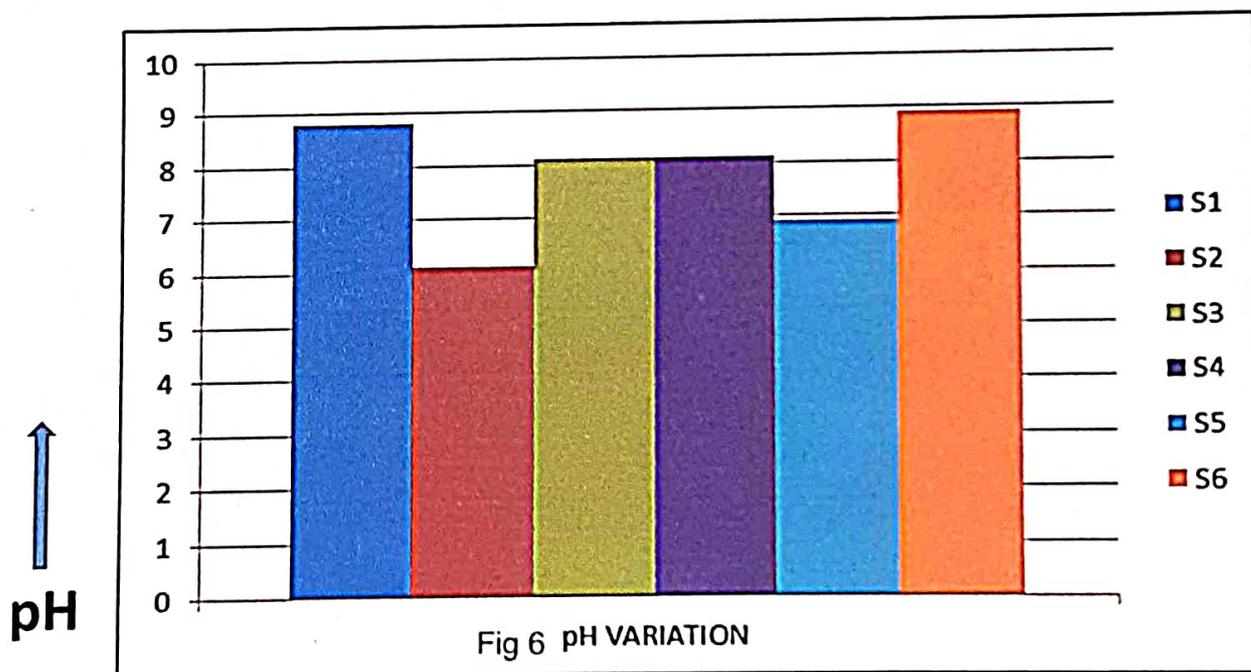## Fig 4 Monthly Variation In BOD (mg/L)

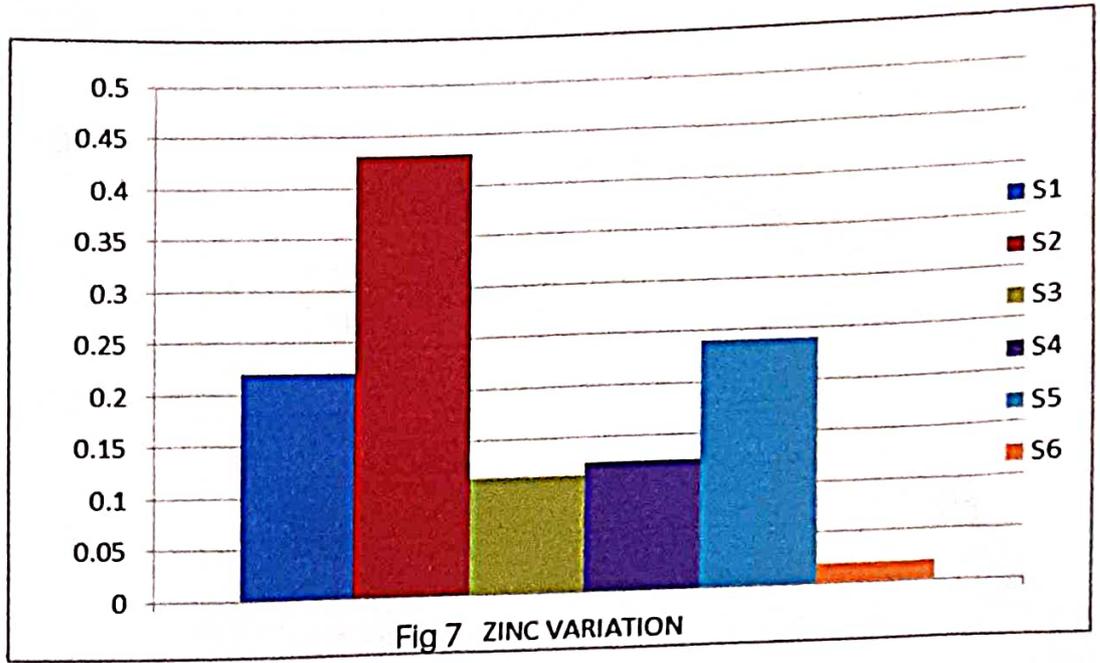## Fig 5 Monthly Variation in Chloride Content(mg/L)

13

The discharge of industrial effluents into receiving water bodies in Malanpur Industrial area, invariably result in the presence of high concentrations of pollutant in the water and sediment. The pollutants have been shown to be present in concentrations, which may be toxic to different organisms. The effluents also have considerable negative effects on the water quality of the receiving water bodies and as such, they are rendered not good for human use. The higher concentrations of metals in industrial effluents indicate negligence of industries towards waste water treatment. Various small scale and some major industries in this area, release their effluents openly which may contaminate water reservoir and cause serious health hazards in humans. Therefore, there is an urgent need to enforce effluent treatment to reduce environmental and health risks

Table 2 : Showing Sampling Locations

S. No.	Sample	Sampling Location	Types of Location
1	S_1	Banmore, Morena	Industrial area
2	S_2	Banmore, Morena	Industrial area
3	S_3	Malanpur, Bhind	Industrial area
4	S_4	Malanpur, Bhind	Industrial area
5	S_5	Malanpur, Bhind	Industrial area
6	S_6	Ghirongi, Bhind	Industrial area

pH

Fig 6 pH VARIATION

14

Zinc (mg/l)

Fig 7   ZINC VARIATION

COD (mg/l)
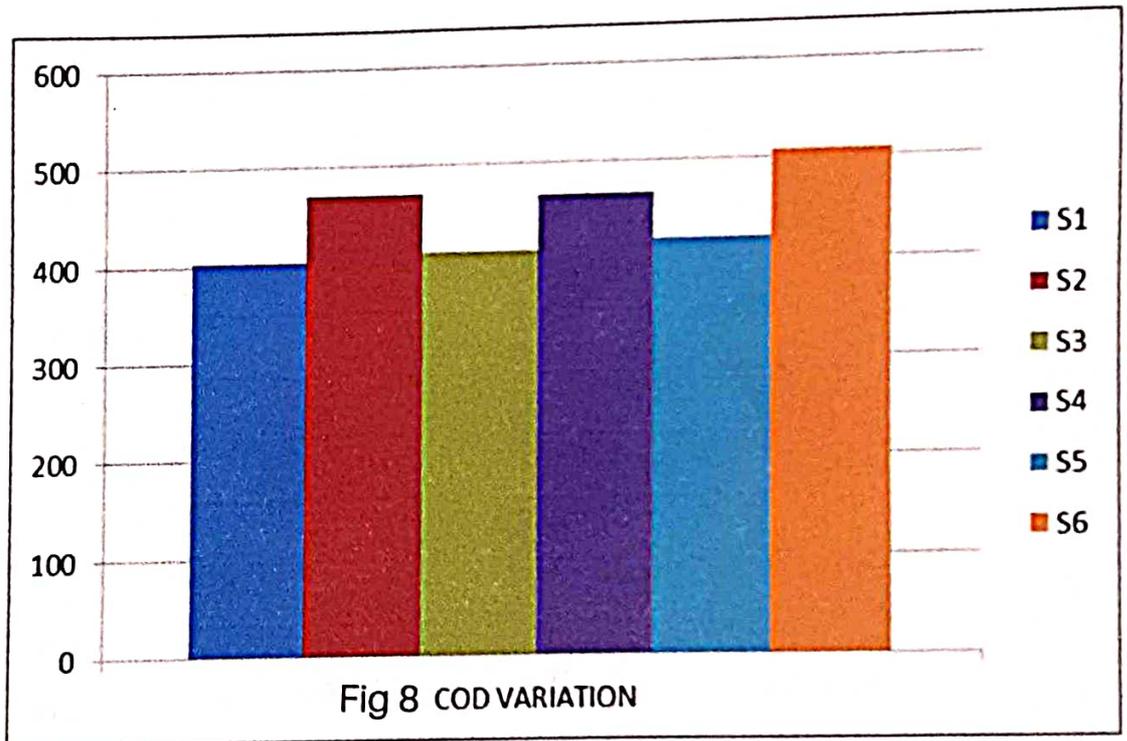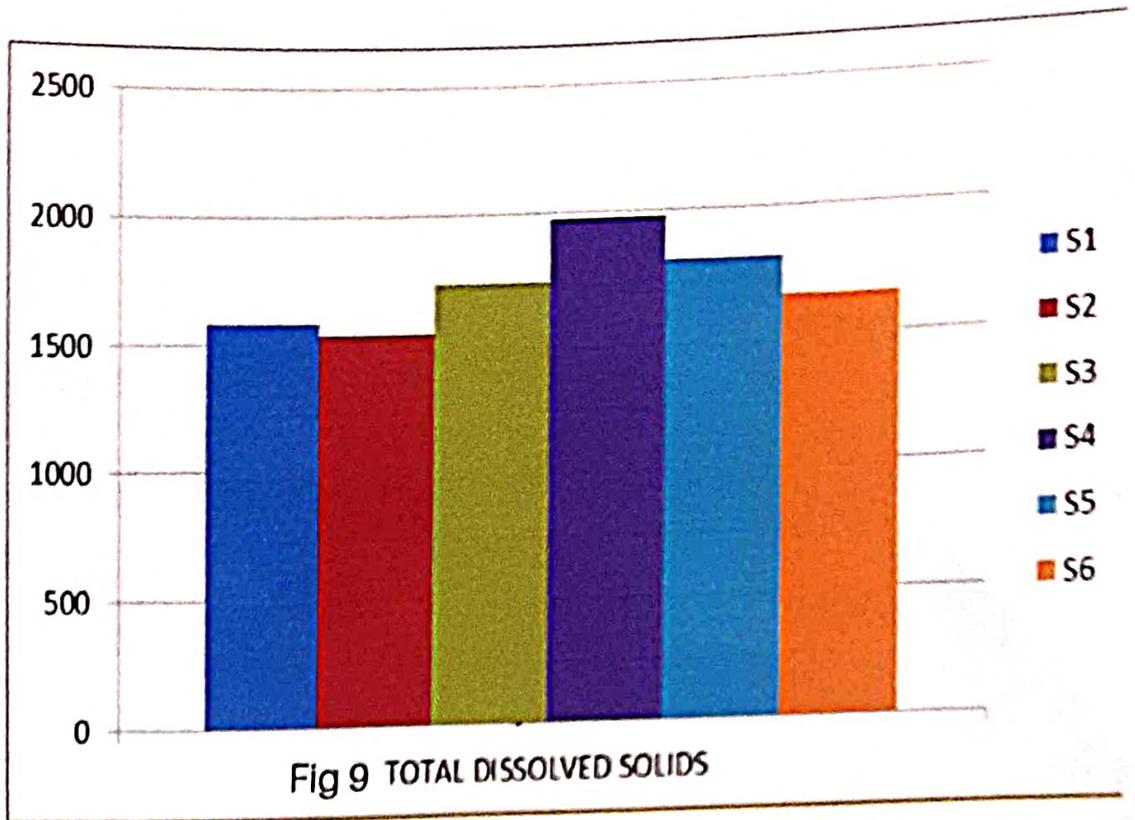
Fig 8 COD VARIATION

Fig 9 TOTAL DISSOLVED SOLIDS

TDS (mg/l)

Legend: S1, S2, S3, S4, S5, S6

Fig 10 ELECTRICAL CONDUCTIVITY VARIATION

Electrical Conductivity [μmho S/cm]

Legend: S1, S2, S3, S4, S5, S6
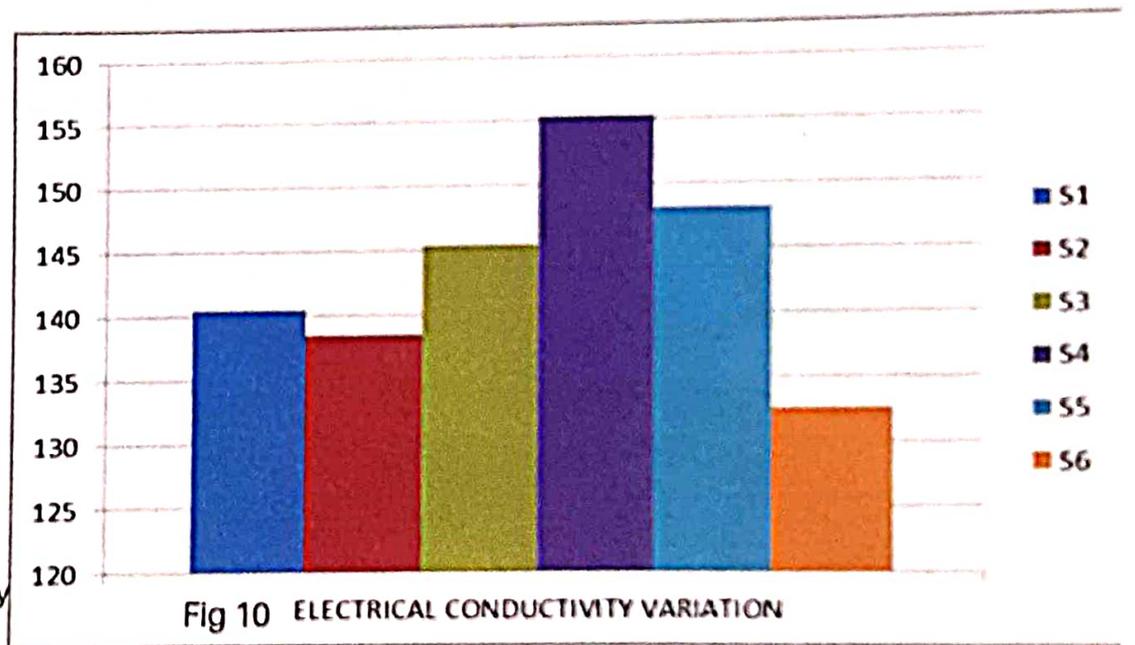
Table 3 Analytical results of Industrial effluents

Zinc variation – (0.019 mg/L – 0.431 mg/L)
pH variation – (6.1 – 8.9)
COD variation – (403 mg/L – 508 mg/L)
TDS variation – (1535 mg/L – 1975 mg/L)
Electrical conductivity variation – (132.6 mho/cm – 155.3 mho/cm

5.ASSESMENT OF SOIL SAMPLE AT INDUSTRIAL AREA JADERUA

From most of the land in the study area is open scrub land (34.6%), Agriculture Land (22.0%) Fallow Land (18.4%) Forest Land (12.5%) Built-up Land (6.7%) Water Body (2.7%) Grazing Land (2.5%) and Industry (0.6%).

Diagram of Study Area Jaderua (10.0 km radius)
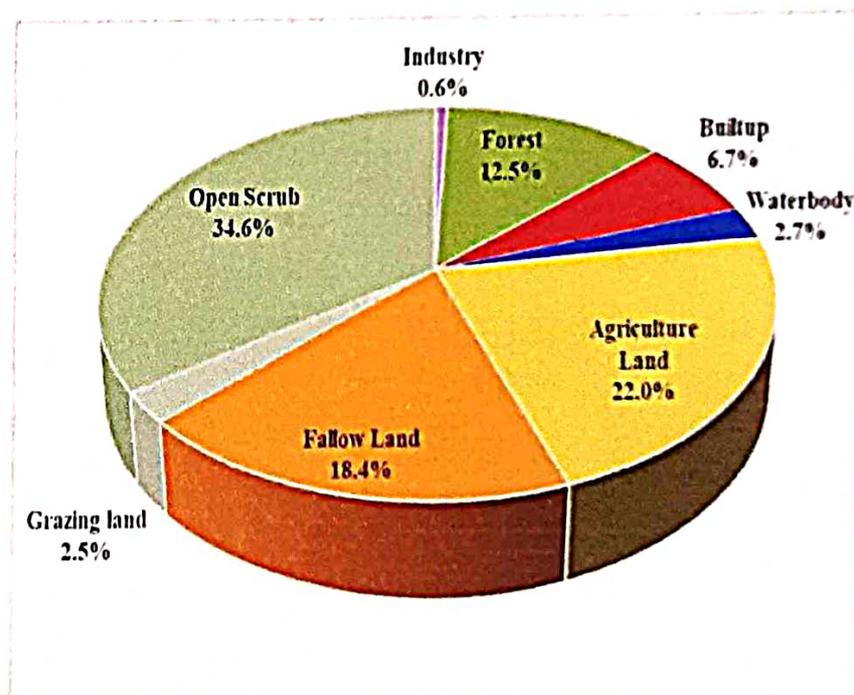
Fig 11

Table 4 Soil Characteristics

Parameters	Unit	Project Site	Pari Ka Pura	Sihora Ka Pura	Bamur Basai RF Near Doraoli
Location Code ❾		S1	S2	S3	S4
Distance (km) ❾		-	0.8	1	2
Direction ❾		-	W	SE	SW
Soil colour	----	Brownish Grey	Grey	Brown	Blackish Brown
pH	----	7.26	7.69	7.81	7.45
Electrical Conductivity	μmhos/cm	236	341	392	287
Moisture	%	5.2	6.5	8.2	4.5
Soil texture	----	Silty Clay Loam	Silty Clay	Silty Clay Loam	Silty Clay Loam
Clay	%	36	41	39	33
Silt	%	56	52	48	61
Sand	%	8	7	13	6
Infiltration Rate	cm/hr	1.85	1.65	1.76	1.95
Bulk density	gm/cm^3	1.41	1.35	1.39	1.41
Porosity	%	47	49.2	47.7	47
Nitrogen as N	kg/ha	162	136	158	179

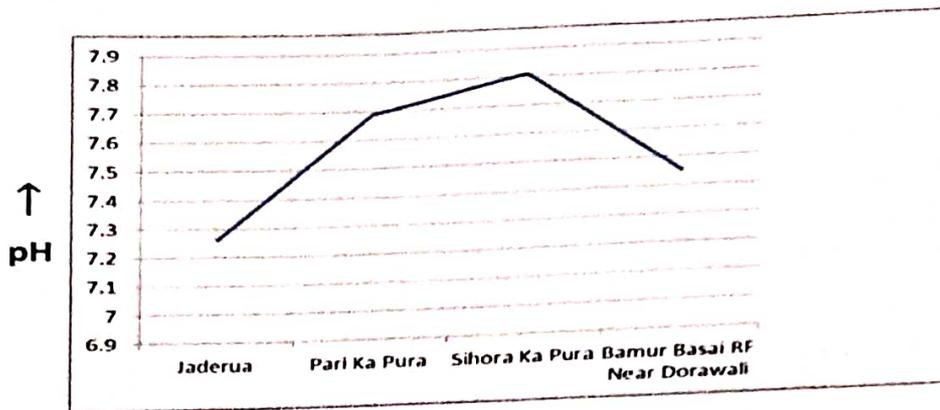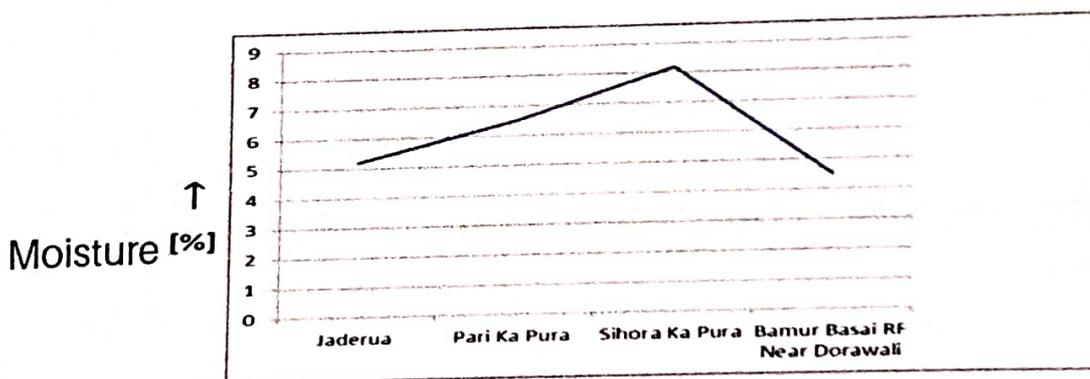|					
Phosphorus	kg/ha as P	21	18	32	25
Potassium as K	kg/ha as K	365	402	395	378
Organic Carbon	%	0.26	0.24	0.23	0.3
Organic Matter	%	0.45	0.41	0.39	0.52

Fig 12 **pH of soil**

Fig 13 **MOISTURE[%] IN SOIL**
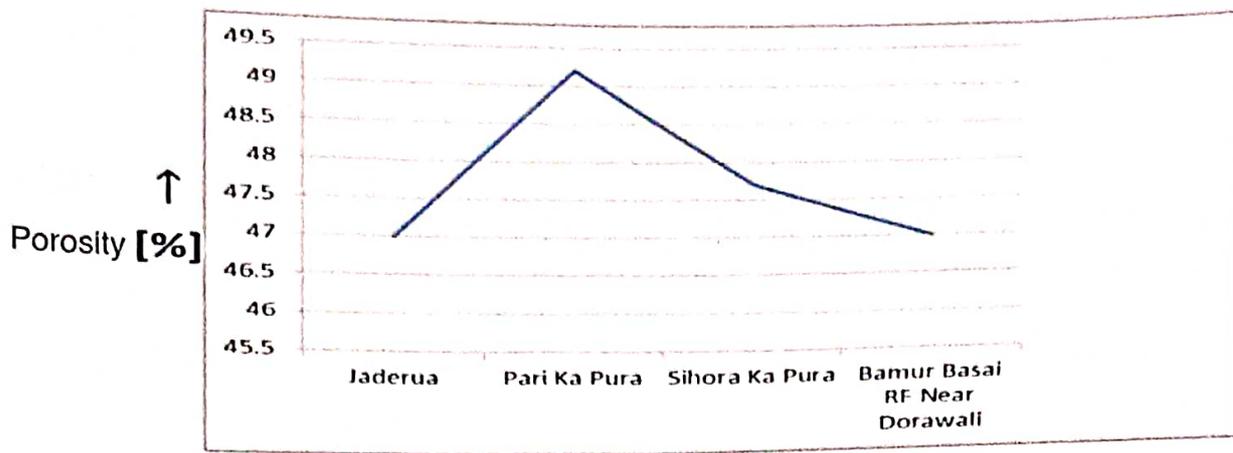
Fig 14 **POROSITY[%] IN SOIL**
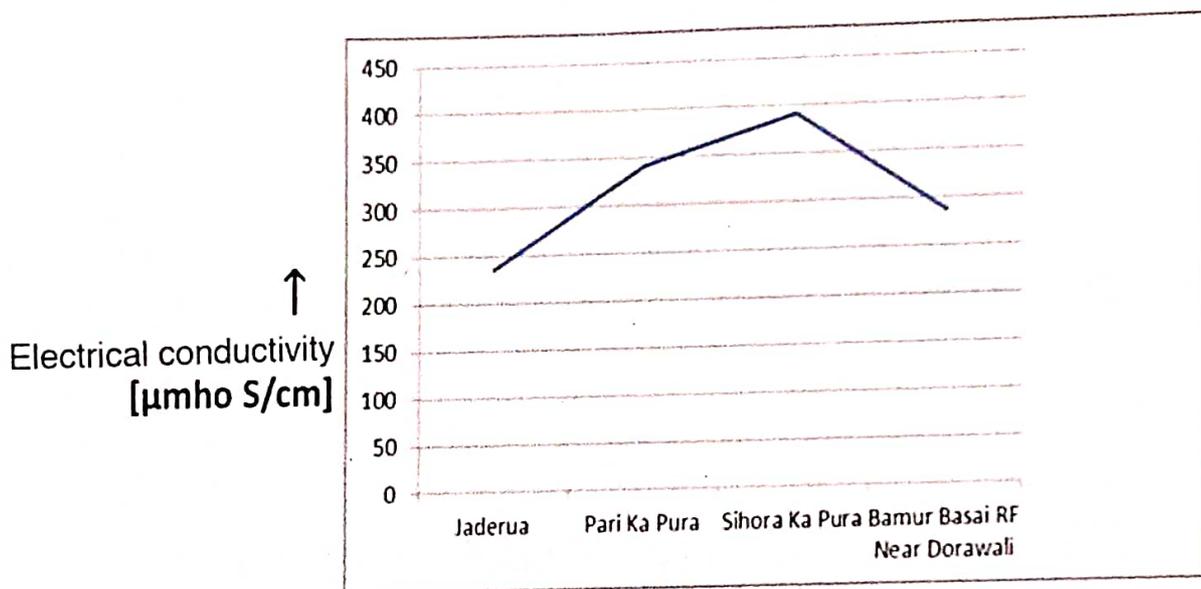
Fig 15 **ELECTRICAL CONDUCTIVITY[μmho S/cm] OF SOIL**
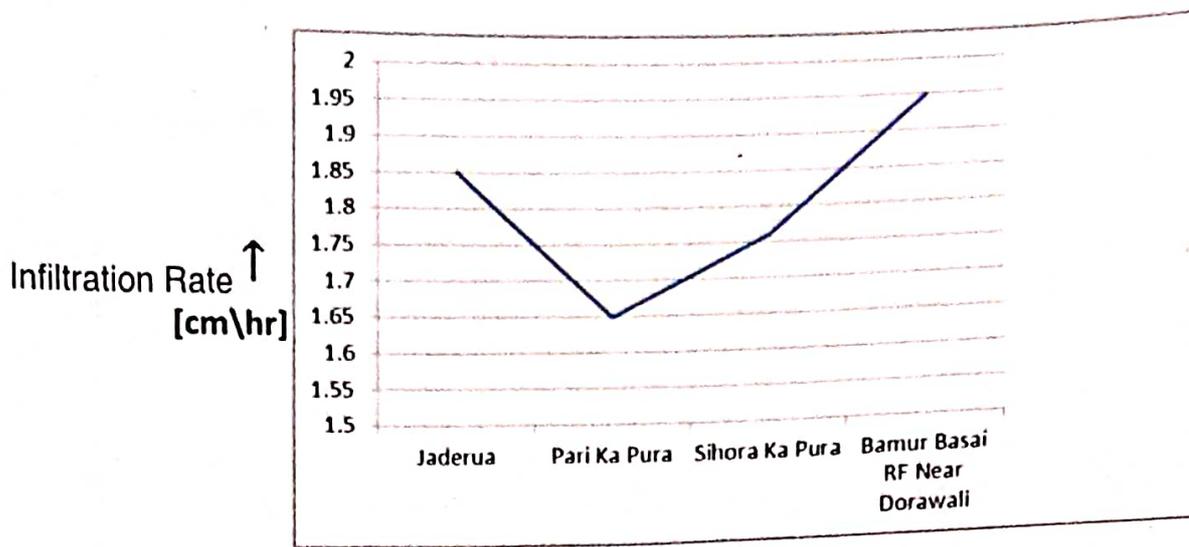
Fig 16 INFILTRATION RATE[cm\hr]
OF SOIL

The soil was silt clayey loam in the study area. The pH was ranges 7.26 to 7.81 which was neutral to moderately alkaline as per ICAR guideline. The conductivity was varying from 236 µmhos/cm to 392 µmhos/cm in the study area which is meeting to average soil quality. The organic carbon of the study area was less (0.23%) to (0.30%) in term of fertility. Nitrogen was observed varying from 136 kg/ha to 179 kg/ha which is better for crop growth. Phosphorous was variable in study area as the quantity was less to medium in the soil. The potash content was more than sufficient in soil in terms of fertility. Overall the soil quality was good having the good bulk density, porosity and infiltration rate.

6.ASSESMENT OF WATER SAMPLE AT INDUSTRIAL AREA JADERUA

Two surface water samples were collected from the available identified water bodies during the pre monsoon season (March to may 2018). Four ground water sources were examined for physico-chemical and heavy metals to access the effect of already ongoing activities on surface and ground water.

i)Ground Water

Table 5 Ground Water

Parameters	Unit	Pari Ka Pura	Doraoli	Jaderua	Nurabad	IS 10500 :2012	
						Acceptable Limit	Permissible Limit
Location Code ⊙	-	GW-1	GW-2	GW-3	GW-4		
Direction ⊙ Distance (km) ⊙		W 0.8	SW 1.8	NE 2.0	SE 4.5		
Turbidity	NTU	<1	<1	<1	<1	1	5
pH	--	7.69	7.51	7.28	7.53	6.5- 8.5	NR
Conductivity	µS/cm	2561	2832	2931	2654	$	$
Total Dissolve Solids	mg/l	1603	1682	1820	1539	500	2000
Alkalinity as $CaCO_3$	mg/l	418.2	462.1	492.8	428.5	200	600

Parameter	Unit						
Total Hardness as CaCO₃	mg/l	563.8	574.5	636.1	529.9	300	600
Calcium as Ca	mg/l	96.5	93.2	104.2	86.2	75	200
Magnesium as Mg	mg/l	78.5	83.1	91.4	76.5	30	100
Sodium	mg/l	298	315	342	291	$	$
Potassium	mg/l	16	12	8	15	$	$
Bicarbonate	mg/l	418.2	462.1	492.8	428.5	$	$
Chloride as Cl	mg/l	463.0	452.0	461.0	429.0	250	1000
Sulphate as SO₄	mg/l	184.0	215.0	264.0	185.0	200	400
Nitrate as NO₃	mg/l	12.3	14.2	15.1	12.9	45	NR
Flouride as F	mg/l	0.31	0.42	0.25	0.15	1.00	1.5
Phenolic compound as C₆H₅OH	mg/l	BDL	BDL	BDL	BDL	0.001	0.002
Iron	mg/l	0.21	0.16	0.22	0.17	0.3	NR
Zinc	mg/l	3.5	4.1	2.6	1.9	5	15

Physical Parameters:-

The Physical parameters were meeting to the permissible limits of drinking water as TDS was very high observed as varying from 418.2 mg/ltr to 462.1 mg/ltr. It may be due to the more dissolved solids as cations and anions. Other physical parameters as pH, Na, K are meeting to the acceptable limit of drinking water standard 10500:2012.

Chemical Parameters:

The chemical parameters were analyzed as alkalinity, calcium, hardness, chloride, Sulphate, fluoride and nitrate etc. The Sulphate was slightly meeting to the acceptable limits of drinking water standard and other parameters was exceeding much from acceptable limits but meeting to the permissible limits of drinking water standards IS 10500:2012 at all locations. It may because of the major extraction of ground water in past or salt pane in the area.

Heavy Metals:

The heavy metals were analyzed, only metals were detected as iron & zinc which was meeting to the acceptable limits of drinking water standard 10500:2012 and other metals were below to the detection limits of laboratory.

ii)Surface Water

Table 6 Surface Water

Parameters	Unit	Asan Nadi	Sankh Nadi	Water Quality Criteria as per CPCB
Location Code ⊙	-	SW-1	SW-2	
Distance (km) ⊙	-	1.7	3.8	
Direction ⊙	-	NW	SE	
Turbidity	NTU	168	3.1	S
pH	--	8.04	7.82	Class A
Conductivity	µS/ m	2148	483	S
Total Dissolve Solids	mg/l	1308	269	S
Alkalinity as CaCO3	mg/l	582.1	116.5	S
Total Hardness as CaCO3	mg/l	582.4	122.4	S
Calcium as Ca	mg/l	198.3	30.4	S
Magnesium as Mg	mg/l	21.3	11.3	S
Sodium	mg/l	133	22	S

Potassium	mg/l	16	3	$
Bicarbonate	mg/l	582.1	116.5	$
Chloride as Cl	mg/l	218.3	39.2	$
Sulphate as SO₄	mg/l	127.1	19.8	$
Nitrate as NO₃	mg/l	3.8	8.5	$
Fluoride as F	mg/l	0.54	0.57	$
Phenolic compound as C₆H₅OH	mg/l	BDL	BDL	$
Cyanide	mg/l	BDL	BDL	$
Aluminium	mg/l	BDL	BDL	$
Arsenic	mg/l	BDL	BDL	$
Cadmium	mg/l	BDL	BDL	$
Chromium as Cr^+_6	mg/l	BDL	BDL	S
Iron	mg/l	0.87	0.51	S
Copper	mg/l	BDL	BDL	S
Lead	mg/l	BDL	BDL	S
Manganese	mg/l	BDL	BDL	S
Mercury	mg/l	BDL	BDL	S
Zinc	mg/l	15.2	1.4	S
Dissolve Oxygen	mg/l	2.4	5.8	Class B & Below E
COD	mg/l	204.5	4.6	$
BOD, 27°C 3 days	mg/l	61.3	1.8	Class B, C & Below E
Total Coliforms	MPN/100ml	1950	<350	Class B & C

25

Physical Parameters:

The physical parameters were analyzed as turbidity, pH, TDS, Na and K. The turbidity was observed high in both rivers which was due to the domestic discharge into the river and Emergent plants include cattails, flowering rush and bulrushes in the river.

Chemical Parameters:

Alkalinity, Total Hardness, Calcium, Magnesium, Chloride, Bicarbonate, Sulphate, Nitrate, Fluoride, DO and COD were analyzed. The chemical parameters were not observed high due to flowing water. Dissolved oxygen & BOD were observed accorded to Class C & E and Below class E accordingly as per CPCB water quality criteria.

Heavy Metals:

The heavy metals were also analyzed in the surface water. Only iron & zinc were detected. Other parameters were below to the detection limits. Biological Parameters: Total coliform was meeting to the Class C of water quality criteria as defined by CPCB.

CONCLUSION

The study assessed the industrial effluents quality of neighboring districts of Gwalior. A comparative study of effluents was carried out in different months and the samples are collected from the different sites in the prescribed manner. This study indicated that the level of pollution is increasing from July to November. Especially TDS, COD observations are drawing the attention of the environmental activists. Various small scale and some major industries like alcoholic beverages, milk and milk products, food & food products, chemical and polymer in this area, release their inefficiently treated effluents openly which may contaminate water reservoir and raise serious abdominal health problems in humans as constipation, stone, stomach and intestinal ulcers, skin ailments and eyes irritation. Therefore, there is an urgent need to implant effluent treatment units in the industry itself to reduce environmental and health risks. The results of the investigations point out the need to implement common objectives, compatible policies and programmes for the improvement of waste water management.

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