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ISSN 2277 - 5730
AN INTERNATIONAL MULTIDISCIPLINARY
QUARTERLY RESEARCH JOURNAL

AJANTA

Volume - VIII Issue - I January - March - 2019

English Part - X

Peer Reviewed Refereed
and UGC Listed Journal

Journal No. 40776

IMPACT FACTOR / INDEXING
2018 - 5.5
www.sjifactor.com

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❖ PUBLISHED BY ❖

Ajanta Prakashan
Aurangabad. (M.S.)

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20. Chloride and Residual Chlorine: Agents of Pollution Observed During Analysis of Water from Jalna District

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Abstract

Paper discusses hazards of chlorine while performing Physico-Chemical analysis of water from Jalna district. The highlight is on chloride and residual chlorine containment of water. This study analyses major areas of Jalna district giving statistical results. Paper gives analysis performed on the data collected after experimentation.

Keywords: Chlorine. Residual Chlorine. Industrial waste. Physico-Chemical analysis. Water

1. Introduction

Pesticides contamination to water systems has received particular attention during these last few years. More than 700 pesticides are approved for use around the world, many of which are suspected to endocrine disrupts [1]. Other pesticides, though no longer used, persist in the environment where they bioaccumulation in the flora and fauna. If the compounds are present only in very low concentrations, they are hazardous because some species of aquatic life are known to concentrate 100-fold or more. High concentrations of herbicides flushed with surface water during spring runoff may adversely affect the growth and survival of aquatic plants, which are essential food sources and breeding grounds for aquatic organisms [2]. Major objective of WHO is, to find out strategies and analytical tools for rapid monitoring of water pollution. This has accelerated research activities of environmental scientists to find out analytical tools, model and method. The main threats to human health from heavy metals are associated with exposure to lead, cadmium, copper, nickel etc. [3]

About 25 million people in 8700 villages in India are using ground water having fluoride concentration more than 1.5 mg/L. In skeletal flourosis, high dose of fluoride replaces bone calcium fluoride, bones become soft, crumble and chalky white. Maximum effects of fluoride are detected in

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the neck, knee, pelvic, shoulder joints, small joints of the hands and feet. In children dental flourosis is observed but skeletal manifestations are not observed. In old age patients, disease like osteoporosis, rheumatoid arthritis etc are chief causes of knee joint affection. In young patients, flourosis is chiefly responsible for knee joint problem [4].

Eight places in Jalna district, S1- Ambad, S2- Ghansawangi, S3-Badnapur, S4-Bhokardan, S5-Partur, S6-Jafrabad, S7-Jalna City and S8-Mantha tehsils were selected for collection of water samples. Water samples were collected every month from each site in bottles of 5 litters as per APHA standards [5]. All chemicals used for experimentation are A. R. grade. Standard methods were adopted for collection, preservation and analysis of water.

2. Source of water

Atmospheric Water: Rain water and water formed by snow are grouped under of atmospheric water. At the time rain or snow falls it brings down all dust particles and other suspended particles to the ground. It also brings down the bacteria present in air [6].

Surface Water: Surface water is water on the surface of continents such as in a river, lake, or wetland. It can be contrasted with groundwater and atmospheric water. Non-saline surface water uses is replenished by precipitation and by recruitment from ground-water. It is lost through evaporation, seepage into the ground where it becomes ground-water, used by plants for transpiration, extracted by mankind for agriculture, living, industry etc. or discharged to the sea where it becomes saline [7].

Stored Water: Water storage is a broad term referring to storage of both potable water for consumption and non potable water for use in agriculture. In both developing countries and some developed countries found in tropical climates, there is a need to store potable drinking water during the dry season. In agriculture water storage, water is stored for later use in natural water sources, such as groundwater aquifers, soil water, natural wetlands, and small artificial ponds, tanks and reservoirs behind major dams. Storing water invites a host of potential issues regardless of that waters intended purpose, including contamination through organic and inorganic means [8].

3. Need of Analysis

Water chemistry analyses are carried out to identify and quantify the chemical components and properties of water samples. The type and sensitivity of the analysis depends on the purpose of the analysis and the anticipated use of the water. Chemical water analysis is carried out on water used in industrial processes, on waste-water stream, on rivers and stream, on rainfall and on the sea. In all cases the results of the analysis provides information that can be used to make decisions or to provide re-assurance that conditions are as expected [9].

4. Origin of Water Pollutants

Human activity is primarily responsible for water pollution, even if natural phenomenon - such as landslides and floods - can also contribute to degrade the water quality. Inadequate sewage collection and treatment are sources of water pollution. According to the United Nations, more than 80% of the worldwide wastewater goes back in the environment without being treated or reused. Even though it does not have a direct impact on water quality, urbanization and deforestation have a lot of indirect effects [10]

5. Sources of Water Pollutants

Natural Sources: The natural sources are storm, wash and seepage from groundwater's, swamp drainage and aquatic life of the streams. Natural rainwater has an approximate pH 5.6. However, during the last 25 years reports from many developed countries have indicated that rain water has much higher acidity. This has brought about by strong acid formed from sulphur dioxide and nitric acid from nitrogen oxides, and probably hydrofluoric acid from fluoride. [11].

Domestic Sewage: Normally the sewerage system serves the business and commercial areas, residential area and industrial area. The extent to which this system services the city and its surrounding sub-urban and industrial fringe is a measure of controllable source. The discharge of huge amount of municipal and household wastes into rivers and rivulets (or Nullahs) is one of the major sources of pollution of our water bodies. Most sewerage systems mainly contain human and animal wastes. [12]

Agricultural Waste: Chemical fertilizers, pesticides and herbicides are of increasing significance as a source of pollution. The rapidly increasing use of inorganic fertilizers, especially the readily soluble nitrogenous salts, has led to nutrient enrichment of many of our water bodies. This kind of agriculture drainage encourages algal growths and contaminates drinking water particularly with nitrates. Pesticides and fungicides from agricultural runoff when taken in by fish and other aquatic organisms become concentrated in the bodies of organisms, higher in the food-feb. [13].

Industrial Waste: Today industry contributes more water pollution than do household users. The major industrial pollutants are the chemicals, metals, paper and food industries etc. Wastes from industries such as pulp mills, leather work, tanneries, sugar mills, oil refineries, jute mills, coal washeries, petroleum and chemical fertilizer plants are mostly complex organic compounds. [14].

6. Parameters as Indices of Water Quality

Chlorides

The estimation of chloride of all the sample have been made by the Argentometric method by titrating samples against standard silver nitrate solution using potassium chromate solution. Silver nitrate reacts with chloride to form very slightly soluble white precipitate of AgCl. At the end point when all the chlorides gets precipitated free silver ions react with chromate to form silver chromate of reddish brown colour [15]. The results have been expressed as 'Cl⁻' in ppm

$$\text{Chloride mg/L} = \frac{(\text{ml} \times \text{Normality}) \text{ of } AgNO_3 \times 1000 \times 50}{\text{ml of sample}}$$

A Mohr's method was used for the estimation of chloride. A known volume of sample was taken in a conical flask K_2CrO_3 was added as indicator and titrated against standard $AgNO_3$ solution till a brick red precipitate obtained

Residual Chlorine

Chlorine is a relatively cheap and readily available chemical that, when dissolved in clear water in sufficient quantities, will destroy most disease causing organisms without being a danger to people. The chlorine, however, is used up as organisms are destroyed. If enough chlorine is added, there will be some left in the water after all the organisms have been destroyed, this is called free chlorine. Free chlorine will remain in the water until it is either lost to the outside world or used up destroying new contamination. Therefore, if we test water and find that there is still some free chlorine left, it proves that most dangerous organisms in the water have been removed and it is safe to drink. We call this measuring the chlorine residual. Measuring the chlorine residual in a water supply is a simple but important method of checking that the water that is being delivered is safe to drink

7. Experimentation

Table 1: Variation in Chloride Analysis of samples collected from all site

Sr No	Month	Chloride mg/l							
	Sample Site =>	S1	S2	S3	S4	S5	S6	S7	S8
1	Oct-16	120.00	160.00	156.00	290.00	100.00	220.00	120.00	60.00
2	Nov-16	88.00	228.00	152.00	160.00	70.00	140.00	112.00	40.00
3	Dec-16	200.00	116.00	160.00	160.00	136.00	160.00	244.00	80.00

4	Jan-17	192.00	100.00	152.00	172.00	116.00	240.00	219.00	90.00
5	Feb-17	220.00	121.00	130.00	160.00	100.00	110.00	102.00	104.00
6	Mar-17	80.00	136.00	142.00	144.00	132.00	376.00	254.00	60.00
7	Apr-17	192.00	136.00	139.00	154.00	140.00	295.00	95.00	60.00
8	May-17	154.00	142.00	129.00	142.00	141.00	152.00	215.00	64.00
9	Jun-17	200.00	104.00	124.00	154.00	125.00	140.00	217.00	68.00
10	Jul-17	112.00	168.00	120.00	126.00	133.00	160.00	261.00	59.00
11	Aug-17	132.00	121.00	199.00	120.00	104.00	80.00	235.00	62.00
12	Sep-17	125.00	64.00	104.00	140.00	102.00	130.00	256.00	120.00
13	Oct-17	80.00	556.00	100.00	132.00	100.00	180.00	152.00	100.00
14	Nov-17	464.00	84.00	104.00	150.00	90.00	90.00	124.00	100.00
15	Dec-17	156.00	112.00	168.00	80.00	80.00	70.00	100.00	80.00
16	Jan-18	156.00	104.00	116.00	80.00	110.00	120.00	104.00	80.00
17	Feb-18	132.00	44.00	154.00	90.00	130.00	100.00	104.00	90.00
18	Mar-18	24.00	128.00	144.00	180.00	112.00	80.00	132.00	80.00
19	Apr-18	120.00	28.00	140.00	100.00	100.00	80.00	160.00	87.00
20	May-18	141.00	100.00	100.00	100.00	105.00	90.00	272.00	83.00
21	Jun-18	200.00	104.00	116.00	100.00	103.00	140.00	245.00	80.00
22	Jul-18	112.00	168.00	120.00	110.00	106.00	160.00	256.00	80.00
23	Aug-18	132.00	120.00	117.00	120.00	112.00	80.00	256.00	80.00
24	Sep-18	125.00	64.00	104.00	140.00	110.00	130.00	256.00	120.00

The overall average of Chloride is 135.19 mg/l varying from 101.88 mg/l to 175 mg/l. The month-wise variation shows maximum 556 mg/l in the month of Aug-17 at site S2 and minimum 24 mg/l in Jan-18 at site S1 were observed as per fig 4.9 and fig 4.10. Chloride ranges between 24-556 mg/l. The maximum value of chloride 556 mg/l was reported in the well sample of industrial colony.

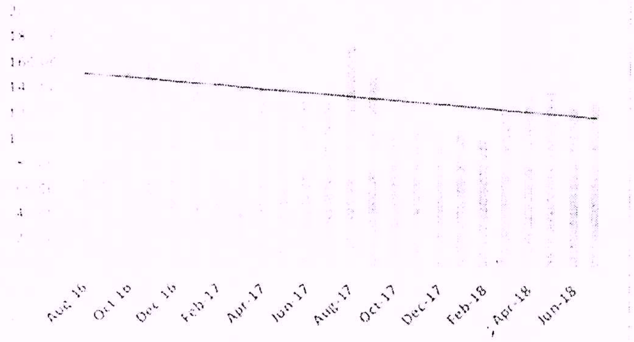

Fig 1: Linear regression representation of data for Chloride

Chloride content in samples at all the sites throughout the study period shows a linear relation of regression

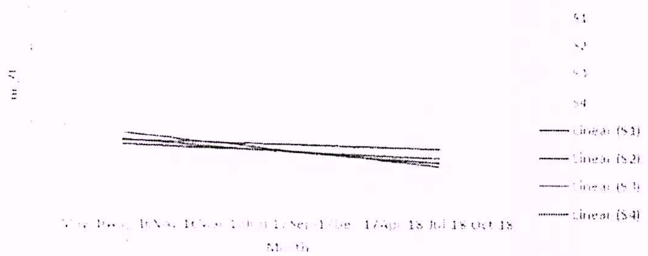

Fig 2: Chloride in water sample collected from sites S1, S2, S3 & S4

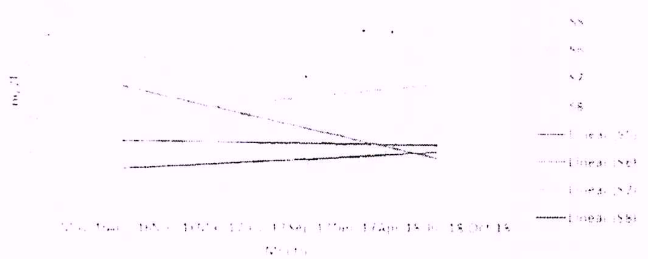

Fig 3: Chloride in water sample collected from sites S5, S6, S7 & S8

Abnormal concentrations of Chloride are in ranges: 57 to 13,652 mg/l, were found in groundwater, and one possible source might be the tannery, where common salt was used as a raw material. The Chloride values were very high in the various locations close to the residential areas and also in places, where the density of tannery was significant. Linear regression relations are shown in fig 2 and fig 3 for different sample sites.

Table 2: Variation in Residual Chlorine Analysis of samples collected from all site

Sr No	Month	Residual Chlorine (RC) mg/l							
Sample Site =>		S1	S2	S3	S4	S5	S6	S7	S8
1	Oct-16	0.30	0.30	0.60	0.30	0.30	0.40	0.30	0.30
2	Nov-16	0.30	0.50	0.30	0.30	0.30	0.40	0.30	0.30
3	Dec-16	0.50	0.30	0.30	0.30	0.30	0.40	0.30	0.30
4	Jan-17	0.30	0.50	0.30	0.30	0.30	0.40	0.30	0.30
5	Feb-17	0.30	0.30	0.50	0.30	0.30	0.40	0.30	0.50
6	Mar-17	0.30	0.30	0.60	0.30	0.30	0.30	0.30	0.30
7	Apr-17	0.60	0.50	0.30	0.30	0.50	0.30	0.30	0.30
8	May-17	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
9	Jun-17	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
10	Jul-17	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
11	Aug-17	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
12	Sep-17	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
13	Oct-17	0.30	0.30	0.60	0.30	0.30	0.40	0.30	0.30
14	Nov-17	0.30	0.50	0.30	0.30	0.30	0.40	0.30	0.30
15	Dec-17	0.50	0.30	0.30	0.30	0.30	0.40	0.30	0.30
16	Jan-18	0.30	0.50	0.30	0.30	0.30	0.40	0.30	0.30
17	Feb-18	0.30	0.30	0.50	0.30	0.30	0.40	0.30	0.50
18	Mar-18	0.30	0.30	0.60	0.30	0.30	0.30	0.30	0.30
19	Apr-18	0.60	0.50	0.30	0.30	0.50	0.30	0.30	0.30
20	May-18	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
21	Jun-18	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
22	Jul-18	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
23	Aug-18	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
24	Sep-18	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30

Fig 4 Linear regression representation of data for Chloride

Residual Chlorine values in samples from all the sites throughout the study period shows constant and in permissible limits. Linear relation of regression was observed.

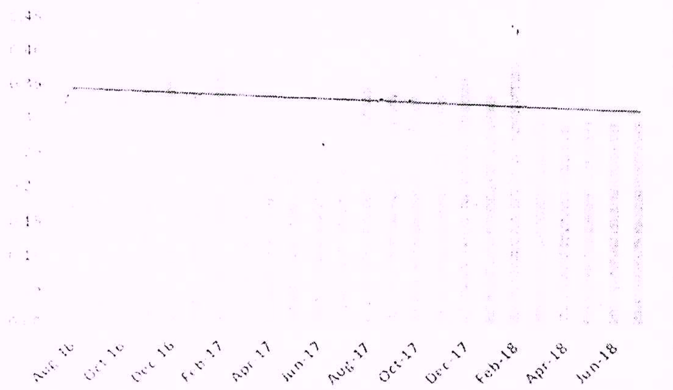

Fig 5: Residual Chlorine in water sample collected from sites S1, S2, S3 & S4

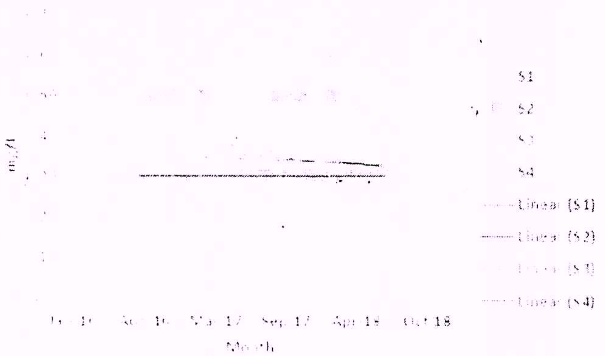

Fig 6: Residual Chlorine in water sample collected from sites S5, S6, S7 & S8

Residual chlorine (RC) is the low level amount of chlorine remaining in the water after a certain period or contact time after its initial application. It constitutes an important safeguard against the risk of subsequent microbial contamination after treatment—a unique and significant benefit for public health. Total RC of the present study varies from 0.3 mg/l to 0.6 mg/l. In all of the data, RC maximum is 0.6 mg/l and minimum is 0.3. As per fig. 5 and fig 6 overall RC value of water lies in the permissible range

8. Conclusion

Water analysis of Jalna revealed that, water collected doesn't comply with BIS standards. The result shows residual chlorine level can be reduced as improvement. If we neglect this contamination, big health hazards can be seen in long run. So it is concluded that pollution check is required and that water for domestic and drinking purposes is required to be purified to a substantial degree of purification before being used

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