© 2015 IJSRSET | Volume 1 | Issue 4 | Print ISSN : 2395-1990 | Online ISSN : 2394-4099
Themed Section: Engineering and Technology

A Comparative Assessment of Water Quality for Pithampur Industrial Area, Indore, India

Dr. Nitin Goyal*, Shailendra Singh, Lalitesh Sinha, Utkarsh Jain

Civil Engineering Department, Indore Institute of Science & Technology, Indore, Madhya Pradesh, India

ABSTRACT

Industrial revolution in the late eighteenth is an important event in the history. On the one hand it ushered an area of modern civilization by catalyzing the industrialization and elevating standard of human life. On the other hand it created some problems for human in shape of pollution, which started exhibiting implications on various aspects of plant and human life.

In the Pithampur Industrial area there is no proper drainage system, which may become a major problem for drinking water contamination in future as number of industries increasing day-by-day. The industries are also having residential areas that generate domestic waste & the discharge was going as such because of no drainage system. A study was conducted to determine the water quality of surface and ground water sources, near a busy industrial area at Indore. Buddhi, et al. (2009) reported that the ground water quality of this industrial area had deteriorated. Similar observations were found in the present study as substantiated by the values of Hardness, Chlorides and Alkalinity. The major problem indicated by the residents was related to health issues and the decline in crop yield.

Finally it was concluded that the Ground water in the sector no. 1 of the Pithampur industrial area was hard and had higher concentration of chlorides. Though, the surface water had relatively less hardness and chloride content. The overall quality of water indicated that these were within the permissible limits, and could be utilized for drinking purpose after suitable treatment.

Keywords: Water Quality, Assessment, pH, Turbidity, DO.

I. INTRODUCTION

Industrial revolution in the late eighteenth is an important event in the history. On the one hand it ushered an area of modern civilization by catalysing the industrialization and elevating standard of human life. On the other hand it created some problems for human in shape of pollution, which started exhibiting implications on various aspects of plant and human life. At present human civilization is facing this problem in the most severe way. Presently the air we breathe, the water we drink, the soil on which our food is grown and overall component of environment is contaminated with different types of pollutants. The problem of water pollution is more specific and serious because it remains localize to certain extent and the possibility of dilution remain low as compared to air pollution. The study area, catering the needs of about 1000 medium & large scale industrial unit (chemical, soya, drug, automobile, polymer & textile industries).

In the Pithampur industrial area there is no proper drainage system, which may become a major problem for drinking water contamination in future as number of industries increasing day-by-day. The industries are also having residential areas that generate domestic waste & the discharge was going as such because of no drainage system.

II. METHODS AND MATERIAL

1. Site Selection for Sampling

Two ground water and two surface water sources were selected based on the preliminary survey and also the accessibility of the sampling sites. These 4 locations were:

a) Mhow Cantonment Pond:

This site was situated near Pithampur Industrial Area about 3 kms away and alongside the highway from Ghatabillod to Mhow. This site was selected as it was near to the pithampur industrial area.

b) Sanjay Jalashay Pond in Sector 1, Pithampur:

This pond was situated in the vicinity of Pithampur Industrial Area and was alongside the Agra – Mumbai National Highway No.3. Large number of industrial establishments was present in the vicinity of this sampling location also indicating a high probability of waste water discharge in the pond.

c) Hand Pump, New Shanti Nagar colony, Sector 1, Pithampur

This hand Pump was in the New Shanti Nagar Colony, Sec. No. 1, Pithampur. This site was representing the Ground water source and was selected because it was near the drains that are used by the industries to dispose the waste water.

d) Well, New Shanti Nagar colony, Sector 1, Pithampur

This well, again representing a ground water source, was situated near to the drain carrying waste water from the industrial area.

2. Sampling Frequency

The samples were collected once at each location, for three continuous weeks, from all the sampling locations simultaneously. Three samples were collected from each location and a total of 12 samples were collected from the four locations. Table 1 shows the sampling dates and sites.

Table -1: Sampling Dates and Sites

Sampling No.	Location 1 Mhow Pond	Location 2 Pithampur Pond	Location 3 Hand Pump	Location 4 Well
Sampling 1st	**April 14, 2015**			
Sampling 2nd	**April 20,2015**			
Sampling 3rd	**April 27,2015**			

3. Analysis Protocols and Lab Methods of Analysis

The following tests were performed in laboratory of the institute.

a) Ph Test

pH was measured on a logarithmic scale between 1 and 14 with 1 being extremely acid, 7 neutral and 14 extremely basic. The largest variety of freshwater aquatic organisms prefers a pH range 6.5 to 8.0. Samples were tested with Universal Indicator and with pH meter.

b) Turbidity

Turbidity is a measure of how the particles suspended in water affect water clarity. It is an important indicator of suspended sediment and erosion levels. Typically it will increase sharply during and after a rainfall, which causes sediment to be carried into the creek. Elevated turbidity will also raise water temperature, lower dissolved oxygen, prevent light from reaching aquatic plants which reduces their ability to photosynthesize, and harm fish gills and eggs. Turbidity of the samples was measured by turbidity meter in NTU.

c) Conductivity

This is a measure of the capability of a solution such as water in a stream to pass an electric current. This is an indicator of the concentration of dissolved electrolyte ions in the water. It doesn't identify the specific ions in the water. However, significant increases in conductivity may be an indicator that polluting discharges have entered the water. Higher conductivity will result from the presence of various ions including nitrate, phosphate, and sodium. Samples were tested in Conductivity meter. The basic unit of measurement for

conductivity is micromhos per centimeter (µmhos/cm) or microsiemens per centimeter (µS/cm). It is a measure of the inverse of the amount of resistance an electric charge meets in traveling through the water. Distilled water has a conductivity ranging from 0.5 to 3 µS/cm, while most streams range between 50 to 1500 µS/cm. Freshwater streams ideally should have Conductivity between 150-500 µS/cm to support diverse aquatic life.

d) Dissolved Oxygen

Dissolved oxygen is oxygen gas molecules (O2) present in the water. Plants and animals cannot directly use the oxygen that is part of the water molecule (H2O), instead depending on dissolved oxygen for respiration. Oxygen enters streams from the surrounding air and as a product of photosynthesis from aquatic plants. Consistently high levels of dissolved oxygen are best for a healthy ecosystem.

Dissolved oxygen was measured in mg/L.

0-2 Mg/L: not enough oxygen to support life.

0-3 2-4 Mg/L: only a few fish and aquatic insects can survive.

0-4 4-7 Mg/L: good for many aquatic animals, low for cold water fish.

0-5 7-11 Mg/L: very good for most stream fish.

Procedure: Sample was taken in DO bottle and then 2 ml of Sodium azide, 2 ml of Magnous Sulphate, 2 ml of Sulfuric acid of normality 98.08 i.e. concentrated H_2So_4 was added and then shaken properly.

Formula used for DO content = (BR x 0.025 x 10 x1000)/ (Sample Taken)

After that 250 ml of sample was taken from DO bottle in conical flask then 2 drops of starch in this sample was added.

Fill Thiosulphate HPo4 solution in burette then the sample was titrated with thiosulphate till the sample turned to colorless or to red color. And the initial and final reading of the burette was taken. The amount of the DO was calculated by following formula:

[Burette reading x N (.025) X 10 X 1000] / [Sample taken]

e) Total Dissolved Solids (TDS)

Total dissolved solids (TDS) are a measure of the combined content of all inorganic and organic substances contained in a liquid in molecular, ionized or micro-granular (colloidal sol) suspended form.

Primary sources for TDS in receiving waters are agricultural and residential runoff, leaching of soil contamination and point source water pollution discharge from industrial or sewage treatment plants.

Procedure: The empty beaker of 50 ml in analytical balance was weighted and noted that as W_1. Beaker was filled with 20 ml of water sample and put that beaker on Hot Plate until the whole water was evaporated. After this beaker was again weighted in analytical balance and noted as W_2.

The difference of these two = TDS in that water sample.

f) Suspended Solids

The floating solids on the surface of water are the suspended solids.

Procedure: 20 ml of water sample was taken in a beaker. Filter paper in analytical balance weighted as W_1 .Folded Filter paper in conical shape to put over flask .Water sample was passed through paper to filter the water. After fully filtration of water, the filter was allowed to dry in Hot Oven. After drying the paper, filter paper was weighted and noted as W_2.

The difference of these two weights was equal to the Suspended solids amount presented.

g) Acidity

Acidity is a measure of a solution's capacity to react with a strong base (usually sodium hydroxide, NaOH) to a predetermined pH value. This measurement is based on the total acidic constituent of a solution (strong and weak acids, hydrolyzing salts, etc.)

Procedure: 20 ml water sample was taken & then 2 drops of Phenolphthaleina, 2 drops of Methyl Orange were addded.The sample was titrated with NaOH (0.2N) till the red color came.

Formula used for Acidity content = (BR x 0.02 x 50 x1000)/ (Sample Taken)

h) Alkalinity

Alkalinity is a measure of the capacity of water to neutralize acids (see pH description). Alkaline compounds in the water such as bicarbonates (baking soda is one type), carbonates, and hydroxides remove H+ ions and lower the acidity of the water (which

means increased pH).Alkalinity is the name given to the quantitative capacity of an aqueous solution to neutralize an acid.

1. Measuring alkalinity is important in determining a stream's ability to neutralize acidic pollution from rainfall or wastewater. It is one of the best measures of the sensitivity of the stream to acid inputs.
2. There can be long-term changes in the alkalinity of rivers and streams in response to human disturbances.
3. Alkalinity does not measure the same property as the pH (namely basicity).

i) Chlorides

Chlorides are widely distributed as salts of calcium, sodium and potassium in water and wastewater. In potable water, the salty taste produced by chloride concentrations is variable and dependent on the chemical composition of water. Chlorides associated with sodium (Sodium Chloride) exert salty taste when its concentration is more than 250 mg/l

Procedure

50 ml sample of water was taken & then 2-3 drops of Potassium chromate indicator was added & then the sample was titrated with AgNo3 (Silver Nitrate) solution till the sample turned to Brick red color.
Formula used for Chloride content = (BR x 0.0141 x 35.45 x 1000)/ (Sample Taken)

j) Hardness

The hardness of water is due to the presence of calcium and magnesium minerals that are naturally present in the water. The usual signs of a hard water supply are scaling inside kettles, poor lathering of soaps and scum. Hard water is formed when water passes through or over limestone or chalk areas and calcium and magnesium ions dissolve into the water.

Procedure: Take 50 ml water sample and add a Pinch of Erocrome Black T indicator & 2-3 ml Ammonium Buffer solution. After that titrate with EDTA (0.02N) till the sample turns to light Blue.

Formula used for Hardness = (BR x 1000)/ (Sample Taken)

III. RESULTS AND DISCUSSION

a) pH

The pH values at all sites were found to be within the limits. Figure 1 shows the average pH values as measured at the sampling locations.

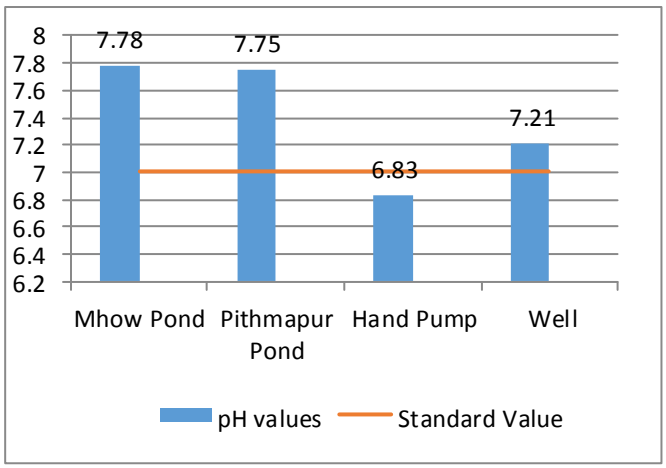

Figure 1: Variation in water Quality – pH

b) Conductivity

Figure 2 shows the average values of the conductivity as measured at the sampling locations. The water (at Well) had lowest conductivity and the water (at Pithampur pond) had the highest conductivity. Overall the conductivity of water at all the sites was found to be within the limits i.e. under the range of the 250 to 500 µS.

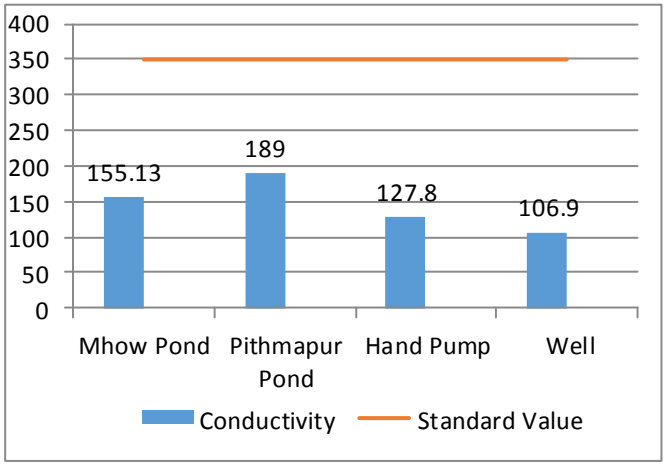

Figure 2 : Variation in water Quality – Conductivity

c) Turbidity

Figure 3 shows the average values of the turbidity as measured at the sampling locations. The well water had

almost zero turbidity and the both the pond had turbidity of 4.5 NTU but the values were under the limit i.e. 5 NTU.

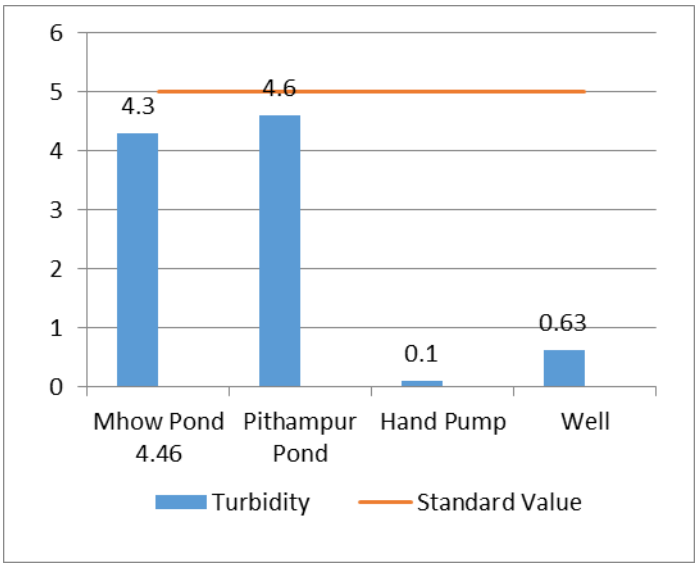

Figure 3: Variation in water Quality – Turbidity

d) Total Dissolved Solids

Figure 4 shows TDS of the water (at Hand Pump) and water (at Mhow Pond) had the same Total Dissolved Solids (TDS).The Pithampur pond had the highest TDS value.

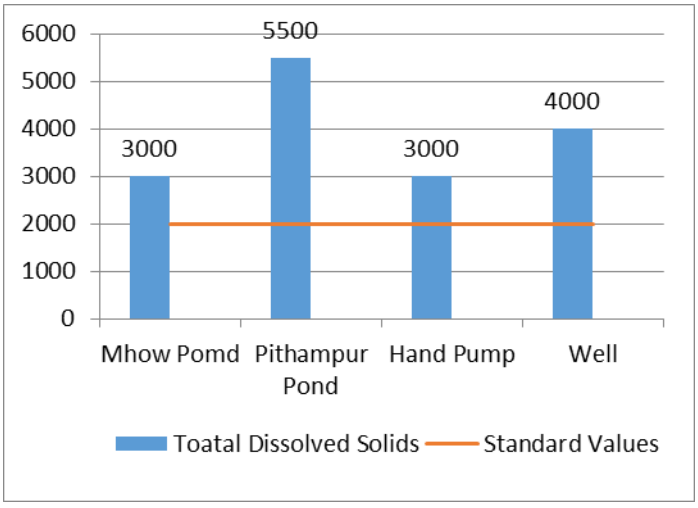

Figure 4: Variation in water Quality – Total Dissolved Solids

All the sites were found to be having value of the TDS above the permissible limits.

e) Suspended Solids

Figure 5 shows the average values of the Suspended solids. Water (at Well) had highest content of SS and the Water (at Mhow pond) had the lowest SS. Overall amount of suspended solids at all the sites were found to be higher than the limit.

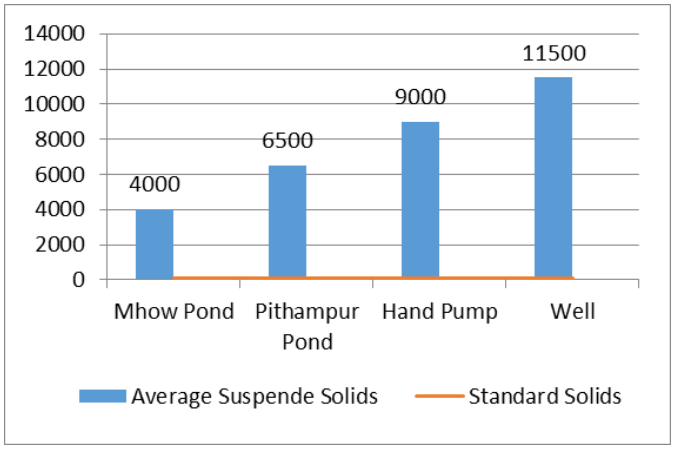

Figure 5: Variation in water Quality – Suspended Solids

f) Hardness

Figure 6 shows the average values of the Total Hardness as measured at the sampling locations. Water (at Well) and Water (at Hand Pump) had hardness of about 3 to 4.5 times the permissible limit. The surface waters i.e. Pithampur and Mhow Pond had the hardness within the permissible limits.

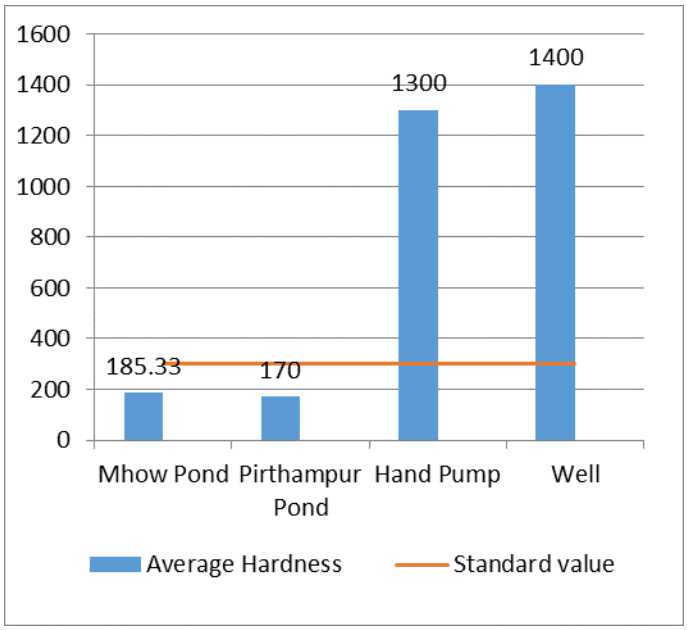

Figure 6: Variation in water Quality – Hardness

g) Chloride

Figure 7 shows the average values of the chloride content. The water (Hand pump) and Well water were having high chlorides. The Hand Pump was having 2.6

times the permissible limits and well was having highest chloride content and also was observed by Buddhi (2009) report. The surface water had less chloride. Pithampur pond had lowest chloride content.

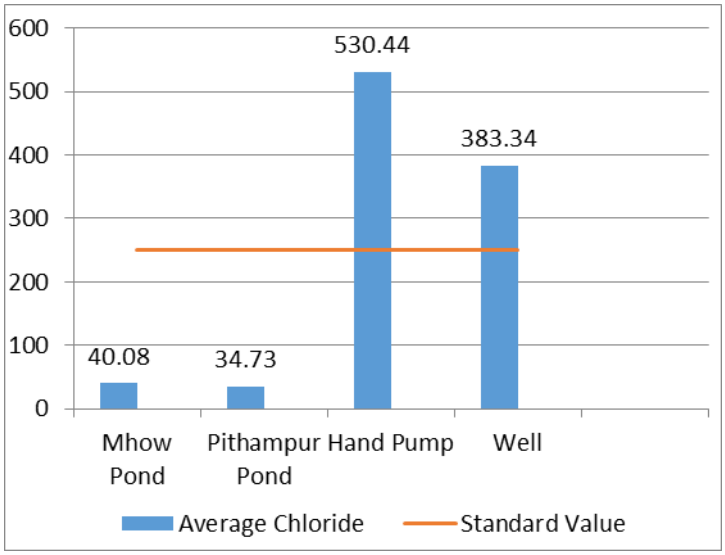

Figure 7: Variation in water Quality – Chloride

h) Acidity

Figure 8 shows the average values of the acidity. The hand pump had the highest value of the acidity. The Pithampur pond was having lowest acidity i.e. 25 ppm among the other sites' values.

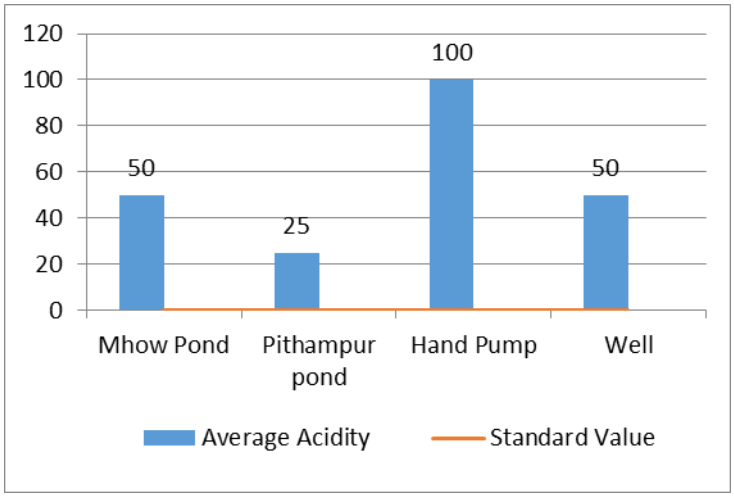

Figure 8: Variation in water Quality – Acidity

i) Alkalinity

Figure 9 shows the average alkalinity values. The Hand pump and the well were found to be having 2.6 to 4 times the permissible value i.e. 200 ppm. Mhow pond was having somewhat more value of alkalinity than the permissible value. Pithampur pond was found to be having less than the limit value.

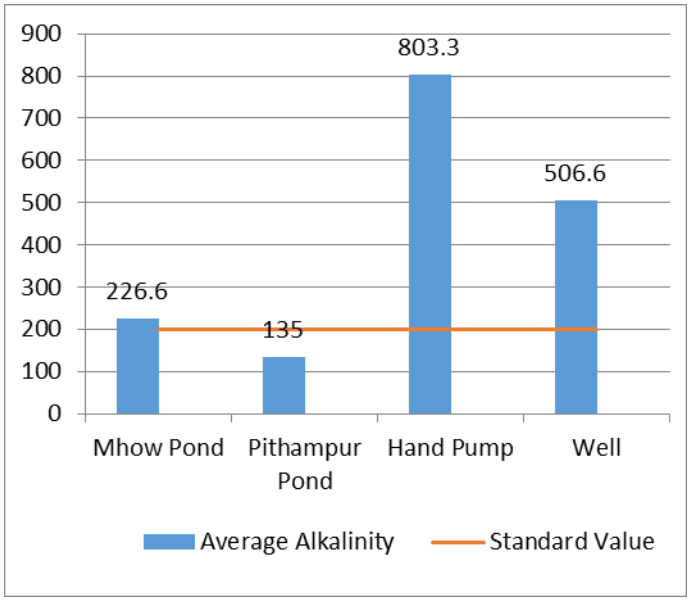

Figure 9: Variation in water Quality – Alkalinity

j) Dissolved Oxygen

Figure 10 shows the D.O. values in average. This parameter in all the sites was having in good amount and more than the permissible limit. But only one site i.e. water (at Well) had less amount of oxygen.

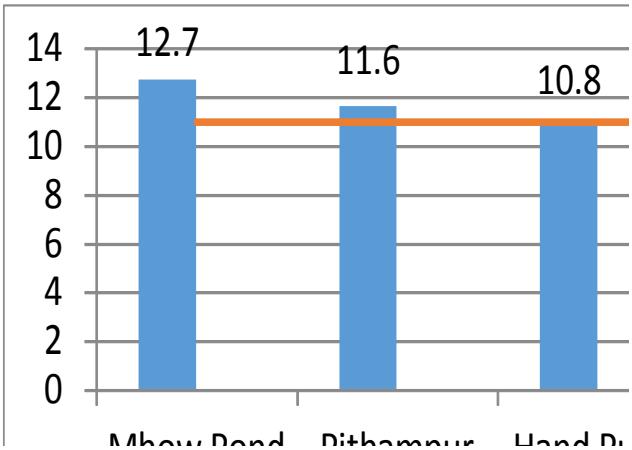

Figure 10: Variation in water Quality – Dissolved Oxygen

Table 2: Results at Site I –Mhow Pond

Parameters	Sample 1	Sample 2	Sample 3	Average	Standard values
pH(ppm)	7.75	7.85	7.76	7.78	6.5-8.5
Conductivity (µS)	153.2	152.3	159.9	155.13	250-500
Turbidity(NTU)	8	2.9	2.5	4.46	5
Tds(ppm)	1000	500	3400	3000	500
SS(gm/20 ml)	0.11	0.05	0.08	0.08	100 ppm
Hardness(ppm)	176	205	175	185.33	300
Chloride(ppm)	32.75	52.5	35	40.08	250
Acidity(ppm)	25	75	50	50	0
Alkalinity(ppm)	135	335	210	226.66	200
D.O.(ppm)	12.7	11.6	10.8	11.7	7-11

Table 3: Result at Site II – Pithampur Pond

Parameters	Sample 1	Sample 2	Sample 3	Average	Standard values
pH(ppm)	7.85	7.8	7.62	7.75	6.5-8.5
Conductivity(µS)	189.3	184.1	193.8	189.0	250-500
Turbidity(NTU)	6	4.4	3.4	4.6	5
Tds(ppm)	500	2000	14500	5500	500
SS(gm/20 ml)	0.03	0.22	0.15	0.13	100
Hardness(ppm)	172	190	150	170	300
Chloride(ppm)	40.69	26.80	36.72	34.73	250
Acidity(ppm)	25	20	30	25	0
Alkalinity(ppm)	40	175	190	135	200
D.O.(ppm)	7.5	15	12	11.5	7-11

Table 4: Results at Site III – Hand Pump

Parameters	Sample 1	Sample 2	Sample 3	Average	Standard values
pH(ppm)	7.22	6.72	6.55	6.83	6.5-8.5
Conductivity(µS)	120	131	132.5	127.8	250-500
Turbidity(NTU)	0	0	0.1	0.03	5
Tds(ppm)	4500	1500	4000	3000	500
SS(gm/20ml)	0.20	0.16	0.18	0.18	100
Hardness(ppm)	1070	1140	1300	1270	300
Chloride(ppm)	800.97	285.86	497.49	530.44	250
Acidity(ppm)	35	140	125	100	0
Alkalinity(ppm)	610	800	1000	803.3	200
D.O.(ppm)	17.5	7.8	10.7	12	7-11

Table 5: Results at Site VI – Well

Parameters	Sample 1	Sample 2	Sample 3	Average	Standard values
pH(ppm)	7.5	7.09	7.00	7.21	6.5-8.5
Conductivity(µS)	100	109.9	111	106.9	250-500
Turbidity(NTU)	0	1.0	0.9	0.63	5
Tds(ppm)	4500	1500	7000	4000	500
SS(gm/20ml)	0.36	0.14	0.20	0.23	100
Hardness(ppm)	2420	3020	1400	2280	300
Chloride(ppm)	349.39	372.25	428.40	383.34	250
Acidity(ppm)	15	60	75	50	0
Alkalinity(ppm)	340	520	640	506.6	200
D.O.(ppm)	6	10	12	9.3	7-11

IV. CONCLUSION

A study was conducted to determine the water quality of surface and ground water sources, near a busy industrial area at Indore. Buddhi, *et al*. (2009) reported that the ground water quality of this industrial area had deteriorated. Similar observations were found in the present study as substantiated by the values of Hardness, Chlorides and Alkalinity.

Hardness of the water (at Hand pump) determined as 1270 ppm which was **4.23** times the standard values. Further, the water (at Well) had a Hardness of 2280 ppm which was **7.6** times the standard value.

Chloride and the alkalinity of the ground water i.e. water of hand pump and the well was found to be above the standard parameters than the standard values. Chlorides content in the water (at Hand pump) and the water (at Well) was determined as 497.5 ppm and 428.4 ppm respectively which were 1.5 - 2 times the standard values.

Further Alkalinity of water of these two sites was determined as 803.3ppm and 506.6ppm respectively which were 4 and about 2.5 times the permissible limit respectively.

The water (at Pithampur pond and the Mhow pond) was not contaminated with the chlorides and the hardness was in the range of the permissible values.

Finally it was concluded that the Ground water in the sector no. 1 of the Pithampur industrial area was hard and had higher concentration of chlorides. Though, the surface water had relatively less hardness and chloride content. The overall quality of water indicated that these were within the permissible limits, and could be utilized for drinking purpose after suitable treatment.

V. REFERENCES

[1] Buddhi, D., Tyagi, P., R.L. Sawhney*** & Richa Kothari, (20XX), "Report on Ground water quality of Pithampur industrial area: Opinion survey of the residents", School of Energy & Environmental Studies, Devi Ahilya University, Khandwa Road, Indore, M.P-452017, India.

[2] Adebayo, I. A. and Adesoji, S. A. (2008) Comparative assessment of the profit margin of catfish reared in concrete tank and earthen pond. African Journal of Agricultural Research 3(10): 677-680.

[3] American Public Health Association (APHA) (1998) Standard method for the examination of water and wastewater. A.P.H.A.16th ed.Washington D.C. : Mc Graw Hill.

[4] Boyd, C.B. (1981) Water Quality in Warm water fish ponds. Auburn University Agricultural Experiment Station, Auburn, USA. 359pp.

[5] Boyd, C.B. (1990) Variation of temperature and biological oxygen demand in fish ponds. Transaction of American Fisheries Society, 102; 606 - 611

[6] Boyd, C. B. (1999) A study of the Physico-Chemical parameters for hydrology and Zooplankton in ponds. Transaction of American Fisheries Society, 105:536-540.

[7] Bronmark, C. and Hansson, L. A. (2005) The biology of lakes and ponds. Oxford University Press, Oxford. 285pp.

[8] Davenport, Y. (1993) Responses of the Blennius pholis to fluctuating salinities. Marine Ecology Progress Series 1:101 – 107.

[9] Abdul-Razak, Asiedu A.B., Entsua-Mensah R.E.M. and DeGraft-Johnson K.A.A., Assessment of the Water Quality of the Oti River in Ghana, West Afr. J. Appl. Ecol., 15, 2009, 45-60.

[10] Yisa J. and Jimoh T., Analytical Studies on Water Quality Index of River Landzu" Am. J. Appl. Sci.,7 (4), 2010, 453-458.

[11] Rao V.S., Prasanthi S., Shanmukha K.J.V. and Prasad K.R.S., Physicochemical analysis of water samples ofNujendla area in Guntur District, Andhra Pradesh, India, Int. J. ChemTech Res., 4 (2), 2012, 691-699.

[12] Rathod S.D., Mohsin M. and Farooqui M., Water Quality Index In & Around Waluj – Shendra Industrial Area Aurangabad. (M.S.), Asian J. Biochem. Pharmaceut. Res., 1(2), 2011, 368-372.

[13] Mehta K.V., Physicochemical and statistical evaluation of groundwater of some places of Deesa taluka in Banaskantha district of Gujarat state (India), Int. J. ChemTech Res., 3(3), 2011, 1129-1134.

[14] Nkansah M.A., Ephrain J.H., Physicochemical Evaluation of the Water From Boreholes Selected From E J and BAK Districts of the Ashanti Region of Ghana, Thammasat Int. J. Sc. Tech., 14(3), 2009, 64-73.

[15] Bhuvana J.P. and Ramesh K., Water Quality Index For Assessment Of Water Quality In South Chennai Coastal Aquifer, Tamil Nadu, India, Int. J. ChemTech Res., 4(4), 2012, 1582- 1588.

[16] Agarwal A. and Saxena M., Assessment of pollution by Physicochemical Water Parameters Using Regression Analysis: A Case Study of Gagan River at Moradabad-India, Adv. Appl. Sci. Res., 2 (2), 2011, 185 -189.

[17] Kumar S.S. and Ravichandran S., Ground Water Quality Assessment in Cheyyar Region, Int. J. ChemTech Res., 3(3), 2011, 1060-1063.

[18] Chaurasia N.K. and Tiwari R.K., Effect of industrial effluents and wastes on physico- chemical parameters of river Rapti, Adv. Appl. Sci. Res., 2(5), 2011, 207-211.

[19] Sen S., Paul M.K. and Borah M., Study of some Physico-Chemical Parameters of Pond and River water with reference to Correlation Study, Int. J. ChemTech Res., 3(4), 2011, 1802-1807.

[20] Chauhan N. B. and Thakor F. J., A Study of Water Quality Index (W.Q.I) of Heranj Lake, Dist. Kheda – Gujarat, Asian J. Exp. Biol. Sci., 3(3),2012, 582-588.