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## Research Article

# PHYSICO-CHEMICAL STUDIES ON GROUND WATER AND SURFACE WATER IN AND AROUND KATNI CITY, MADHYA PRADESH

**[1,*]Indra Prasad Tripathi, [2]Arvind Prasad Dwivedi and [1]Rinku Sahu**

[1]Pro-Vice-Chancellor and Dean, Faculty of Science and Environment
[2]Junior Research Fellow, Department of Physical Sciences, M.G.C.G.V. Chitrakoot, Satna (Madhya Pradesh)

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**ABSTRACT**

Katni is located in the Mahakoshal region of central India. The Katni district extends Frome latitude $23^0$ 37' N to $24^0$80' N and $79^0$57' E to $80^0$58'E. The district has an area of 4949.52 $km^2$ with a population of 1064167. The present study was conducted during the month of March to july-2015. Thirty two samples were collected from bore wells, hand pumps, and river of three different area (industrial, Residential and surface water) of Katni city. The procedures were followed as per the standard methods. Temperature, nitrate, sulphates and copper content of all the samples of study are were below the permissible limit prescribed by WHO. As a conclusion, Surface water and ground water in the study area were greatly affected from the anthropogenic activities, especially industrial activities, waste water drains and leakage from sewage system and agriculture activities.



## INTRODUCTION

Katni, also known as Mudwara is situated on the bank of two rivers namely Katni and Simrar. Katni is located in the Mahakoshal Region of central India. The Katni district extends Frome latitude; 23°37´N to 24°80´Nand Longitude; 79°57´E to 80°58´E, the district has an area of 4949.52 km² with a population of 1064167. Mundwara Katni Chhoti Mahanadi and Umdar are the main rivers of this district (ICRA, 2011). Katni district is famous for various minerals, some of them are Lime stone; Dolomite, Fireclay, Latrite, Bauxite, Soapstone, Quartz, Batrize, Colsite, Iron etc. As agriculture-wheat, Paddy, Gram, and Pulses are major crops (Bajpai, 2011). Katni derives its importance from the following aspects. One of the largest railway junction located in the mineral tourist place, biggest diesel loco shed of Indian railway, biggest wagon repairs shop. Katni is host to a wide range of industries, these include refractory, pulse mills, marble, lime industries, rice mills; plastic industry etc. Stone Park is cluster of mineral based industries with primary attention to marble industry. Katni district has major tourist locations, which are Dhimarkhera, Bahoriband Murwara, and Karondi. The claimate is moderate. Slimnabad a village located here is famous for its marbles. Katni is known as city of lime.

****Corresponding author: Indra Prasad Tripathi,***
*Pro-Vice-Chancellor and Dean, Faculty of Science and Environment.*

Water supply facility in Katni city is provided by Municipal Corporation which undertakes sourcing establishing networks, maintenance and collection of user charges. The Water samples were collected from Katni city analysed for a period of three months from March 2015 to May 2015. The results were compared with the BIS and WHO standard and they revealed that the most of the parameters are exceeding the permissible limit for drinking water. Toxic metals are usually present in industrial, municipal and urban runoff, which can be harmful to humans and biotic life. Increased urbanization and industrialization are to be blamed for an increased level of trace metals, especially heavy metals, in our waterways. The heavy metals in drinking water linked most often to human poisoning are lead, iron, cadmium copper, zinc, chromium etc .They are required by the body in small amounts , but can also be toxic in large doses.

They constitute one important group of environmentally hazardous substances if present (Singh, 2011). The known fatal effects of heavy metal toxicity in drinking water include damaged or reduced mental and central nervous function and lower energy level. They also cause irregularity in blood composition, badly effect vital organs such as kidneys and liver (Begum, 2009). Lead has the ability to replace calcium in bone to form sites for long term replacements. Heavy metals like copper are the essential trace elements but show toxicity in excess.

Toxicity can result from any of the heavy metals if they are present more or less from its original limits in drinking water. Drinking water is obtained from a variety of sources like wells, rivers, lakes, reservoirs, ponds etc. The various sources of water pose the greatest risk to human health due to contamination of these sources. A water pollutant mainly consists of heavy metals, micro-organisms, fertilizers and thousands of toxic organic compounds. Heavy metals in water occur only in trace levels but are more toxic to the human body (Sardar, 2013).

The numbers of problems Worldwide related with the lack of clean and fresh water are well known: 1.2 billion people lack Access to safe and clean drinking water, 2.6 billion has little or no sanitation, and millions of People die annually, 3,900 children a day, from diseases transmitted through unsafe water or Human faeces. Most of the population is dependent on surface water as the only source of drinking water supply. The ground water is believed to be comparatively much clean and free from pollution than surface water. But prolonged discharge of industrial effluents, domestic sewage and solid waste dump causes the groundwater to become polluted and created health Problem. The long term exposure of these metals result in physical, muscular, neurological degenerative processes that cause Alzheimer's disease Parkinson's disease, muscular dystrophy (progressive skeletal muscle weakness), multiple sclerosis (a nervous system disease that affects brain and spinal cord), Also, lead is one of the most common heavy metal in drinking water, if occurred more than its permissible limit shows general metabolic poison and enzyme inhibitor (WHO, 1999).

**Table 1. Sampling station of Katni City**

| S.N. | Sampling station | Sampling area |
|---|---|---|
| 1 | Iw1 | Near Ordinance Factory |
| 2 | Iw2 | Cement Factory of Camore. |
| 3 | Iw3 | Cement Factory of N.K.G. |
| 4 | Iw4 | ACC Factory Camp. |
| 5 | Iw5 | Primiyam Factory NKG. |
| 6 | Iw6 | Mahakausal Factory Bargva. |
| 7 | Iw7 | ACC Factory camore |
| 8 | Iw8 | Everest Factory Nirman Camore |
| 9 | Iw9 | Near Railway crassing NKG |
| 10 | Iw10 | Near Gov. Sec. High, School Mangal Nagar. |
| 11 | Rw1 | Near bus stand |
| 12 | Rw2 | Bhind KCNIT Collage |
| 13 | Rw3 | District Hospital katni. |
| 14 | Rw4 | Near kotvali |
| 15 | Rw5 | SDM Colony |
| 16 | Rw6 | Tilak Collage Prem Nagar. |
| 17 | Rw7 | Near Railway station katni junction. |
| 18 | Rw8 | Near Civil line. |
| 19 | Rw9 | Near in Misan Chauk. |
| 20 | Rw10 | Near in Chandak Chauk. |
| 21 | Rw11 | Near in Aajad Chauk. |
| 22 | Rw12 | Near in Kharaini Phatak. |
| 23 | Rw13 | Near in Gayatri Nagar. |
| 24 | Rw14 | Near Shree hospital Bargava. |
| 25 | Rw15 | Near in Camp area katni. |
| 26 | Sw1 | Chhaparvah river Gandhi school. |
| 27 | Sw2 | Mai river- Near Ajad chauk. |
| 28 | Sw3 | Mahakausal river-katayghat. |
| 29 | Sw4 | Katni river-near main city. |
| 30 | Sw5 | Baba ghat mangal nagar |
| 31 | Sw6 | Bilahari river-Fort of bilahari |
| 32 | Sw7 | Bilagva river- Shashkiy vidyalay bilagva. |

**Collection of Water samples:** The present study was conducted during the month of March to April 2015. Thirty two sample were collected Frome bore wells, hand pump and river of three different area (industrial, residential, surface water) of Katni city. all the water sample were collected in 1L polyethylene bottle which were pre-cleaned by washing non-ionic detergents, rinsed in tap water,1:1 dilute nitric acid and finally deionised water. Before sampling, the bottle were rinsed the water to be analysed and collected. Then the samples were carefully transported to be laboratory for analysis with in short duration after collection with maintaining the temperature of 4°C for the determination of physico-chemical parameter. The determination of water quality parameters carried out by standards method (APHA, 1998). The sampling location are presented in Table 1.

**WATER SAMPLE**

The sampling sites are indicating as Industrial area (Iw), Residential area (Rw), surface area (Sw).

## RESULTS AND DISCUSSION

The ground water samples were analysed some parameter like temperature, pH, total hardness, nitrate, sulphate and heavy metals. Physico-chemical characteristics of ground water and surface water samples of Katni city were analysed all the results show in Table 2-7 and drinking water standard values are presented in Table 8.

**INDUSTRIAL AREA**

Study of physical chemical parameter- The water temperature was found to be maximum 33.5 $^0$C in sampling station (Iw2) Cement Factory of N.K.G. the minimum water temperature 27 $^0$C in sampling station (Iw8) Everest Factory Nirman Camore. The average water temperature is found 29.98 are below than the permissible limit prescribed W.H.O. as 25 $^0$C to 35 $^0$C. Which is supported by the study of Lodh *et al* 2014 physico-chemical studies of water quality with special reference to ancient lakes of Udaipur City, Tripura, India? The studied water temperatures were measured in 28.25 $^0$C - 31.50 $^0$C. The PH values of drinking water sample are between 6.9 to 8.0. Its highest value found 8.6 and lowest value found 7.1. pH value of at sampling stations (Iw2 ) Cement Factory of Camore (8.4), (Iw5) Primiyam factory N.K.G. (8.6), (Iw7) ACC Factory camore (8.2) and (Iw9) Near Railway crossing NKG (8.1) are more than the permissible limit prescribed WHO as 6.9-8.0. Garnaik *et al.,* 2013 carried out Seasonal Variation of Nagavali river water Quality at the Vicinity of Paper Mill near Jaykaypur, Odisa, India.

The study is noted pH value 6.9 to 7.5 mg/l. In the present study the TH of water was found to be 310.2 to 876.0 mg/l. The highest value was found 876.0 mg/l at sampling location (Iw5) Primiyam Factory NKG and lowest value was found 310.2 mg/l at sampling location (Iw10) Near Gov. Sec. High, School Mangal Nagar. Sharma *et al.,* 2013 study in Physico chemical Analysis of Surface and Ground Water of Abhanpur Block in Raipur District, Chhattisgarh. Studied the water hardness ranged from a 130 to 280 mg/l. The value of total hardness at sampling station (Iw2) Cement factory of Camore is 792.0 mg/l and (Iw9) Near Railway crossing NKG is 769.0mg/l. All the samples were below the permissible limit prescribed by WHO except two samples (Iw2) (Iw9). Vishwakarma *et al.,* 2013 studied assessment of water quality of Betwa River, Madhya Pradesh, India. Recorded the TH values ranged from 14.6 to 58.6 mg/l. the amount of total dissolved solids in water indicates salinity of water and may also be used as an indicator

**Table 2. The physico-chemical characteristic of industrial area (Iw) of Katni city**

| S.N | Sampling station | Temper ature | pH | Total hardness | TDS | Nitrate | Sulphate |
|---|---|---|---|---|---|---|---|
| 1 | Iw1 | 30.2 | 7.8 | 375.7 | 975.7 | 6.71 | 8.7 |
| 2 | Iw2 | 33.5 | 8.4 | 792.0 | 939.6 | 5.42 | 10.8 |
| 3 | Iw3 | 31.4 | 7.6 | 343.3 | 457.0 | 4.33 | 7.8 |
| 4 | Iw4 | 29.5 | 7.2 | 378.0 | 639.6 | 3.27 | 14.5 |
| 5 | Iw5 | 30.0 | 8.6 | 876.0 | 1143.0 | 9.41 | 8.1 |
| 6 | Iw6 | 28.5 | 7.1 | 335.0 | 519.3 | 0.69 | 18.2 |
| 7 | Iw7 | 30.5 | 8.2 | 362.0 | 582.0 | 2.12 | 12.1 |
| 8 | Iw8 | 27.0 | 6.9 | 325.4 | 447.0 | 1.29 | 17.3 |
| 9 | Iw9 | 29.2 | 8.1 | 769.0 | 1065.0 | 7.00 | 29.4 |
| 10 | Iw10 | 30.0 | 7.3 | 310.2 | 216.0 | 6.53 | 24.5 |
| | Mean | 29.98 | 7.72 | 526.66 | 698.35 | 4.67 | 15.14 |
| | SD | 1.720 | 0.590 | 227.27 | 310.98 | 2.82 | 7.29 |
| | Cv | 5.73 | 7.64 | 43.15 | 44.30 | 60.38 | 48.15 |

**Table 3. The physico-chemical characteristic of Residential area (Rw) of Katni city**

| S.N | Sampling station | Temperature | pH | Total hardness | TDS | Nitrate | Sulphate |
|---|---|---|---|---|---|---|---|
| 1 | Rw1 | 30.0 | 7.9 | 375.0 | 296.0 | 6.72 | 6.9 |
| 2 | Rw2 | 29.6 | 7.7 | 310.0 | 323.0 | 3.26 | 11.2 |
| 3 | Rw3 | 32.0 | 8.6 | 630.0 | 946.0 | 0.56 | 8.3 |
| 4 | Rw4 | 28.7 | 7.3 | 285.0 | 270.0 | 0.64 | 5.7 |
| 5 | Rw5 | 30.5 | 7.8 | 296.0 | 305.0 | 4.21 | 2.9 |
| 6 | Rw6 | 33.0 | 8.5 | 662.0 | 887.0 | 9.82 | 36.0 |
| 7 | Rw7 | 29.6 | 6.8 | 373.0 | 380.0 | 4.94 | 3.6 |
| 8 | Rw8 | 31.2 | 7.6 | 205.0 | 195.0 | 2.72 | 7.3 |
| 9 | Rw9 | 30.4 | 7.8 | 336.0 | 310.0 | 9.96 | 12.0 |
| 10 | Rw10 | 29.7 | 6.1 | 285.0 | 292.0 | 2.36 | 9.5 |
| 11 | Rw11 | 30.0 | 7.4 | 250.0 | 230.0 | 3.16 | 4.8 |
| 12 | Rw12 | 31.6 | 8.2 | 623.0 | 769.0 | 4.57 | 31.0 |
| 13 | Rw13 | 28.2 | 6.9 | 273.0 | 256.0 | 2.13 | 6.2 |
| 14 | Rw14 | 32.3 | 7.5 | 348.0 | 365.6 | 8.35 | 15.0 |
| 15 | Rw15 | 28.9 | 8.6 | 545.0 | 1133. | 8.07 | 21.5 |
| | Mean | 30.38 | 7.64 | 386.4 | 463.8 | 4.76 | 12.12 |
| | SD | 1.390 | 0.698 | 151.1 | 305.1 | 3.12 | 9.93 |
| | Cv | 4.57 | 9.13 | 39.07 | 65.78 | 65.54 | 81.93 |

**Table 4. The physico-chemical characteristic of Surface Water Area (Sw) of Katni city**

| S.N | Sampling station | Temperature | pH | Total hardness | TDS | Nitrate | Sulphate |
|---|---|---|---|---|---|---|---|
| 1 | Sw1 | 30.0 | 7.9 | 240.0 | 772.0 | 48.3 | 0.49 |
| 2 | Sw2 | 33.0 | 6.9 | 124.0 | 316.0 | 1.9 | 0.94 |
| 3 | Sw3 | 29.0 | 7.5 | 297.8 | 398.0 | 5.4 | 3.14 |
| 4 | Sw4 | 30.0 | 8.1 | 220.0 | 215.0 | 26.8 | 6.21 |
| 5 | Sw5 | 34.0 | 7.8 | 316.0 | 565.0 | 10.5 | 2.64 |
| 6 | Sw6 | 27.0 | 7.7 | 234.0 | 566.5 | 2.3 | 7.69 |
| 7 | Sw7 | 33.0 | 8.0 | 286.0 | 468.0 | 16.8 | 8.13 |
| | Mean | 30.85 | 7.7 | 245.4 | 471.5 | 16.0 | 3.46 |
| | SD | 2.54 | 0.40 | 64.44 | 184.1 | 16.78 | 3.15 |
| | Cv | 8.23 | 5.19 | 26.25 | 39.08 | 104.8 | 91.04 |

**Table 5. Heavy metal contents in industrial area (Iw) of Katni city.**

| S.N. | Sampling station | Pb | Cd | CU | Zn | Fe |
|---|---|---|---|---|---|---|
| 1 | Iw1 | 0.019 | 0.0047 | 0.015 | 0.165 | 0.062 |
| 2 | Iw2 | 0.045 | 0.0213 | 0.157 | 0.326 | 0.328 |
| 3 | Iw3 | 0.164 | 0.0065 | 0.118 | 0.129 | 0.089 |
| 4 | Iw4 | 0.013 | 0.0054 | 0.080 | 0.193 | 0.058 |
| 5 | Iw5 | 0.006 | 0.0029 | ND | 0.236 | 0.014 |
| 6 | Iw6 | 0.107 | 0.0038 | ND | ND | 0.076 |
| 7 | Iw7 | 0.023 | ND | 0.148 | ND | 0.037 |
| 8 | Iw8 | 0.056 | 0.0193 | 0.066 | 0.131 | 0.024 |
| 9 | Iw9 | 0.007 | ND | 0.034 | 0.022 | 0.121 |
| 10 | Iw10 | 0.002 | 0.0012 | ND | ND | 0.008 |
| | Mean | 0.0442 | 0.0081 | 0.088 | 0.1717 | 0.081 |
| | SD | 0.052 | 0.0076 | 0.054 | 0.095 | 0.093 |
| | C v | 117.64 | 93.82 | 61.36 | 55.55 | 114.81 |

**Table 6. Heavy metal contents in Residential Area (Rw) of Katni.**

| S.N. | Sampling station | Pb | Cd | CU | Zn | Fe |
|---|---|---|---|---|---|---|
| 1 | Rw1 | 0.062 | ND | 0.056 | 0.132 | 0.281 |
| 2 | Rw2 | 0.010 | ND | 0.028 | 0.325 | ND |
| 3 | Rw3 | 0.016 | 0.0008 | ND | 0.265 | 0.054 |
| 4 | Rw4 | 0.023 | ND | ND | 0.137 | ND |
| 5 | Rw5 | 0.035 | ND | ND | ND | 0.060 |
| 6 | Rw6 | 0.020 | 0.0021 | 0.013 | 2.462 | 0.532 |
| 7 | Rw7 | 0.048 | 0.0010 | 0.066 | 0.124 | 0.384 |
| 8 | Rw8 | ND | ND | ND | ND | 0.048 |
| 9 | Rw9 | 0.057 | 0.0027 | 0.087 | 0.136 | 0.178 |
| 10 | Rw10 | 0.025 | 0.0023 | 0.093 | 3.123 | ND |
| 11 | Rw11 | 0.082 | 0.0031 | 0.020 | 1.256 | 0.123 |
| 12 | Rw12 | 0.012 | 0.0036 | 0.009 | 2.578 | 0.736 |
| 13 | Rw13 | ND | ND | 0.002 | ND | 0.068 |
| 14 | Rw14 | ND | 0.0063 | 0.032 | 0.156 | ND |
| 15 | Rw15 | 0.042 | 0.0074 | 0.079 | 3.243 | 1.321 |
| | Mean | 0.036 | 0.0032 | 0.044 | 1.16 | 0.344 |
| | SD | 0.022 | 0.002 | 0.033 | 1.301 | 0.394 |
| | Cv | 61.11 | 0.0032 | 75 | 112.15 | 114.53 |

**Table 7. Heavy metal contents in Surface Water Area (Sw) in Katni city.**

| S.N. | Sampling station | Pb | Cd | CU | Zn | Fe |
|---|---|---|---|---|---|---|
| 1 | Sw1 | 0.031 | 0.0243 | ND | 1.246 | ND |
| 2 | Sw2 | 0.058 | ND | 0.026 | 0.231 | 0.041 |
| 3 | Sw3 | 0.040 | ND | 0.035 | ND | ND |
| 4 | Sw4 | 0.055 | 0.0021 | 0.019 | 0.614 | 0.068 |
| 5 | Sw5 | 0.039 | 0.0085 | 0.077 | 0.678 | 0.030 |
| 6 | Sw6 | 0.042 | 0.0072 | ND | ND | 0.035 |
| 7 | Sw7 | ND | 0.0050 | ND | 1.245 | ND |
| | Mean | 0.037 | 0.009 | 0.0392 | 0.802 | 0.043 |
| | SD | 0.010 | 0.008 | 0.026 | 0.438 | 0.016 |
| | Cv | 270 | 88.88 | 6.63 | 54.61 | 37.20 |

**Table 8. WHO guideline for drinking water quality, 1984**

| Parameter | Standard value |
|---|---|
| Temperature | 25—35 |
| PH | 6.9—8.0 |
| TDS | 500 |
| Total hardness | 300-600 |
| Nitrate | 40 -50 |
| Sulphate | 150 -250 |

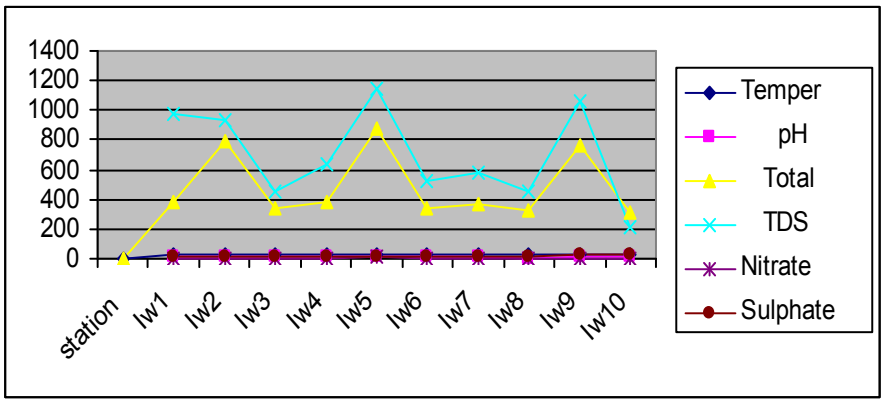


**Figure- 1. The physico-chemical characteristic of industrial area (Iw) of Katni city**

for sewage contamination. In the present study the lowest value of TDS are 216mg/l and the highest value of 1143mg/l. In this average TDS value is measured 698.35mg/l. TDS value at sampling station (Iw1) Near Ordinance Factory (975.7mg/l), (Iw2) Cement Factory of Camore (939.6mg/l), (Iw4), ACC Factory Camp (639.6mg/l), (Iw6) Mahakausal Factory Bargva (519mg/l), (Iw7) ACC Factory Camore (582.mg/l) and (Iw9) Near Railway crassing NKG (1065mg/l). The entire samples were below the permissible limit. Tripathi *et al.,* 2014 studied Physico-Chemical Characteristics of Water of River Mandakini in Chitrakoot Region and reported the Total Dissolved Solid of river water was ranged from 290-470mg/l. The nitrate value ranges from 0.69 mg/l to 9.41.0 mg/l. The highest nitrate value was recorded (9.41.0 mg/l) at sampling

g station (Iw5) Primiyam Factory NKG while the lowest nitrate value was observed (0.69 mg/l) at sampling station (Iw6) Mahakausal Factory Bargva as show in Table-2. All the results were below the permissible limit prescribed by WHO (1984) as 450 mg/l. Sharma *et al.,* 2011 Evaluation of Water Quality of Narmada River With reference to Physico-chemical Parameters at Hoshangabad city, MP, India, on the work in the Nitrate was found to be in the range of 0.063-0.93 mg/l. The sulphate value ranged from 7.8 mg/l to 29.4mg/l. All the sulphate values of all the samples were recorded with in the permissible limit. Bundela *et al.* 2012 Studied Physico-chemical Analysis of Ground Water Near Municipal Solid Waste Dumping Sites In Jabalpur, the concentration of sulphate in water sample ranged from 2.9 to 171 mg/l.

## HEAVY METALS

Lead (Pb) was accumulated in very less quantities in the industrial area. Pb of the samples was found between 0.006 to 0.164 mg/l. The highest Pb was recorded 0.164 mg/l at sampling station (Iw3) Cement Factory of N.K.G. All the samples were below the permissible limit. The Cd of water was found value of range in 0.0012 to 0.213 mg/l. Highest value was found 0.0213 mg/l at sampling station (Iw2) Cement Factory of Camore, (Iw8) Everest Factory Nirman Camore 0.0193 mg/l and lowest value was found 0.0012 mg/l Near Gov. Sec. High, School Mangal Nagar. The Cadmium of all the samples was below the permissible limit except two samples (Iw2), (Iw8). Malassa Husam et al 2014 carried out assessment of ground water pollution With heavy metals.

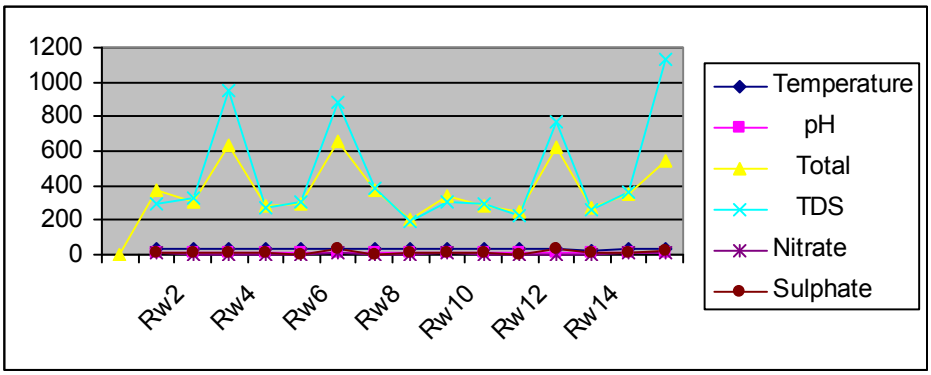


**Figure 2. The physico-chemical characteristic of Residential area (Rw) of Katni city**

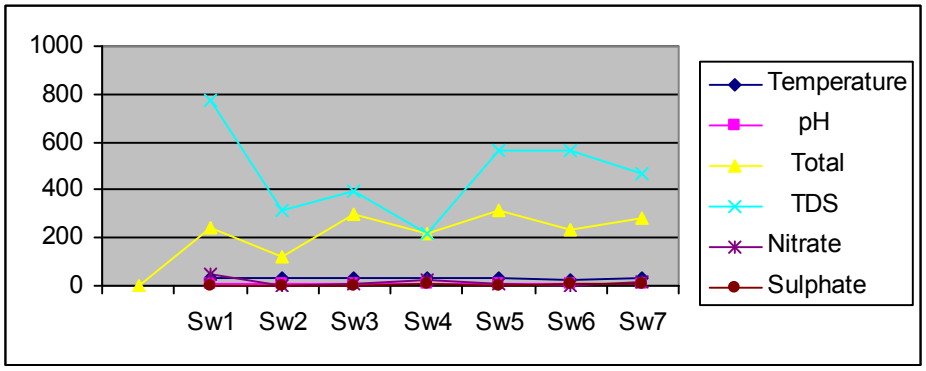


**Figure 3. The physico-chemical characteristic of Surface Water Area (Sw) of Katni city**

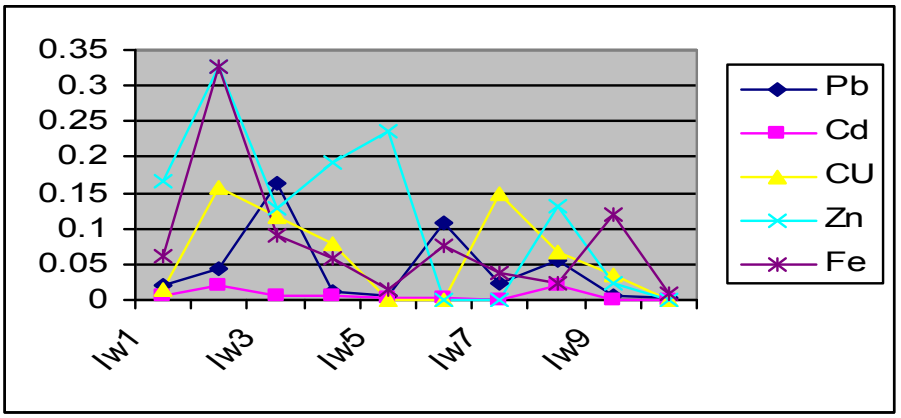


**Figure 4. Heavy metal contents in industrial area (Iw) of Katni city**

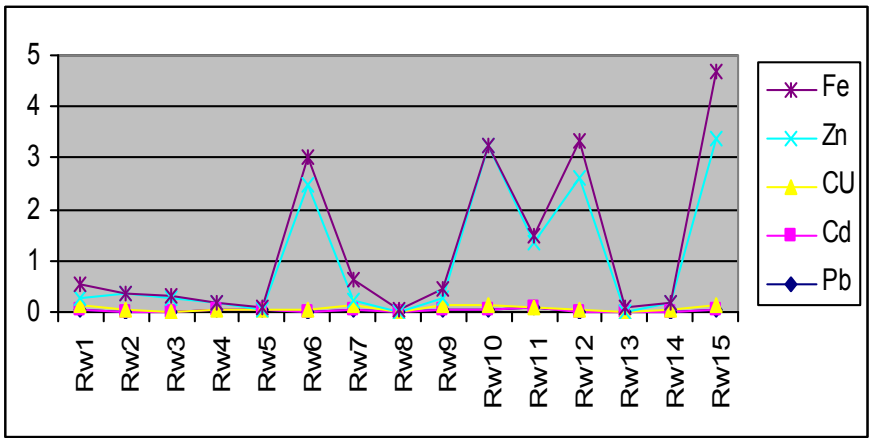


**Figure 5. Havey metal contents in Residential Area (Rw) of Katni**

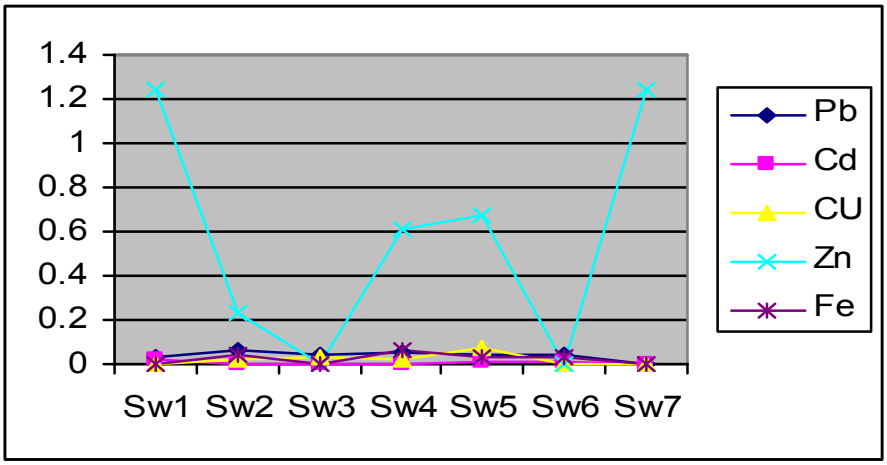


**Figure 6. Heavy metal contents in Surface Water Area (Sw) in Katni city**

In North West Bank/Palestine by ICP-MS. The study Cd range 0.0 to 1.35 mg/l. Cu concentration was found between 0.015 to 1.5 mg/l. The highest Cu was recorded 0.157mg/l in sampling station (Iw2) Cement Factory of Camore. All the results were below the permissible limit prescribed by WHO as 1.5 and shown in the Table- 5.

Mohod Chaitali *et al.,* 2013 carried out review of Heavy Metals in Drinking Water and Their Effect on Human Health, and Cu were determined in the range 8-69 mg/l. In the present study the lowest value of Zn are 0.022 at the sampling station (Iw9) Near Railway crossing NKG (0.0022 mg/l) and highest value of (0.326 mg/l) at sampling station (Iw2) Cement Factory of Camore (0.326 mg/l). Copper of all the sampling station were below the permissible limit. Iron (Fe) was found ranged 0.014 to 0.328mg/l. Iron concentrations of all were below water sampling station of permissible limit.

## RESIDENTIAL AREA

The water temperature of ground water is higher than that of the water supply slightly varied ranged. The maximum temperature ($33^0$c) was recorded at sampling station (Rw6) Tilak Collage Prem Nagar. While the minimum temperature (28.2 $^0$c) was recorded at sampling station (Rw6) Near in Gayatri Nagar. All the water sampling was below the permissible limit prescribe by WHO.

The pH concentration in ground varied ranged between 6.9 - 8.0.The maximum pH 8.6 was recorded at sampling station (Rw15) and (Rw3) Near in Camp area Katni and District Hospital katni. While the minimum pH observed at sampling station (Rw10) Near in Chandak Chauk. The concentration of pH at sampling station (Rw6) Tilak Collage Prem Nagar (8.5) and (Rw12) Near in Kharaini Phatak (8.2). pH concentration all the water sampling station were below the permissible limit prescribed By WHO except four samples (Rw15),(Rw3),(Rw6) and (Rw12). The total hardness of ground water sample were found in the range of 205 -662 mg/l which is further compared with the standard value of WHO ranged 300-600 mg/l. The maximum TH 662 mg/l was found at sampling station (Rw6) Tilak Collage Prem Nagar.

The minimum TH 205 mg/l was found at sampling station (Rw8) Near Civil line. Water hardness is usually due to the multivalent metal ions, which comes from minerals dissolved in the water. The haire value at sampling station (Rw3) District Hospital Katni 630mg/l and (Rw12) Near in Kharaini Phatak 623mg/l. all the water sample were below the permissible limit except two samples (Rw3) and (Rw12).Total dissolved solids varied from 195mg/l to 1133.0mg/l. The TDS concentration was found to be above the permissible limit in WHO. Which may be due to the leaching of various pollutants in sampling station as (Rw15) Near in Camp area Katni 1133 mg/l, (Rw3) District Hospital katni 946 mg/l, (Rw6) Tilak Collage Prem

Nagar 887 mg/l, and (Rw12) Near in Kharaini Phatak 769 mg/l. All the TDS water sample were below the permissible limit except four samples (Rw15), (Rw12), (Rw3) and (Rw6).The nitrate varied from 0.56mg/l in sampling station (Rw3) District Hospital katni to 9.82 mg/l in sampling station (Rw6) Tilak Collage Prem Nagar. Nitrate water sample were below the permissible limit. The sulphate value ranged from 2.9 mg/l in sampling station (Rw5) SDM Colony to 31mg/l in sampling station (Rw12) Near in Kharaini Phatak. All the sulphate water sampling stations were below the permissible limit prescribed by (WHO, 1984).

**HEAVY METAL**

The Lead values found are minimum value 0.010 mg/l in sampling station (Rw2) Bhind KCNIT Collage. The maximum value found in 0.082 in sampling station (Rw11) Near in Aajad Chauk. While the Lead water sample were more high value (Rw1) Near bus stand 0.062 mg/l. and (Rw9) Near in Misan Chauk 0.057 mg/l. The Lead all the sampling station were found in the ranged of permissible limit except three samples (Rw11) (Rw1) (Rw9). The Cupper, Zink, Cadmium, and Iron were found 0.002 to 0.093 mg/l, 0.124 mg/l to 3.243 mg/l, 0.0001mg/l to 0.0075 mg/l., and 0.123 mg/l- 2.462mg/l, all the samples were below the permissible limit. Iron was recorded all the sampling station were found within the ranged of permissible limit except four sample, (Rw6) Tilak Collage Prem Nagar,(Rw10) Near in Chandak Chauk, (Rw12) Near in Kharaini Phatak and (Rw11) Near in Aajad Chauk.

**SURFACE AREA**

Study of physical chemical parameter-Temperature of the samples were found ranged 27$^{o}$C to 34 $^{o}$C, the highest temperature was recorded 34$^{o}$C at sampling station (SW5) Baba ghat mangal nagar. The lowest value recorded 27 $^{o}$C at sampling station (Sw6) Bilahari river-Fort of bilahari. Water temperature all the samples were below the permissible limits prescribed by WHO. The observed pH ranged value in 6.0 - 8.1.The highest observed value are at sampling station (Sw4) 8.1 and lowest observed value are at sampling station (Sw2) 6.9. All the PH samples were below in the permissible limit prescribed by WHO except one samples (Sw4). These presented are Table-4. The water of TH was ranged to 124 to 316.0 mg/l. The highest value was found 316 mg/l at sampling location (Sw5) Baba ghat mangal nagar. All the TH water samples were below the permissible limit prescribe by WHO as (300-600 mg/l) except one samples (Sw5). Total dissolve solid content of a sample of water is important in deciding wither the water suiTable for drinking purpose or not. The lowest value of TDS in 215.0 mg/l at sampling station (Sw4) Katni river near main city.

The highest value of 772mg/l at sampling station (Sw1) Chhaparvah River Gandhi School While the most value (565.0mg/l) at sampling station (Sw5) Baba ghat mangal nagar and (566.0mg/l) at sampling station (Sw6) Bilahari river-Fort of bilahari. All the TDS samples were below the permissible limit prescribed by WHO (1984) except three samples (Sw1), (Sw5), and (Sw6). The nitrate value ranges from 1.9 mg/l to 48.3mg/l. The highest nitrate value was recorded 48.3 mg/l at sampling station (Sw1) Chhaparvah River Gandhi School. While the lowest nitrate value was observed 1.9 mg/lat sampling station (Sw2) Mai river- Near Ajad chauk. All the Nitrate water sampling station were found within the ranged permissible limit prescribed by WHO (1994). The sulphate value ranged from 0.49mg/l to 8.13mg/l. All the Sulphate water sampling stations were found within the ranged permissible limit prescribed by WHO [17] (1994) as 150- 250mg/l shown in Table -4.

**HEAVY METAL**

The Lead (Pb) was accumulated in very less quantities in the surface area. Lead was recorded all the sampling station in the ranged of 0.031 to 0.058 mg/l. the permissible limit except two samples 0.058 mg/l at sampling station (Sw2) Mai river- Near Ajad chauk. and 0.055 mg/l at sampling station (Sw4) Katni river-near main city. The Cadmium was found ranged 0.0021-0.0243 mg/l. at all the sampling station was below the permissible limit by prescribed by WHO. The Cupper was found ranged 0.019 to 0.077 mg/l. All the sampling stations were below the permissible limit. In the present study the lowest value of Zink are 0.0231 mg/l at the sampling station (Sw2) Mai river-Near Ajad chauk. and highest value of 1.246 mg/l at sampling station (Sw1) Chhaparvah river Gandhi school, and 1.245 mg/l in sampling station ($SW_7$).The Iron was recorded all the sampling station were found within the range of permissible limit by prescribe WHO and show are the Table-7.

**Conclusion**

In the Present study water sample were collected from industrial area, Residential area and Surface water area of Katni city Madhya Pradesh. The collected sample are characterized for physico-chemical parameters, temperature pH, TDS TH, Nitrate, Sulphate and the heavy metals by following standard procedures of APHA and the analyzed data are presented in Table 1 to 6. In industrial area, temperature, pH, Nitrate and Sulphate of all the samples were below the limit. Total hardness of all the samples were below the limit except two samples Iw5 and Iw9. Seventy percent samples of TDS are more than the permissible limit. Copper, Zinc and Iron concentration of all the sampling station of the industrial area are below the permissible limit.

Lead and Cadmium were recorded at all the sampling stations with in the limit except one station are Iw8. In Residential area, temperature, nitrate and sulphate were recorded at all the sampling stations are below the permissible limit. pH concentration was recorded at sampling station Rw3, Rw6 and Rw15 are above the limit of WHO. Total hardness was recorded with in the limit except two station Rw3 and Rw6. Total Dissolved Solid was detected at sampling station Rw3, Rw6, Rw12 and Rw15 are higher than the permissible limit. Cadmium and Copper concentration of all the samples of Residential area are below the permissible limit prescribed by WHO. Iron was detected at all the sampling station were below the permissible limit except one station Rw15. Lead was reported in residential area of Katni city at sampling station Rw1, Rw9 and Rw11are above the permissible limit. Zinc concentration was recorded at sampling station Rw6, Rw10, Rw12 and Rw15 are more than the permissible limit. Temperature, PH, Total Hardness and sulphate of all the samples of surface water area of Katni city were below permissible limit.

TDS was found at sampling station Sw1, Sw5 and Sw6 are higher than the limit set by WHO. Nitrate of all the samples of surface water area were below the permissible limit except one sampling station Sw1. Copper and Iron concentration of all the samples of surface water area are below the limit set by WHO. Cadmium of all the sampling stations are below the limit except one station Sw1. Lead was reported in the surface water area of Katni city at sampling station Sw2 and Sw4 are except the limit of WHO. Seventy five percent samples of Zinc content was reported more than the permissible limit. As a conclusion, surface area and ground water in the study area were greatly affected from the anthropogenic activities, especially Industrial activities, waste water drains and leakage from sewage system and agriculture activities.

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