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Research Paper

Reduction of Fluoride at Municipal Waste Water Treatment Plant Badwai, Bhopal, (M.P.), India

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Abstract *- Fluoride is a normal constituent of natural water samples. Its concentration varies significantly depending on the water sources both in urban and rural areas. Although both geological and man-made sources contribute to the occurrence of fluoride in water, the major contribution comes from geological resources. Except in isolated cases, surface waters seldom have fluoride exceeding 0.3 mg/l. The increase in water demand in addition to water shortage has led to growing interest in wastewater reuse. In the present study wastewater samples from different stages of sewage treatment plant Badwai, situated at Bhopal, Madhya Pradesh, were analyzed for Fluoride by using standard methods. During present study the sewage treatment system using different materials showed excellent potential in Fluoride removal from the wastewater. The results of analysis of treated water for Fluoride indicate that the treated water can be used for secondary purposes like industrial cooling and agricultural uses.*

Key words: Fluoride, STP, Wastewater, Influent water, Effluent water etc.

Introduction

Water is distributed to a variety of residential, industrial, commercial and municipal clients. Waste water coming from all these sources is collected by sewer system and thereafter transported to the sewage treatment plant. Industrial and human wastes increase fluoride levels in sewage. During treatment of sewage, Primary Treatment Unit removes suspended solid by screening, filtration, flocculation, coagulation, and sedimentation. Several common process using iron salt coagulation, lime or activated alumina may remove fluoride at high concentrations; however, these effects are less effective at the low concentrations of fluoride usually found in municipal sewage. [1,2] The microorganisms present in most secondary treatment system absorb large quantities of fluoride and may reduce fluoride concentrations in effluent water by up to 50 percent.[3,4] As water pollutant, elevated concentrations of fluoride may affect a number of organisms, including fish, amphibians, insects, snails, shellfish, protozoa and some aquatic plants. [5] Industrial waste and municipal sewage water may add to the fluoride which is naturally present in all surface water. [6].Throughout many parts of the world, high concentrations of fluoride occurring naturally in ground water and coal have caused wide spread of fluorosis, a serious bone disease among local populations, Sometimes fluoride is purposely used to fluoridate number of every day products, notably toothpaste and drinking water to offset its proven benefits on preventing dental decay, because for decades there is a belief that fluoride in small quantities does not have any adverse effects on health. But more and more scientists are now seriously questioning the benefits of fluoride even in small amounts. As there has been conflicting reports where use found to be detrimental in prolong use. Fluoride exists fairly in the earth's crust and can enter ground water by natural processes. The soil at the foot of the mountains is particularly likely to be high in fluoride from the weathering and leaching of bedrock with high fluoride content. Since some fluoride compounds in the earth's upper crust are soluble in water.

Material and Methods

The present sewage treatment plant (Badwai) is situated at a geographical location of coordinates 23° 15' 44'' N, 77° 28' 23'' E. Badwai sewage treatment plant receives the wastewater generated in CTO, Hemu Colony, Beta village, Koh-e-fiza etc areas. Badwai sewage treatment plant is designed to treat 16.67 MLD sewage. The Badwai STP is based on waste stabilization technique using anaerobic and facultative ponds.

Wastewater samples were collected from influent to effluent of different stages of sewage treatment plant (STP) from the month of January to December, 2009.Samples were analyzed to determine the efficiency of the treatment plants in reducing the fluoride from the influent to effluent samples. Sewage samples were collected in glass containers, precleaned by washing with non-ionic detergents, rinsed in tap water, in 1:1 hydrochloric acid and finally with deionised water before usage. Before sampling, the bottles were rinsed three times with sample water and then filled and Fluoride was determined by spectrophotometer technique in the analytical laboratory according to the methods prescribed in the American Public Health Association (APHA), 1989.Standard methods for the Analysis. 7th Edn., University Press, Washington DC, New York, USA APHA.

Results and Discussion

Monthly samples were collected from different stages of the Sewage Treatment Plant (STP) Badwai, Bhopal. The results obtained for Fluoride is shown in the table-1.

During period investigation in the influent water, Fluoride concentration varied from 0.798 mg/l to 1.358 mg/l and 0.393 mg/l to 1.026 mg/l in the effluent water. The minimum value was observed in the month of January while the maximum value was observed in the month of May in the influent water of sewage treatment plant (STP). The minimum value was observed in month of December while maximum value was observed in the month of May in the final treated effluent water of sewage treatment (Figure-1-12). The present study was conducted to evaluate the effectiveness of the Sewage treatment plant in reducing the fluoride concentration at various stages of treatment. The present Sewage treatment plant is based on oxidation processes. The STP is consists of five stages having two anaerobic ponds, two facultative ponds, a raw filter. During present investigation maximum reduction in fluoride concentration was observed in Facultative Tank - 2 followed by facultative pond.

While comparing the percent reduction of fluoride concentration in different months, it was observed that maximum reduction of fluoride was observed in the month of July while maximum reduction was observed in the month of May.

An overview of data reveals that fluoride in drinking water may vary from 0.5 mg/l to 0.5 mg/l [8]. Excessive ingestion of fluoride for a prolonged period (6 month to several years) causes fluoride toxicity in the from of dental, skeletal and gut fluorosis. Fluoride toxicity also affects the soft tissues and enzyme system but its effect on teeth, bones and gut are of practical importance. Out of 6 lakh village in India at least 50% have fluoride content in drinking water exceeding 1.0 mg/l [9, 10]. During the present investigation of Fluoride concentration at effluent water of sewage treatment plant was found within in the prescribed limit of BIS (11). Burearo of Indian Standard in view of the health problems has laid down the Indian Standard as 1.0 ppm as the maximum permissible limit. This means the body may tolerate fluoride upto a certain limit of 1.0 ppm depending upon the nutritional standard and body physiology. There will be traces of fluoride in any water samples therefore, though BIS has laid down the upper limit as 1.0 ppm it is further specified that lesser the better as the fluoride causes where even 0.4 ppm fluoride in drinking water has caused dental fluorosis [8].

Conclusion

High fluoride increased in the water, its origin involved prevent of a more arid climate and recent exploitation of groundwater recharge during the past arid climate phases. High fluoride in drinking water has resulted in dental fluorosis and skeleton fluorosis in the local residents. In fact, if the fluoride level in drinking water is more then 1.5 ppm, risk of endemic fluorosis will exist. The high fluoride content is therefore causing serious environment degradation.

The present study reveals the assessment of Fluoride concentration in waste water, due to various stages of sewage treatment plant (STP) Bhopal. Performance of STP of Badwai was evaluated which has shown its capability to reduce Fluoride from raw sewage. From the above study, it was observed that high concentration of Fluoride was present in the inlet of sewage treatment plant however better water quality was found after treatment in effluent water. Instead of discharging the sewage onto the nearby body of water, it is proposed to let it pass through the sewage treatment plant which would reduce most of the pollutants. So the sewage treatment is essential for maintaining the water quality and the final treated wastewater can be used for secondary purposes like irrigations gardening and industrial cooling.

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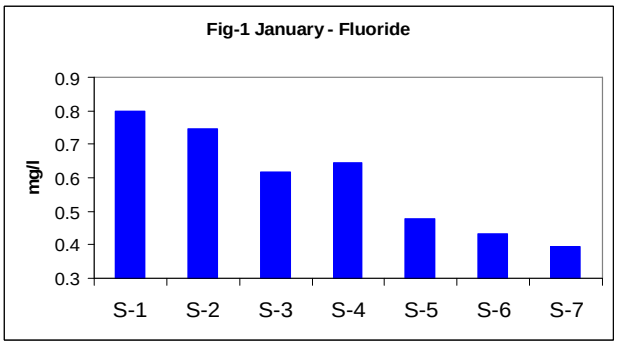
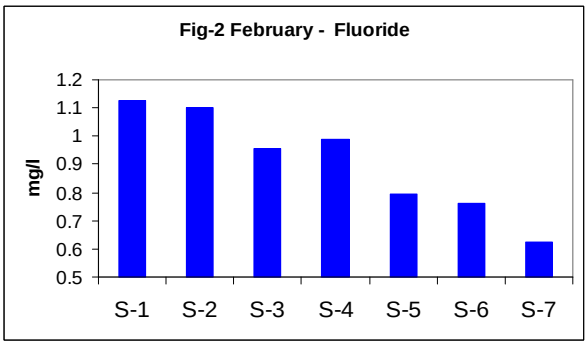
Table-1 Variation of Fluoride in the month of January to December at different stages of STP.

stations/ Months	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Ave rage
S-1	0.798	1.124	0.957	1.358	0.954	1.145	1.564	1.685	1.102	0.994	1.245	0.842	1.147
S-2	0.747	1.102	0.847	1.293	0.926	1.068	1.515	1.597	1.052	0.965	1.188	0.798	1.091
S-3	0.616	0.954	0.835	1.285	0.842	1.124	1.475	1.402	0.915	0.972	1.186	0.724	1.027
S-4	0.645	0.987	0.714	1.124	0.798	0.967	1.313	1.398	0.968	0.864	1.052	0.742	0.964
S-5	0.478	0.794	0.668	1.107	0.821	0.932	1.262	1.296	0.824	0.842	0.991	0.652	0.888
S-6	0.432	0.762	0.526	0.954	0.787	0.842	1.104	1.125	0.814	0.705	0.902	0.634	0.798
S-7	0.393	0.626	0.489	0.885	0.714	0.815	1.026	1.085	0.751	0.675	0.885	0.571	0.742

S -1: Inlet of STP
S -2: Anaerobic Tank-1
S -3: Anaerobic Tank-2
S -4: Facultative Tank-1
S -5: Facultative Tank-2
S -6: Rock Filter
S -7: Outlet of STP

Variation of Fluoride at different stages of treatment of sewage is shown in following figures.





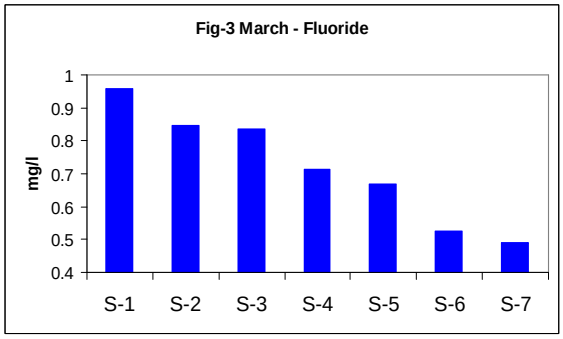


Fig-3 March - Fluoride
mg/l
1
0.9
0.8
0.7
0.6
0.5
0.4
S-1 S-2 S-3 S-4 S-5 S-6 S-7

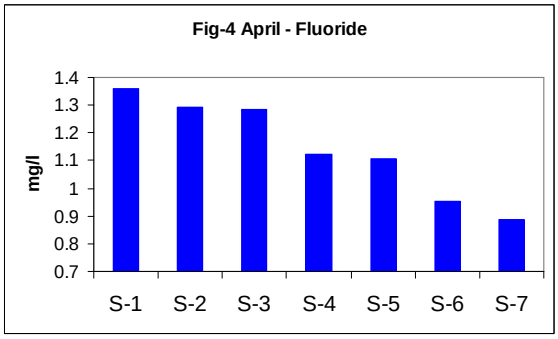


Fig-4 April - Fluoride
mg/l
1.4
1.3
1.2
1.1
1
0.9
0.8
0.7
S-1 S-2 S-3 S-4 S-5 S-6 S-7

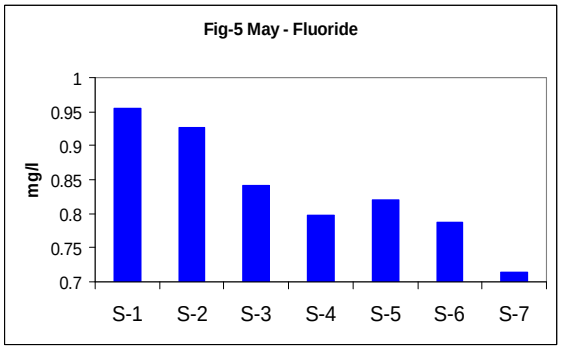


Fig-5 May - Fluoride
mg/l
1
0.95
0.9
0.85
0.8
0.75
0.7
S-1 S-2 S-3 S-4 S-5 S-6 S-7

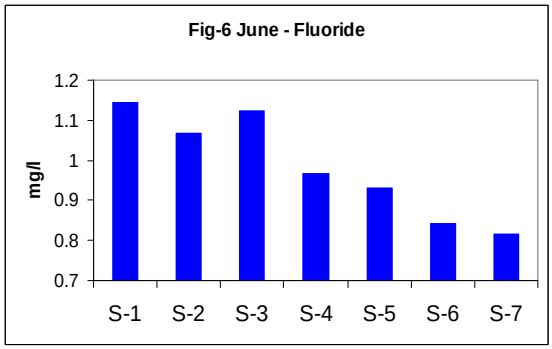


Fig-6 June - Fluoride
mg/l
1.2
1.1
1
0.9
0.8
0.7
S-1 S-2 S-3 S-4 S-5 S-6 S-7

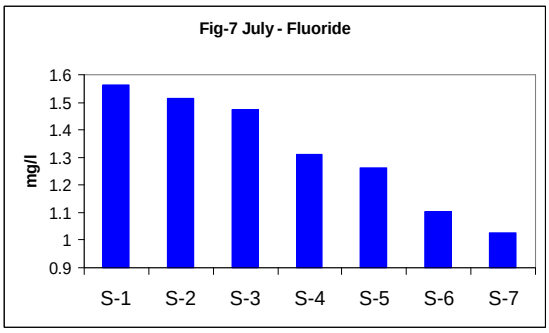


Fig-7 July - Fluoride
mg/l
1.6
1.5
1.4
1.3
1.2
1.1
1
0.9
S-1 S-2 S-3 S-4 S-5 S-6 S-7

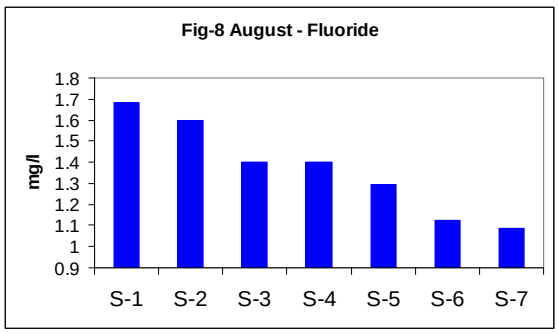


Fig-8 August - Fluoride
mg/l
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1
0.9
S-1 S-2 S-3 S-4 S-5 S-6 S-7

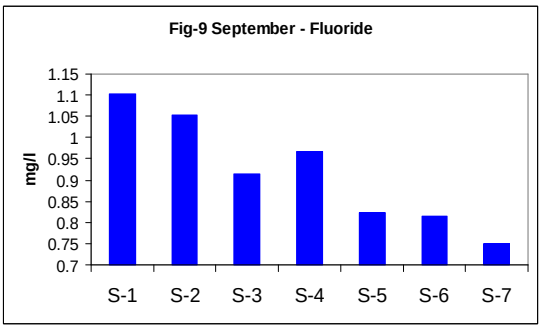


Fig-9 September - Fluoride
mg/l
1.15
1.1
1.05
1
0.95
0.9
0.85
0.8
0.75
0.7
S-1 S-2 S-3 S-4 S-5 S-6 S-7

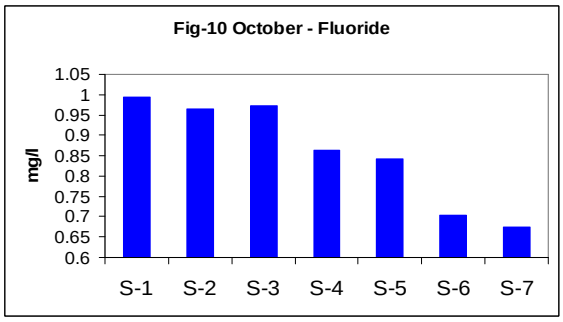


Fig-10 October - Fluoride
mg/l
1.05
1
0.95
0.9
0.85
0.8
0.75
0.7
0.65
0.6
S-1 S-2 S-3 S-4 S-5 S-6 S-7

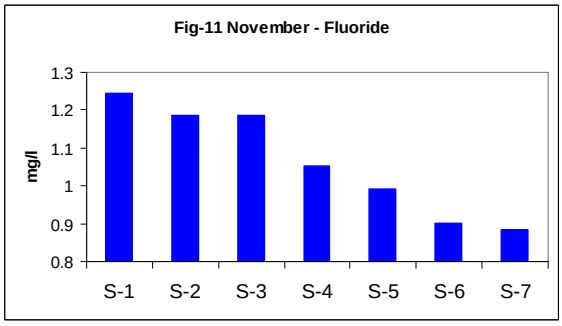


Fig-11 November - Fluoride
mg/l
1.3
1.2
1.1
1
0.9
0.8
S-1 S-2 S-3 S-4 S-5 S-6 S-7

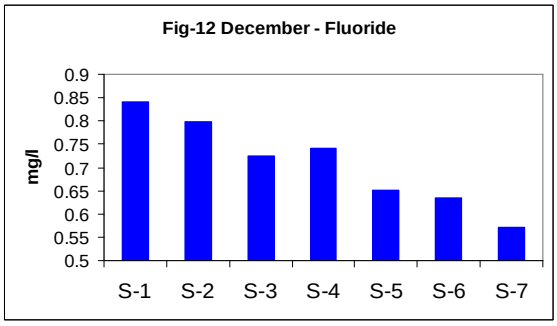


Fig-12 December - Fluoride
mg/l
0.9
0.85
0.8
0.75
0.7
0.65
0.6
0.55
0.5
S-1 S-2 S-3 S-4 S-5 S-6 S-7