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Water Quality Status Near Kalindi Vihar Colony, Tedi Bagiya, Agra, Uttar Pradesh, India.

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----------**Abstract**----------
A study was carried out in Agra of UP (India). The water quality status of Kalindi Vihar colony was assessed under the influence of urbanization. Physic- chemical and biological analysis of water reflected values of water supplied to the resident of the colony. The values of sulphate, TDS was very high. Water was very hard needs to be treated. The values of fluoride, iron, arsenic and heavy metals are within desirable limit for most of the samples. In general, water in the area is acceptable to a certain limit only and needs to be further treated before being supplied to houses especially for drinking purposes.

Keywords: *Water, Surface Water, Ground Water, Water Quality.*

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I. Introduction:

The research site is located in the district of Agra in the state of Uttar Pradesh, India. The site is located near Kalindi Vihar, Tedi Bagiya on the outskirts of the city of Agra.

1.1 Agra : formerly known as Akbarabad is a city on the banks of the river Yamuna in the northern state of Uttar Pradesh, India, 363 kilometer west of state capital, Lucknow and 200 kilometers south from national capital New Delhi. The modern city of Agra was founded way back in the 16th century by Sikandar Lodhi, who was a king of the Lodhi dynasty. In geographical terms, the city of Agra lies between 26°44' N to 27°25'N and 77°26'E to 78°32'E. The city is located at an average altitude of 171 meters or 561 feet above the sea level. Agra features a semiarid climate that borders on a humid subtropical climate. The city features mild winters, hot and dry summers and a monsoon season. It is one of the most populous cities in Uttar Pradesh and the 19th most populous in India. Agra district population grew by 21% in the decade 2001-2011 and 31% in the decade 1991–2001. Roughly 57% of the population of Agra district lives in urban areas. On the basis of landmass, Agra is the third largest city in the state of Uttar Pradesh. Because 80 percent of the city's sewage flows into Yamuna River, it is 20th most polluted city in India. Agra Airport (Kheria Airport) is about 12.5 km from city center. Agra is on the central train line between Delhi and Mumbai (Bombay) and between Delhi and Chennai. Agra is famous for its Historical monuments like Taj Mahal, Agra Fort, Sikandra, Fatehpur sikri, etc. and also petha (a sweet dish). Large number of Tourists both Indian's and Foreigner's visit Agra every day.

1.2 Research Site: As mentioned above the site is located on the outskirts of the city. The geographical location of the work site is about 27°22'N, 78°08'E. The Site is located near NH 2 (towards Tundla) which connects Agra to Kanpur. From Aligarh it is about 80 km and it takes about 2 hrs to reach the site travelling on NH 93 which connects Agra to Aligarh. At proposed work site, EWS (Economically Weaker Section) Houses are to be constructed for economically backward section of society. This Project comes under the proposed Welfare Scheme of "Manyawar Shri Kanshiram Ji Shahri Garib Awas Yojna" undertaken by the erstwhile Government of Uttar Pradesh led By Shrimati Mayawati Ji. The work is being handled by U.P. Housing & Development Board under the supervision of Agra Development Authority. The site is an extension of Kalindi Vihar Yojana of Agra Development Authority, under Sector – H. Under the proposed work, 337 houses are to be built.

Figure 1.1 Aerial Photograph of Research Work Site.

1.3 Objective of Study: Research work included finding out possible location of sources of water in the area, testing of the water quality, comparison of those values with Standards specified by the government. Proposal of water treatment technologies depending upon the results of water quality tests carried out in the whole area.

II. Water Quality Parameters:

Public, in general, judges the quality of water supplied based on its appearance, taste and odor at the point of its use. Although appearance, taste, odor etc., are useful indicators of the quality of drinking water, their presence may not necessarily make water unsafe to drink. In the same way, the absence of any unpleasant qualities does not guarantee water to be safe for consumption. True that drinking water should be aesthetically pleasing, ideally looking clear, colorless and well aerated with no unpalatable taste and odor. However, suitability in terms of public health is determined by microbiological, physical, chemical and radiological characteristics. Of these, the most important is microbiological quality. Also a number of chemical contaminants (both organic and inorganic) are found in water. These cause health problems in the long run and, therefore, detailed analyses are warranted. The drinking water, thus, should be:

- Free from pathogenic (disease causing) organisms.
- Clear (with low turbidity and little color).
- Not saline (salty in taste).
- Free from offensive taste or smell.
- Free from compounds that may have adverse effects on health or harmful in long term.
- Free from chemicals that cause corrosion of water supply system or stain clothes washed using it.To ensure safe drinking water, detailed quality standards for physical, chemical, microbiological and radiological characteristics of water have been proposed by different countries and international organizations. These guidelines provide the following information for water authorities, health officials, and consumers:
- Day-to-day operational value to ensure that the supplied water does not carry any significant risk to the consumer.
- A basis for planning and designing water supply schemes.
- Assessment of long-term trends of the performance of the system.

III. Laboratory Analysis Of Water Quality: Materials & Methods:

After initial survey of the site, following notable features were found out:

a) Source of water: Ground water b) Mode of water: Bore – well

3.1 Sampling: The water samples were brought from the Agra and analyzed for different parameters in the Environmental engineering laboratory of Civil engineering department, Z.H.C.E.T, Aligarh Muslim University, Aligarh, Uttar Pradesh, India. Dark plastic bottles of 2 liters capacity each with a stopper were used for collecting samples. Each bottle was washed with 2% Nitric acid and then rinsed three times with distilled water. The bottles were then preserved in a clean place. The bottles were filled leaving no air space, and then the bottle was sealed to prevent any leakage and stored in a cool place. Each container was clearly marked with the name, location and date of sampling.

3.2 Sampling Points: After initial survey of the site, the study area was divided suitably into four parts depending upon the location of source of water. Thus a total of four samples were taken from the whole area from the location of source of water randomly. In the first week of sampling, samples from two points were

taken in two bottles of 2 liters each. Similarly in next week, samples from the other two points were taken in two bottles of 2 liters each. The exact points of location of samples are mentioned and shown in figure below.

1. Near the under construction area of EWS houses
2. Near the Electric Sub station
3. From akhara situated near the main road connecting NH 93 to NH 2
4. At the midpoint of service road and Nallah.

At all the sampling point's source was ground water and mode of water was bore – well.

Figure 3.1 Aerial Photograph showing the Location of Sampling Points

3.3 Water Quality Parameters tested in the laboratory: Following parameters were tested in the laboratory:
3.3.1 pH
3.3.2 Turbidity: Nephelometer Method
3.3.3 Temperature
3.3.4 Sulphate: Nephelometer Method
3.3.5 Alkalinity
3.3.6 Total Hardness: EDTA Titration Method
3.3.7 Dissolved Oxygen, DO: Winkler Azide modified Titrimetric Method
3.3.8 Biochemical Oxygen Demand BOD: Winkler Azide modified Titrimetric Method
3.3.9 Chloride: Argentometric Titration Method
3.3.10 Total Solids
3.3.11 Chemical Oxygen Demand COD: Closed Reflux Titrimetric Method
3.3.12 Fluoride: SPANDS Spectrophotometric method using HACH instrument DR 5000 Method no. 8029
3.3.13 Nitrate: Spectrophotometer Method using HACH DR 5000 series, Method 8039, Cadmium Reduction Method, Powder pillows.
3.3.14 Iron: Spectrophotometer Method using HACH DR 5000 series, Method 8146, 1, 10 Phenanthroline Method, Powder pillows.

IV. Results:

After carrying out various tests for the parameters of water quality mentioned in previous chapter, following results were obtained. The results of analysis are presented in a tabular form for each of the sample collected.

Table 4.1 Water Quality Result Sample 1

S.No.	Parameter	Value
1	pH	7.10
2	Temperature	28°C
3	Turbidity	3 NTU
4	Dissolved Oxygen D.O.	3 mg/l
5	Total Alkalinity	**400 mg/l**
6	Biochemical Oxygen Demand BOD	**5 mg/l**
7	Chemical Oxygen Demand COD	**19.2 mg/l**
8	Total Dissolved Solids	**2400 mg/l**
9	Total Hardness	**440 mg/l**
10	Calcium Ions Ca^{++}	108 mg/l
11	Magnesium Ions Mg^{++}	41.3 mg/l
12	Chloride Cl^-	**769.8 mg/l**
13	Sulphate SO_4^{2-}	**432 mg/l**
14	Fluoride F^-	0.83 mg/l
15	Nitrate NO_3^{2-}	4.3 mg/l
16	Iron Fe	0.1 mg/l

Table 4.2 Water Quality Result Sample 2

S.No.	Parameter	Value
1	pH	7.18
2	Temperature	28.5°C
3	Turbidity	3 NTU
4	Dissolved Oxygen D.O.	2.5 mg/l
5	Total Alkalinity	**420 mg/l**
6	Biochemical Oxygen Demand BOD	**5 mg/l**
7	Chemical Oxygen Demand COD	**6.4 mg/l**
8	Total Solids	**2500 mg/l**
9	Total Hardness	**390 mg/l**
10	Calcium Ions Ca^{++}	96 mg/l
11	Magnesium Ions Mg^{++}	36.5 mg/l
12	Chloride Cl^-	**757.2 mg/l**
13	Sulphate SO_4^{2-}	**424 mg/l**
14	Fluoride F^-	0.84 mg/l
15	Nitrate NO_3^{2-}	4.4 mg/l
16	Iron Fe	0.23 mg/l

Table 4.3 Water Quality Result Sample 3

S.No.	Parameter	Value
1	pH	7.12
2	Temperature	28.3°C
3	Turbidity	4 NTU
4	Dissolved Oxygen D.O.	4.5 mg/l
5	Total Alkalinity	**380 mg/l**
6	Biochemical Oxygen Demand BOD	**10 mg/l**
7	Chemical Oxygen Demand COD	**32 mg/l**
8	Total Dissolved Solids	**2600 mg/l**
9	Total Hardness	**410 mg/l**
10	Calcium Ions Ca^{++}	112 mg/l
11	Magnesium Ions Mg^{++}	31.6 mg/l
12	Chloride Cl^-	**914.8 mg/l**
13	Sulphate SO_4^{2-}	**360 mg/l**
14	Fluoride F^-	1.02 mg/l
15	Nitrate NO_3^{2-}	6.5 mg/l
16	Iron Fe	0.3 mg/l

Table 4.4 Water Quality Result Sample 4

S.No.	Parameter	Value
1	pH	7.20
2	Temperature	29°C
3	Turbidity	5 NTU
4	Dissolved Oxygen D.O.	3.5 mg/l
5	Total Alkalinity	**420 mg/l**
6	Biochemical Oxygen Demand BOD	**12 mg/l**
7	Chemical Oxygen Demand COD	**45 mg/l**
8	Total Dissolved Solids	**3000 mg/l**
9	Total Hardness	**520 mg/l**
10	Calcium Ions Ca^{++}	140 mg/l
11	Magnesium Ions Mg^{++}	41.3 mg/l
12	Chloride Cl^-	**1039.8 mg/l**
13	Sulphate SO_4^{2-}	**592 mg/l**
14	Fluoride F^-	1.13 mg/l
15	Nitrate NO_3^{2-}	2.1 mg/l
16	Iron Fe	0.4 mg/l

V. Comparison

The following graphs gave better illustration of the results obtained during the analysis of water. Here the results obtained are graphically compared for various water quality parameters against desirable and maximum permissible limits specified by BIS.

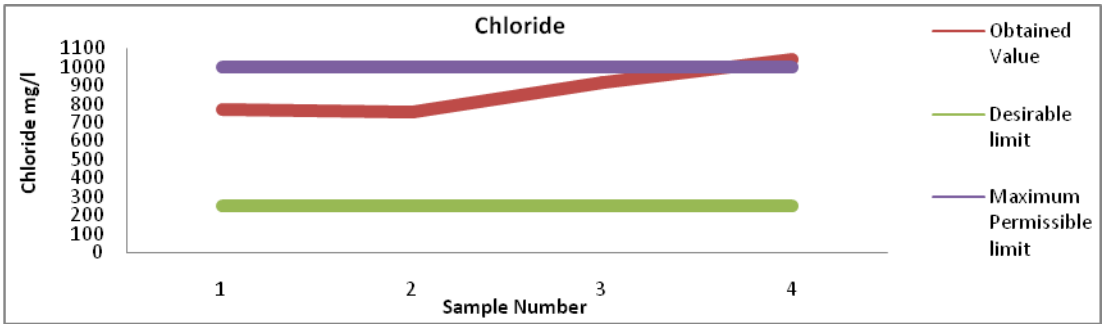

Figure 5.1 Graph between Sample's (Sample Number) v/s Chloride (mg/l)

This graph shows that values obtained for sample's 1, 2, 3 were within maximum permissible limit, but for sample 4 the value was above the maximum limit.

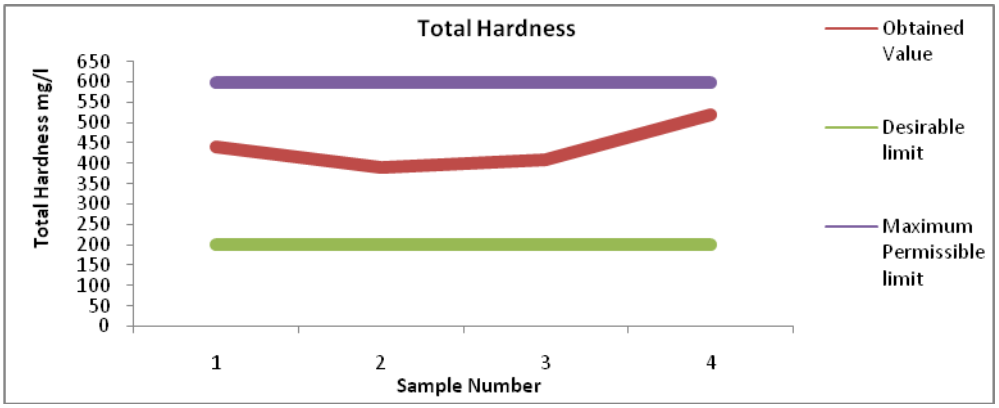

Figure 5.2 Graph between Sample's (Sample Number) v/s Total Hardness (mg/l)

This graph shows that values obtained for all the samples were within maximum permissible limits, but the values are high and the water is very hard.

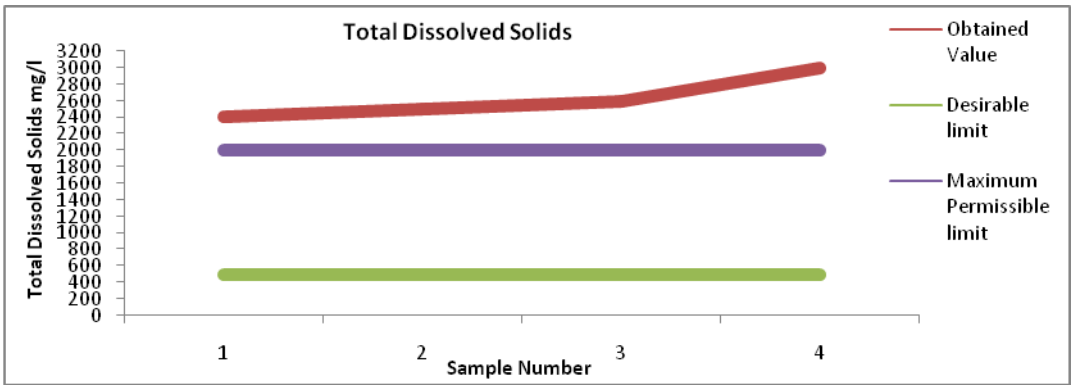

Figure 5.3 Graph between Sample's (Sample Number) v/s Total Dissolved Solids (mg/l)

This graph shows that values obtained for all the samples were well above maximum permissible limits, this shows that water is polluted there and it needs to be treated.

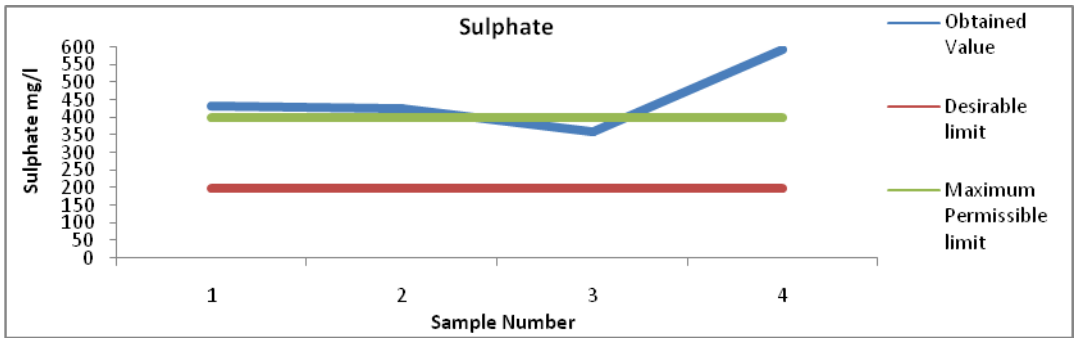

Figure 5.4 Graph between Sample's (Sample Number) v/s Sulphate (mg/l)

This graph shows that the values for samples 1, 2 and 4 were well above the maximum permissible limits and value for sample 3 is just below the maximum permissible limit. It proves that sulphate concentration in water is quite high in the area.

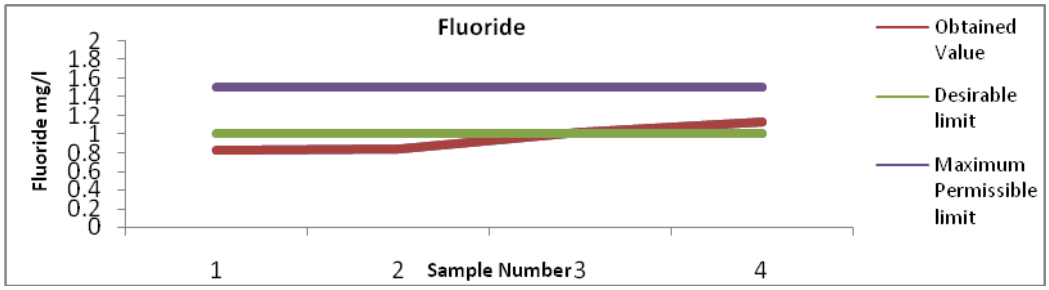

Figure 5.5 Graph between Sample's (Sample Number) v/s Fluoride (mg/l)

This graph shows that the value of Fluoride in water is well below maximum permissible limit and for sample 1 and 2; the value is also below desirable limit.

VI. Conclusion:

Most of the values for various water quality parameters found are below desirable limit to render water as acceptable. But at few places, the values are more than the desirable limit. However at few places, the values are found below maximum permissible limit to render water acceptable after slight modification or treatment. There is no major variation in the values of pH, Temperature, Turbidity, DO, BOD, Total Alkalinity, Magnesium, Iron for the whole area. But as far as values of other parameters are concerned like Total hardness, Total Dissolved Solids, Fluoride, Calcium, Chloride, Sulphate, COD, Nitrate there is considerable variation in the values obtained for the whole area. pH, Temperature, Turbidity of all the samples were within desirable limits. As far as Values of BOD are concerned, sample's 1, 2, 3 are within maximum permissible limits. The value of DO for the area is also less. In the present study area, Phenolphthalein Alkalinity was absent from all the samples which indicates absence of Hydroxyl and carbonate ions and presence of bicarbonate ions. Value of Chloride is high, more than desirable limit and for the sample 4 it is more than maximum permissible limit.

Value of Sulphate is very high almost unacceptable for all the samples collected from the area, barring sample 3 where it is just below the maximum permissible limit. Water is very hard and needs to be treated. Value of TDS is also very high and is unacceptable for all the samples and needs to be properly treated. Value of Fluoride, Iron is within desirable limit for most of the samples. Arsenic is absent from water, which indicates in general the absence of most of the heavy metals and highly poisonous ions from water. In general, water in the area is acceptable to a certain limit only and needs to be further treated before being supplied to houses especially for drinking purposes. The treatment of water should involve such a scheme that would effectively, efficiently remove / reduce TDS, hardness, alkalinity, sulphate, and chlorides to render water suitable for public use. The high values obtained for TDS, Alkalinity, Hardness, Chloride and Sulphate can be attributed to the location of Municipal Solid Waste Landfill (Sharda Landfill) in the vicinity of the site.

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