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STUDY OF WATER QUALITY IN SLUM AREAS OF BHOPAL CITY WITH SPECIAL REFERENCE TO CURRENT STATUS OF DOMESTIC WATER QUALITY & HYGIENE MANAGEMENT

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ABSTRACT

Water is one of the most important natural resources and plays a vital role in human life, but it is not always in the right place, available at the right time or of the right quality. Industrialization, as well as urbanization, affects physicochemical quality of water leads to its spoilage. On the other hand microbiological quality changes due to improper sewage and sanitary systems and illiteracy. Thus, the importance of water quality assessment has been a compelling. Fact for avoiding environmental risks and maintenance of healthy atmosphere. Depleting ground water level and deteriorating ground water quality are threatening water supply in many parts of India. The socio-economic cost of water pollution is extremely high: 1.5 million children under 5 years die each year and country loses about Rs- 366 billion each year due to water related diseases .These figures only suggest that the abetment of pollution is socially desirable and economically justified. With the rapid growth in population in India and massive rural to urban movement there happened to an increase in slum the population in urban areas that may project to 104 million or 9% of total projected national population of 1.28 billion by 2017 (Times of India, 2013). Water sanitation and hygiene have important impact on both health and diseases and any deterioration in its quality have direct impact on human population especially in slum areas. According to current estimate, inadequate drinking water, sanitation and hygiene causes 842000 diarrheal. Disease deaths per year (WHO 2014). All these facts and issues compels to assess the drinking water quality at physic-chemical and microbiological parameters and create a community awareness in slum areas of Bhopal for sustainability, resource conservation and socio-economical of M.P State's Capital.

KEYWORDS: Physicochemical, Deteriration, Slum, Hygiene.

INTRODUCTION

Bhopal city with its ever–increasing construction activity along with the rapid, industrial and population growth including the floating population needs huge quantity of clean and safe water for drinking and domestic purpose.

Industrialization, as well as urbanization, affects physicochemical quality of water leads to its spoilage. On the other hand, microbiological quality changes due to improper sewage and sanitary systems and illiteracy. Thus the importance of water quality assessment has been a compelling fact for avoiding environmental risks and maintenance of healthy atmosphere.[1] Depleting ground water level and deteriorating ground water quality are threatening water supply in many parts of India. The socio-economic cost of water pollution is extremely high: 1.5 million children under 5 years die each year and country loses about Rs- 366 billion each year due to water related diseases.[3] These figures only suggest that the abetment of pollution is socially desirable and economically justified.[2]

With the rapid growth in population in India and massive rural to urban movement there happened to an increase in slum the population in urban areas that may project to 104 million or 9% of total projected national population of 1.28 billion by 2017 (Times of India 2013). Water sanitation and hygiene have important impact on both health and diseases and any deterioration in its quality have direct impact on human population especially in slum areas. According to current estimate, inadequate drinking water, sanitation and hygiene causes 842000 diarrheal disease deaths per year (WHO, 2014).[3]

Water born microbial contamination, however, has attracted renewed attention, both within the scientific community and among public. Water quality is an important as the quantity. The increasing problem of ground water contamination has resulted in the need of

information on ground water quality and a corresponding awareness of the importance of water quality monitoring. A number of studies on ground water quality with respect drinking and irrigation purposes have been carried out in the different parts of the country, but little work on this aspect has so far been done in the slum areas of Madhya Pradesh, India.[4]

All these facts and issues compels to assess the drinking water quality at physico-chemical and microbiological parameters and create a community awareness in slum areas of Bhopal for sustainability, resource conservation and socio-economical of M.P State's Capital. In view of the global concern to access safe drinking water and sanitation following are the objectives undertaken in present study:

1. To evaluate the status of water quality based on physical, chemical and bacteriological parameters.
2. To calculate the water quality index (WQI) of the analyzed water samples.
3. To Plot WQI/Bacteriological parameters of the respective water samples of the representative sampling locations to monitor the contamination at the different level
4. Identification and taxonomic study of dominant microorganism to prevent water borne diseases and infections.
5. To create public awareness for developing the habit of good hygiene sanitary practices to overcome problem of microbial contamination in drinking water.

METHODOLOGY

The present study is designed in such a way that it involves the survey, sampling, and laboratory assessments to generate the scientific data and information that will help in understanding the current status of the problem of drinking water in slum areas and also suggest the measures to overcome the issues if any. To fulfill the proposed objectives, following line of work will be applied.

1. **Selection of Site:** Randomly, 08 slum areas will be selected for the study from the different locations of Bhopal City.
2. **Indian Standard Drinking Water Specification IS 100500:1991:** The given specification will help us in understanding the level of contamination in the sample of drinking water.
3. **Sampling:** Water samples will be collected from various sources like tube wells, municipal taps, and hand pumps. Also from household storage containers 24-36 hours after collection. Samples will be collected on monthly basis for 3 year.

Sampling Techniques: Sterile Polypropylene or sterile glass sampling containers will be preferred. Separate bottles are used for physical, chemical and bacteriological analysis. Sampling details will be recorded (site, source, date, time etc).

4. **Selected Parameters for Physico-Chemical Analysis of Water[5]**

Physical Parameters: Water temperature, Turbidity, Total Dissolved Solutes, pH, Color.

Chemical Parameters: Free CO2, Total Alkalinity, Residual Chlorine, Total Hardness, Nitrates, Chlorides, Fluorides, Iron, Biological Oxygen Demand (wherever required).

5. **Bacteriological Analysis of Water[6]**

A. Determination of Total *Coliforms* – Most Probable Number Method (MPN).
B. Determination of Fecal *Coliforms* – Most Probable Number Method (MPN).
C. Determination of Total *Streptococci* – Most Probable Number Method (MPN).
D. Determination of *Salmonella* spp. – Selective Isolation Method.
E. Determination of Pathogenic Bacteria causing water borne diseases.

The proposed work is designed with the aim to analyze the status of contamination of drinking water and access the microbiological quality of water being used in slums. Also it focuses on significance of clean drinking water and sanitation, reduces health related expenditures and improved quality of life in general.

RESULTS AND DISCUSSIONS

An assessment of drinking water was made based on quantifying significant parameters in and around slum areas of Bhopal city. The present investigation describe the qualitative and quantitative assessment of different water samples collected from various sampling stations of the study area during the study period October2014-September2015**.** The analyzed physico-chemical parameters and WQI values were tabulated in **Table.1&2** Bacteriological values were presented in **Table 3.** A comparison of the various physical chemical and bacteriological characteristics of the studies water samples has been made with the BIS(1992).[7]

Results indicate that pH level of ground water was within limit in all the samples except at S8 which was found to be slightly low (6.2) might be due to the discharge of acidic water into ground water sources through sewage and other domestic activities. Data indicates that the value of parameters such as Alkalinity, Hardness, Ca, Mg, and Chlorides were found to be within limit (Table1&2). Hardness below 300mg/l is considered potable but beyond this limit causes gastrointestinal irritation. According to Joshi et al., ground water values of S1 and S8 are very hard water (above 33 mg/l as $CaCO_3$, (Table-2). The Hardness may be due to decrease in water level by high temperature thereby increasing solubility of calcium and magnesium salts.[8] The addition of sewage, detergents and large scale human use might be another cause of elevation of hardness.[7] Calcium and Magnesium higher than the desirable limit

indicates higher amount of salts of calcium and magnesium. Higher values of Nitrate at S1 and S8 indicate ground water pollution through decayed vegetable and animal waste, sewage sludge disposal to land and industrial effluent rich in nitrate.[9] Higher values of iron at S1 might be due to weathering of rock and discharge of waste effluents on land. According to this study, the ground water quality of the representative slums are suitable for drinking purpose on the basis of physic-chemical parameter except for Iron at S1 and Nitrate(S1 and S8)which exceed the permissible limits of drinking water.

In the present study, Total coli forms, fecal coli forms and fecal streptococci are analyzed as indicator organism of water contamination. In our study, all the slum water samples exceed the safe limit of BIS for all three respective indicator organisms. Maximum number of total coli form (118 MPN/100) was seen in S1 (Zone-4).Maximum value of fecal coli form (23 MPN/100 ml) was seen in S2 (Z0ne-5) and maximum value of fecal streptococci (8 MPN/100 ml) was seen in S1 (Zone-4). Presence of total and fecal coli forms could be due to poor filtering action of soil and more percolation as well as seepage of domestic sewage through soil.[10] The present investigation made on the ground water of selected slum areas revealed that the water quality though exceed the desirable limit for few parameters at some sampling locations but was well within the BIS permissible limits except iron and Nitrate which exceeded the limit at one or two sampling sites. This may be due to addition of waste dumped, deposition of organic matter and intrusion of sewage into the ground water due to improper maintenance of sewage system.[11] Hence, there is need for ground water treatment before it is used for ground water treatment before it is used for consumption and to ensure that it meets the standards of drinking water. In view of these facts such type of studies could provide very useful and significant results Associated with microbial hazards. Its effectiveness is likely to increase with time. This knowledge will serve as input in microbial risk assessment and water born diseases.

Table 1: Comparison of chemical parameters with BIS (1992).

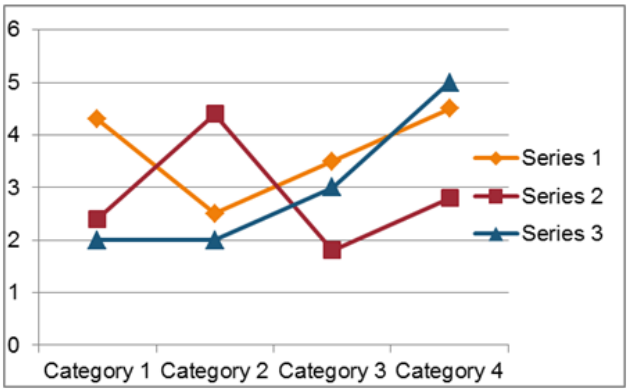
	S1	S2	S3	S4	S5	S6	S7	S8	BIS,1992
Temp.(^{0}C)	28.5	30.6	27.4	31.3	28.2	28.5	31.3	31.5	
pH	6.5	7.5	7.0	8.0	8.4	8.2	7.5	6.2	6.5-8.5
TDS mg/l	1425.0	513.0	352.0	880.0	360.0	425.0	1011.0	1115.0	500-2000*
T .Alkalinity ,mg/l as CaCO3	526.0	212.0	276.0	238.0	114.0	234.0	327.0	336.0	200-600*
T. Hardness, mg/l as CaCO3	472.0	186.0	94.0	272.0	286.0	232.0	146.0	494.0	300-600*
Ca, mg/l	426	148.0	66.0	134.0	125.0	142.0	75.0	385.0	75-200*
Mg, mg/l	84.0	68.0	32.0	44.0	22.0	42.0	36.0	68.0	30-70*
Chlorides, mg/l	194.0	59.0	76.0	224.0	67.0	70.0	84.0	192.0	250-1000*
Nitrate ,mg/l	74.0	36.0	27.0	36.0	32.0	42.2	42.5	62.2	1-45*
Iron, mg/l	1.4	.36	.08	.14	.12	.15	.10	.22	0.3-1.0*

*Permissible limit in the absence of Alternate source.

Table 2: Bacteriological parameters of sample locations during the period (Oct2015- Sept2016).

S.NO.	S.S	TC (MPN/100 ml)	FC (MPN/100 ml)	FS (MPN/100 ml)	Total Bact. No
Zone-1	S1	79	18	03	100
	S2	88	20	04	111
Zone-2	S3	38	08	03	49
	S4	51	09	05	65
Zone-3	S5	43	09	03	55
	S6	108	22	04	136
Zone-4	S7	118	22	08	148
	S8	97	22	05	124
BIS:1992		10/100 ml	NIL/100ml	NIL/100ml	

Classification of water quality on the basis of Hardness



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