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EFFECT OF SURFACTANT AGGLOMERATE IN WATER QUALITY ASSESMENT

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ABSTRACT: The present work deals with the assessment of physico-chemical parameters of shivnath River water in Durg district, Chhatisgarh India. The water samples were collected from sampling station during 2016-2017 in pre monsoon, monsoon and post monsoon seasons .The samples were analyzed for physical properties like colour, temperature, turbidity and odour, chemical properties like pH, alkalinity, total hardness, calcium hardness, magnesium hardness, Total dissolved solids (TDS) and total suspended solids (TSS). The study area was divided into 2 classes i.e. upstream and downstream. All stated physico-chemical properties were analyzed for both upstream and downstream sampling points to determine the effect of residential and industrial discharges on the water quality of river. The addition of discharges has shown many fold increase in all the analyzed physiochemical parameters. Also it was seen that on adding surfactant the quality of water improved as metal ions concentration decreases and comes below the WHO standards. Statistical studies have been carried out by calculating correlation coefficients.

KEYWORDS: physico-chemical parameters, Shivnath River, water quality.

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1.INTRODUCTION

Water is the most important solvent needed by human body. This water is provided by various water reservoirs i.e river, ponds lakes etc. This water helps to maintain good health for plants, animals as well as for humans. Water quality, is an important parameter which is influenced by various natural processes as well as anthropogenic activities and is universal environmental issue concerned[1,2]. The water is contaminated by both organic and inorganic pollutants such as suspended and precipitated (non-floating) substances and organic substances in waters are capable of adhering pollutant particles (adsorption) and from sediments. The sediments, both suspended and precipitated substances stored on the water bottom, forms a reservoir for many pollutants and trace substances of low solubility and low degree of degradability [3]. In India water requirements for domestic and agricultural purposes are fulfilled by ponds, rivers and ground water. The physico-chemical and micro-biological characteristics of water describe its quality. Continuous monitoring of large number of quality parameters is essential. For effective maintenance of water quality through appropriate control measures regular monitoring of all the parameters is required. But it is very difficult and laborious task therefore, in recent years an alternative approach based on statistical correlation, has been used to develop mathematical relationship for comparison of physico-chemical parameters [4,5,6] Present study deals with study of physico-chemical parameters of shivnath river water in Durg, Chhatisgarh in the presence of surfactant named sodium laurel sulfate. The analyzed information was compared with standered values. Systematic correlation coefficient calculation between water quality parameters have been done with the aim of minimizing the complexity and dimensionality of large set of data. The significant correlation has been calculated [7]. Shar g.a 2005 in his paper has explained that surfactant along with chelating agent can form stable complex with the metals and so the metals present in various concentrations can be determined. Increasing population and its wants have result in the deterioration of surface and sub surface water [8].All metabolic and physiological activities and life processes of aquatic organisms as well as humans are influenced by such surface water. Many researchers have undertaken the work on assessment of physiochemical and microbiological quality of water bodies in different parts of the India [9, 10, 11, and 12]. Chhattisgarh state is provided by surplus water resources and many small and big rivers co-originate. Shivnath River is main tributary of river Mahanadi. It is the second important river of Chhattisgarh in terms of carrying of water and length measured in the state. It covers about 290 km through Rajnandgaon, Durg and Janjgir, Champa District.Shivnath is facing a great deal of pollution due to dumping of variety of wastes [13].The present study is aimed on assessment of effect of the discharges on the physicochemical parameters of Shivnath river water in Durg Dist. Durg is part of Chhatisgarh situated at $13^{o}4'$ N and $80^{o}5'$latitude with surplus lentic water ecosystem lying on the middle.

Why surfactant

Surfactants are substances which alter the surface properties of liquids, even when present in small quantities. Surfactants are composed of two fractions, a lyophilic group and a lyophobic group, surfactants migrate to the surface, resulting in the lyophilic portion lying within the solution and the lyophobic group orienting itself away from the solution. This orientation of the surfactant reduces the free energy of the surface, thus decreasing surface tension and increasing surface viscosity. The selection of surfactant is very important to ensure the efficiency of complexometric process. The micellzation property of surfactant is used in this paper and its effect is seen. The chemical classification of surfactant is based on the nature of the hydrophilic head with the subgroup based on the nature of hydrophobic tail. Basically the surfactant can be classified into four groups they are Anionic, cationic, nonionic and Amphoteric. The present analysis is done by using the anionic surfactant because it is cheap, easily available.

2. MATERIALS AND METHODS

Sampling site; - Water samples were collected from Shivnath River in Durg region. (Fig.1).

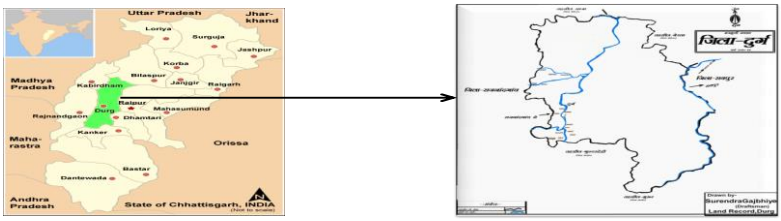

Figure 1: Map of Chhatisgarh – showcasing Sampling site River Shivnath

Water samples were collected from eight different locations of Shivnath River by grab sampling, during the pre monsoon, monsoon and post monsoon seasons. Borosilicate glassware, distilled water and AR grade reagents were used throughout the testing. Samples were collected in sterilized screw-capped polyethylene bottles of one liter capacity and analyzed in laboratory for their physico-chemical parameters. Samples collected from study sites were properly labeled and a record was prepared. The various physiochemical parameters were analyzed (Table 1).Total alkalinities of the water samples were determined by titrating with N/50 H_2SO_4 using phenolphthalein and methyl orange as indicators. The conductivity of the water sample was measured using Water and soil analysis kit. The total hardness of the water samples was determined by Complexometric titration with EDTA using Erichromebalck-T as an indicator [14, 15, and 16]. Other parameters were determined according to Ademoroti, and ICMR Standards. Karl-Pearson correlation coefficient (r) was calculated. Obtained data was compared with standard data [18, 19, 20, 21, and 22,] (Table 2)

Table 1-Analysis of parameters

s/no.	parameters	Method for analysis
1	pH Value	Electrometric Method
2	Hardness	EDTA Titration Method
3	Alkalinity	Neutralization Titration
4	Conductivity	Water and soil analysis kit
5	TDS	Online calculation
6	Iron	Titrimetric Method
7	Ca,Mg	Complexometric method
8	copper, nickel,	Complexometric method
9	Acidity	Titrimetric Method
10	Salinity	Instrumental method

Table.2 -The standard values of physico-Chemical parameters

Parameters	WHO Standards	
	HDL	**MPL**
pH	7-8.5	6.5-9.5
Ec	nil	nil
TDs	500	1000
Acidity	nil	nil
Alkalinity	nil	nil
Temperature	nil	nil
CO_2	nil	nil
Ca	75	200
Mg	30	150
Cu		
Ni		
Fe		

Aliquot preparation: Two sets of sample were prepared, one for standard reading (without surfactant) and with Surfactant. The surfactant used was Sodium laurel sulphate (SLS).

Statiscal Analysis: Correlation analysis was carried out for comparison of the data.

3. RESULTS AND DISCUSSION

Table 1 represents methods of analysis used for evaluation of various parameters. The standard and observed values of physicochemical parameters of experimental water samples are showen in Table 2. The observed pH values ranging from 6.9 to 8.4 without adding surfactant and 7.3 to 8.9 on addition of surfactant and this shows that the present water samples are slightly alkaline which increased on addition of surfactant. These values are within maximum permissible limit prescribed by WHO. The calcium (75-345 mg/L)and 67 to 338 mg With surfactant, hardness (120-375 mg/L) and 108 - 296,with surfactant, TDS (131-195 mg/L) and 152-205 mg/L values of water samples are within the highest desirable or maximum permissible limit set by WHO. Since no prescribed standards are suggested by WHO for parameters like electrical conductivity, for drinking purpose, but it was increasing on the addition of surfactant. In the present study all the parameters have strong significant positive correlation with each other. This shows that any fluctuation in the parameter directly affect the property of water. Table 3, 4 and 5 shows correlation between the parameters. These data have units in ppm, ^{o}C, EC in mu mhos/cm, other parameters in mg/L.

Table 3 Correlation analysis of parameters without adding surfactant

parameters	pH	Cond.	Alkalinity	Acidity	TH	TDS	Temp.	Free CO_2	Ca	Mg	Cu	Ni	Iron
pH	1												
Cound.	0.70	1											
Alkalinity	0.62	0.24	1										
Acidity	0.28	0.05	0.30	1									
TH	0.37	0.24	0.34	0.32	1								
TDS	0.70	0.99	0.23	0.04	0.24	1							
Temp.	0.34	0.14	0.88	0.38	0.38	0.13	1						
Free CO_2	0.54	0.06	0.58	0.61	0.38	0.06	0.44	1					
Ca	0.33	0.29	0.19	0.22	0.98	0.29	0.23	0.66	1				
Mg	0.39	0.14	0.56	0.46	0.94	0.14	0.62	0.83	0.87	1			
Cu	0.53	0.17	0.18	0.49	0.32	0.17	-0.14	0.708	0.32	0.34	1		
Ni	0.14	0.34	0.32	0.45	0.66	0.33	0.57	0.31	0.62	0.69	-0.05	1	
Iron	0.87	0.56	0.63	0.44	0.01	0.56	0.35	0.432	-0.05	0.139	0.57	0.002	1

Table 4 Correlation analysis of parameters with adding surfactant

Parameter	pH	Cound.	Alkalini	Acidit	TH	TDS	Temp.	Free CO_2	Ca	Mg	Cu	Ni	Iron
pH	1												
Cound.	0.37	1											
Alkalinity	0.68	0.41	1										
Acidity	0.016	-0.01	0.22	1									
TH	0.63	0.35	0.39	0.21	1								
TDS	0.36	0.99	0.40	0.004	0.34	1							
Temp.	0.58	0.07	0.88	0.29	0.400	0.07	1						
Free CO_2	0.57	0.25	0.56	0.41	0.80	0.24	0.46	1					
Ca	0.58	0.36	0.24	0.13	0.98	0.36	0.24	0.72	1				
Mg	0.67	0.29	0.61	0.32	0.94	0.29	0.63	0.88	0.87	1			
Cu	0.31	0.91	0.39	0.24	0.39	0.91	0.01	0.46	0.39	0.35	1		
Ni	0.33	0.18	0.34	0.48	0.71	0.18	0.55	0.41	0.67	0.72	0.15	1	
Iron	0.59	0.57	0.68	0.24	0.04	0.57	0.41	0.21	-0.02	0.14	0.59	0.03	1

Table 5 Correlation analysis of the data without and with surfactant

S/no.	parameters	r value	S/no.	parameters	r value
1	pH	0.81	8	Free CO2	0.958
2	Cound.	0.55	9	Ca	0.99
3	Alkalinity	0.99	10	Mg	0.99
4	Acidity	0.963	11	Cu	0.914
5	TH	0.99	12	Ni	0.99
6	TDS	0.547	13	Iron	0.99
7	Temp.	1			

4. CONCLUSION

The work presented here is only to study the chemical quality of the river water, with the help of surfactant. It was seen that on adding surfactant the quality of water improved as metal ions concentration decreases and micellzation of surfactant takes place (Fig.5) and comes below the WHO standards. The anionic surfactant used is sodium laurel sulphate. Surfactant is added to the polluted aqueous solution containing metal ions and/or organic solutes. Graphs were also plotted between sampling sites and parameters and the effect was seen.

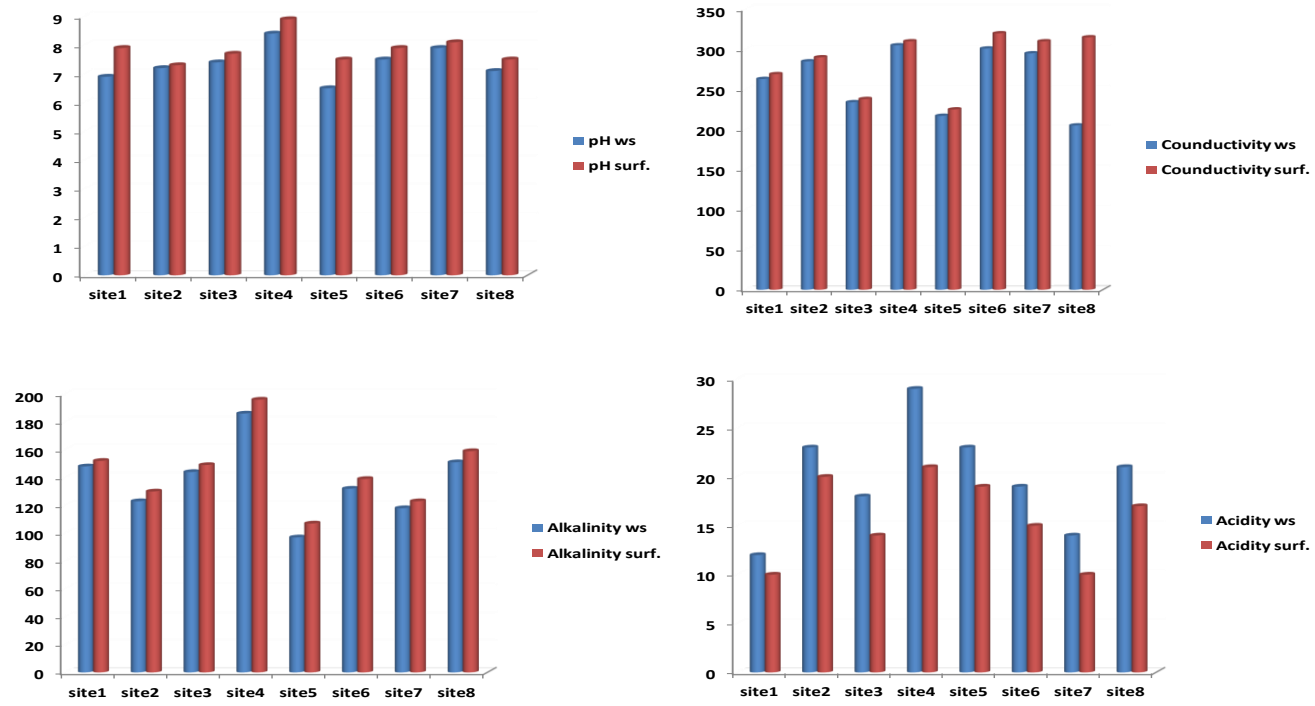

Fig.2 Graphs for pH, Conductivity, Alkalinity and Acidity

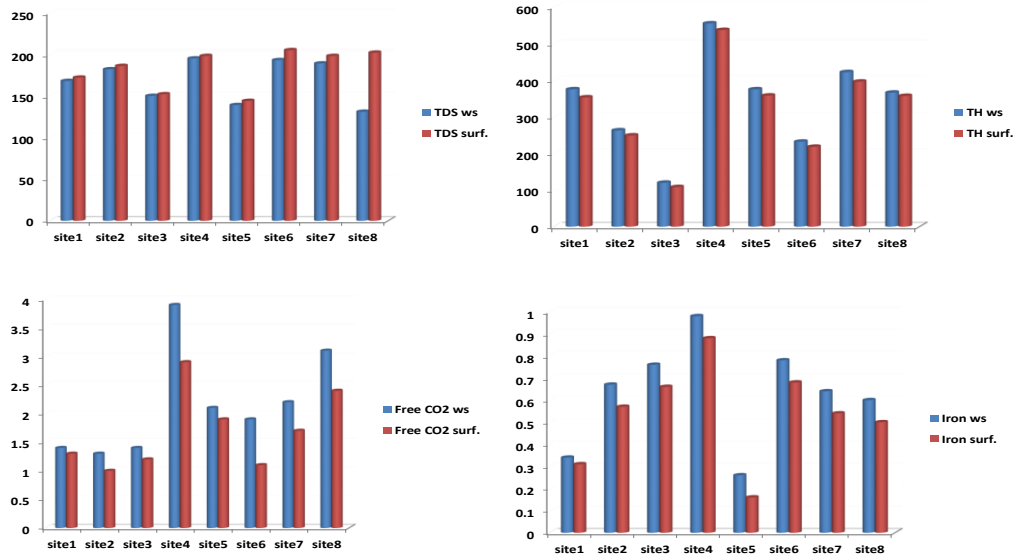

Fig.3 Graphs for TDS, Total Hardness, Free CO_2 and Iron

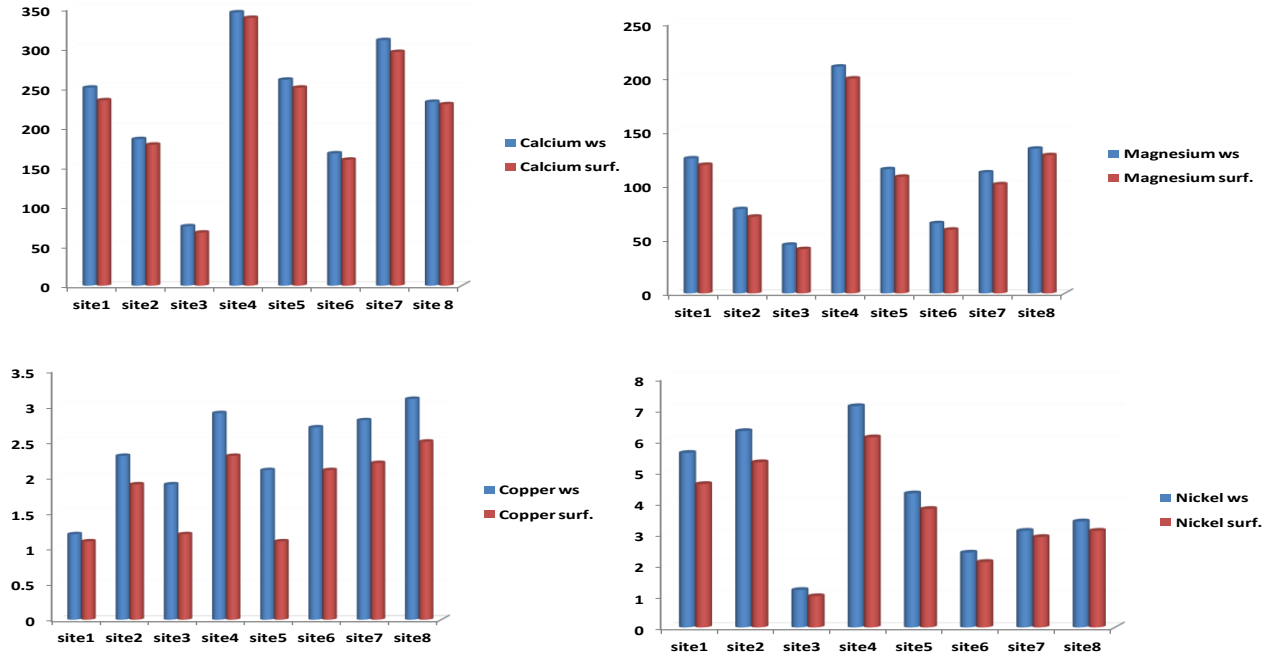

Fig.4 Graphs for Calcium, Magnesium, Copper and Nickel

Mechanism:

Surfactant at cmc ---- metals in water-----surfactant starts to form micelle or aggregates-------micellzation….

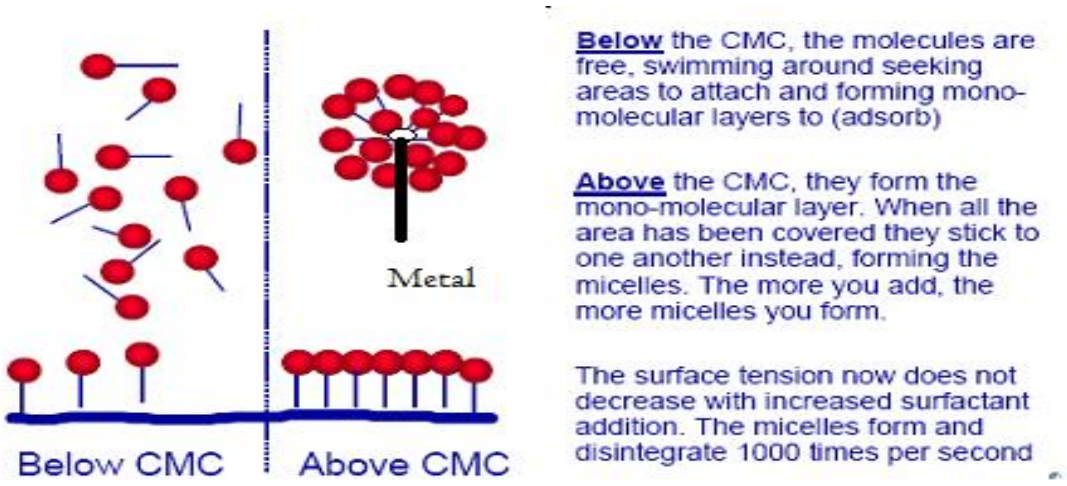

Fig.5 micellzation of surfactant

The surfactant forms micelles at a concentration higher than its critical micelle concentration (cmc). The metal ions are adsorbed on the surface of the oppositely charged micelles by electrostatic attraction. Surfactants above their critical micelle concentration starts to form micelles and they trap the metal ions form the water sample, [23].They adsorbs and help in mobilization of ions and this process is cross checked by complexometric titration. Metal analysis can be done by surfactants and this method can be used for the metal extraction. Surfactants played an important role for determination of aluminum from pharmaceutical samples in the form of Al –alumion complex and have created better conditions to enhance the sensitivity of the method [24]. This method has the following advantages: simple operation; environmentally safer; low-energy requirement; high removal efficiency; easy to recover metal ions; less expensive; separation can be carried out at room temperature [18] It can be concluded that river Shivnath is polluted and rapidly turning toward eutrophication. Its water has become unsuitable for human consumption. Proper biological and chemical treatment of domestic sewage and industrial effluents before discharge to river is suggested. The physico-chemical parameters of Shivnath river water at Durg are within the highest desirable limit or maximum permissible limit set by WHO .Shivnath water recorded higher values of Mg than Ca. Soil erosion, Agricultural practices, Immersion of idols in puja seasons, pouring of left over materials of puja (a mythological concept), farming in sand can be a reason for high values of magnesium than the calcium in the river water. The correlations between different pairs of data are directly or indirectly influenced by number of factors and geological conditions. An appreciable significant positive correlation have been recorded between pH, Mg, hardness and TDS ,hardness, EC .A significant negative correlation was found between calcium, iron, copper and Nickel.

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6. CONFLICT OF INTEREST

No conflict of interest exists.

REFERENCES

1. Y. Ouyang," Evaluation of River water quality monitoring stations by principal component analysis", Water Research, 2005;39 pp 2621–2635.
2. S. Shrestha, F. Kazama,"Assessment of surface water quality using multivariate statistical techniques: A case study of the Fuji River Basin, Japan," Environmental Modelling and Software, 2007; 22, pp 464–475.
3. C. Biney, A.T. Amazu, D. Calamari, N. Kaba, I.L. Mbome, H. Naeve, P.B.O. Ochumba, O. Osibanjo, V. Radegonde, M.A.H. Saad," Review of heavy metals in the African aquatic environment, Ecotoxicology and Environmental Safety".,1994 ;31 pp 134-159.
4. Mayur C Shah, Prateek Shilpkar and Sangita Sharma, *Asian J Chem*., 2007;19(5),3449-3454.
5. Garg D K, Goyal R N and Agrawal V P, *Ind. J. Envir. Prot*., 1990;10(5), 355-359.
6. Mitali Sarkar, Abarna Banerjee, Partha Pratim Parameters and Sumit Chakraborty, *J. Indian Chem. Soc*., 2006;83, 1023-1027.
7. Shar g.a, G.A.Shar,G.A. Soomro, M.I. Bhanger.,*Jour.Chem.Soc.Pak.*, , 2004;26(2), 23-45.
8. T.S. Dhiviyaa Pranavam, T. Venkatesa Rao, L. Punithavathi, S. Karunanithi and A. Bhaskaran*Indian J. Sci.Technol.,* .,2011;4(1), 19-21
9. Nath D,*J Inland Fish Soc India*, 2001;33(2), 37-41.
10. Vijender Singh, *Res J Chem Environ.*, 2006;10(3), 62-66.
11. Mishra A and Bhatt V,*E Journal of Chemistry,* 2008;5(3), 487-492.
12. Ramteke P N, Battacharjee J W , Pathak S P and Karla N, *J Appl Bacteriol*., 1992;**72,** 352.
13. Seema A.Belorkar, "Assessment of the Deterioration in Physiochemical and Microbiological Quality of Shivnath River Water in Durg District, India,"E-journal of chemistry, 2010;7(3), 733-738.
14. Standard methods for the examination of water and wastewater (20th Ed.). Washington DC, USA.
15. APHA (American Public Health Association), AWWA (American Water Work Association) and WEF (Water Environment Federation), Washington DC, 1999**.**
16. Tolerance limits for inland surface waters subject to pollution. Bureau of Indian Standard, New Delhi, (BIS: 2296-1982.);1982.

17. Ademoroti, (1996), and ICMR Standards (1985). Ademoroti CMA. Edition, chapter. 1996; 2:20-50. [Google Scholar]
18. Biswas S, Pratibha S. Kurup "Surfactant Assemblies and Their Application in Pond Water Analysis - A Statistical Approach". Asian Journal of Biochemical and Pharmaceutical Research Issue; 2014;3(4). [Google Scholar]
19. Vogel AI. A text book of Quantitative Inorganic Analysis Including Elementary Instrumental Analysis 4th Ed. The English Language Book Society and Lang man. Co (a. P 837 (b) P 1978; 328:504-506. [Google Scholar]
20. Standard Methods for the Examination of Water and Waste. 1998; [Google Scholar]
21. W.Health. Organization, Guidelines for drinking water quality-I, Recommendations, 2nd Ed. Geneva WHO. 1993; [Google Scholar]
22. Trivedy RK, Goel PK. Chemical and Biological Methods for Water Pollution Studies, Environmental. India: Publication; 1986;[Google Scholar],
23. Katarzyna hac wydro,Iwona palasinska,pawel miskowiec, "The comparative studies on the ability of anionic surfactants to bind lead (ii) ions "Journal of molecular liquids,2016;219,1071-1077.
24. Saba saeed,Hajira tahir, Muhammad sultan ,Qazi jahanzeb,"Effect of foreign ions for the determination of metal ion in the presence of surfactants",Front.chem.china,2011;6(3):243-247.