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Experimental study on water quality assessment and improvement of Thamirabharani river course

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Abstract: Surface water is one of the major sources of water. The water quality of Thamirabarani River is an important domestic and portable water source of Tirunelveli and Tuticorin Districts. The length of the river is 125Km. The river is facing threats due to rapid growth of Population, Urbanization, Industrial wastes from urban Infra structure and Agriculture. The present study has been undertaken to assess the Water Quality and to improve the Thamirabarani River Water. The physical and chemical parameters namely pH, Turbidity, Hardness, Chloride, Dissolved oxygen, Total, Volatile and Fixed solids, Sulphate, Fluoride and Nitrate were analyzed. The main objective of this project is to assess the physical and chemical parameters in Thamirabarani River by obtaining samples from eight different station and conducting laboratory experiments. The main aim of this study is to remove the impurities present in the Thamirabarani River Course effectively.
Keywords: Water quality; Physical parameters; Chemical parameters; Impurities.

I. Introduction

Water is a valuable and finite source on Earth. Both water quantity and quality are becoming dominant issues in many countries like India. Point and non-point sources such as sewage effluents, waste water discharges, agricultural runoff, industrial and mining activities may seriously affect these water sources .As a consequence various pollutants such as pathogen microorganisms, nutrients, heavy metals, toxic elements, pesticides, pharmaceuticals and various other organic micro pollutants may present in water which results in degradation of water quality . Another severe problem especially in coastal areas is the increment of salinity in groundwater due to seawater intrusion in coastal aquifers as a cause of high water demands and overexploitation. The aim of this project is to identify the areas having the current and future problems of fresh water quality in Thamirabarani river course. Samples are collected from Thamirabarani River of various location like Papanasam, Cheranmahadevi, Gopalasamudram, Kokkirakulam, Authoor, Earal, Srivaikundam and Punnaikayal. The samples are tested against physical & chemical parameters. Physical parameter are Turbidity, Colour, Temperature and chemical parameters are pH, Nitrate, Chloride, Sulphate, Fluoride, Hardness and Dissolved oxygen.

II. Experimental Investigation

1. Materials

Sugar cane waste powder and Tamarind seed powder are used for the removal of fluoride in this project. These two adsorbents are naturally available materials with free of cost and those materials can be easily taken all over the surroundings. If we are using these materials for the removal of fluoride environmental pollution gets reduced.

2. Sample treated by using Sugarcane waste powder

The batch adsorption method is used for adsorption. The collected Sugar cane wastes are dried in hot air oven for 72 hours at 110℃. After 72 hours it is changed to brown in colour. Then it is placed in a muffle furnace for making Sugar cane powder by hand crushing or by mechanical method. The powdered Sugar cane waste is taken as 1.25gm and 0.25gm spread in 500ml beaker and 200ml beaker containing water sample for 1 to 24 hours.

3. Sample treated by using Tamarind seed (outer layer) powder

The collected Tamarind seed (outer layer) are dried in hot air oven for 72 hours at 110℃. After 72 hours it changed to brown in colour. Then it placed in a muffle furnace for making Sugar cane powder by hand crushing or mechanically. The powdered ‘Sugar cane waste is taken 1.25gm and 0.25gm spread in 500ml beaker

and 200ml water sample is added The powdered 'Tamarind seed powder' contact with water sample for one to 24 hours.

4. Dosage details

Although membrane methods have successfully reduced fluoride concentration to acceptable levels, surface adsorption retains a major place in Defluoridation research and practice because of its general greater accessibility and lower cost. Thus even in the past decade, when interest in alternative defluoridation approaches has been increasing rapidly, many researchers have continued to explore the development of low-cost and effective adsorbents and to improve the efficiency of all adsorbents. The nature of adsorption of fluoride on some adsorbents, especially clays which contain oxides of iron, aluminium and silicon are used to improve the understanding of fluoride– adsorbent interactions. Theoretically, the adsorption of fluoride on to solid particles normally takes three essential steps.

(i) Diffusion or transport of fluoride ions to the external surface of the adsorbent from bulk solution across the boundary layer surrounding the adsorbent particle, called external mass transfer;
(ii) Adsorption of fluoride ions on to particle surfaces;
(iii) The adsorbed fluoride ions probably exchange with the structural elements inside adsorbent particles depending on the chemistry of solids, or the adsorbed fluoride ions are transferred to the internal surfaces for porous materials (intra particle diffusion).

Evaluating an adsorbent for practical purposes, however, requires consideration of adsorption capacity in dilute solutions, pH, time for fluoride removal, stability of adsorbent, regeneration, and loading capacity in presence of other anions and cation and finally the overall cost for fluoride removal. Not all research papers report on all these factors and indeed various adsorbents cannot be readily compared with respect to adsorbent loads, initial fluoride concentrations and the varied dependent parameters reported.

Even for example the temperature to which titanium-rich bauxite is heated to prepare an activated adsorbent has such a profound effect on adsorption that a difference of 90℃ in calcination temperature can have the effectiveness of the resulting adsorbent in lowering the concentration of fluoride in water. These include activated, and impregnated alumina impregnated silica, carbonaceous materials solid industrial wastes like red mud, spent catalysts and fly ash zeolites and related ion exchangers and modified chitosan in addition to those considered under the heading of membrane techniques and more recently including layered double hydroxides.

The batch adsorption method is used for fluoride adsorption. Experiments are done using the adsorbents (Sugar cane waste powder, Tamarind seed powder). Dosages of powdered adsorbents in the range 0.50 to 1.25g/l is added to 500ml beakers and 200ml water is added. The contact period is varied between one hours to one day. Then the fluoride is determined by volumetric titration.

TABLE I. 0.25 g Dosage of adsorbents

S.No	**Sample**	**Amount of fluoride (0.25 g of sugarcane waste powder)**			**Amount of fluoride (0.25 g of Tamarind seed powder)**		
		1 hr	2 hr	1day	1 hr	2 hr	1day
1.	A	0.38	0.11	0.11	0.30	0.17	0.13
2.	B	0.94	0.64	0.21	0.70	0.63	0.57
3.	C	0.84	0.66	0.42	0.30	0.21	0.13
4.	D	0.77	0.12	0.12	0.21	0.19	0.15
5.	E	0.74	0.49	0.24	0.49	0.44	0.36
6.	F	0.98	0.76	0.53	0.38	0.32	0.25
7.	G	0.60	0.27	0.09	0.30	0.28	0.21

8.	H	0.71	0.53	0.42	0.52	0.46	0.38

TABLE II 0.15 g Dosage of adsorbents

S.No	**Sample**	**Amount of fluoride (0.15 g of sugarcane waste powder)**			**Amount of fluoride (0.15 g of Tamarind seed powder)**		
		1 hr	2 hr	1day	1 hr	2 hr	1day
1.	A	0.73	0.66	0.59	0.33	0.27	0.19
2.	B	0.75	0.68	0.61	0.67	0.57	0.51
3.	C	0.81	0.74	0.66	0.42	0.36	0.32
4.	D	0.33	0.29	0.27	0.29	0.23	0.17
5.	E	0.46	0.42	0.37	0.48	0.40	0.32
6.	F	0.94	0.77	0.76	0.31	0.23	0.21
7.	G	0.51	0.47	0.41	0.27	0.19	0.11
8.	H	0.62	0.56	0.50	0.46	0.42	0.34

TABLE III 0.10 g Dosage of adsorbents

S.No	**Sample**	**Amount of fluoride (0.10 g of sugarcane waste powder)**			**Amount of fluoride (0.15 g of Tamarind seed powder)**		
		1 hr	2 hr	1day	1 hr	2 hr	1day
1.	A	0.31	0.27	0.18	0.27	0.25	0.17
2.	B	0.90	0.70	0.52	0.72	0.63	0.55
3.	C	0.81	0.61	0.54	0.32	0.27	0.21
4.	D	0.64	0.56	0.49	0.25	0.22	0.13
5.	E	0.49	0.44	0.37	0.55	0.49	0.34
6.	F	0.71	0.59	0.47	0.53	0.44	0.38
7.	G	0.47	0.39	0.32	0.23	0.21	0.13
8.	H	0.71	0.71	0.64	0.53	0.42	0.36

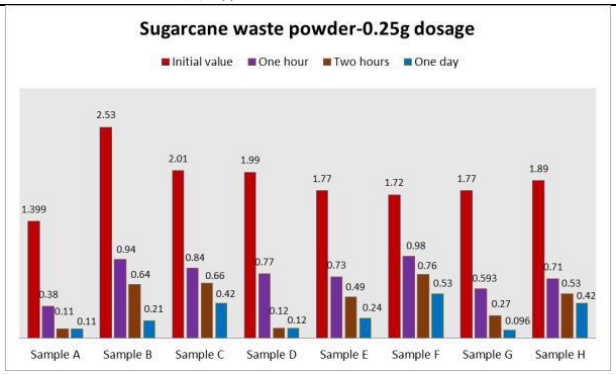

Fig. 1. Amount of fluoride after adsorption by using 0.25g dosage of Sugarcane waste powder

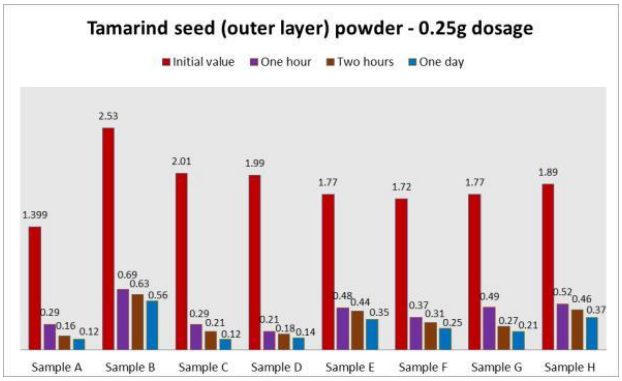

Fig. 2. Amount of fluoride after adsorption by using 0.25g dosage of Tamarind seed powder

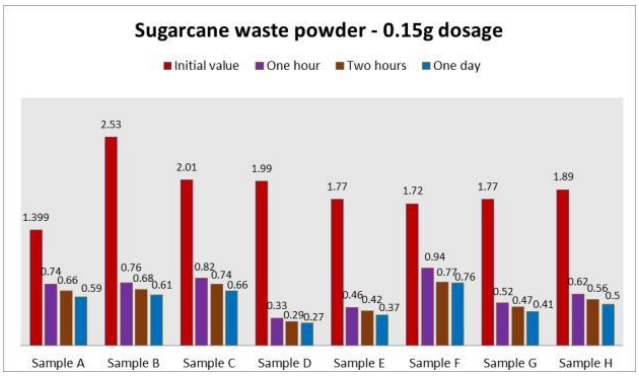

Fig. 3. Amount of fluoride after adsorption by using 0.15g dosage of Sugarcane waste powder

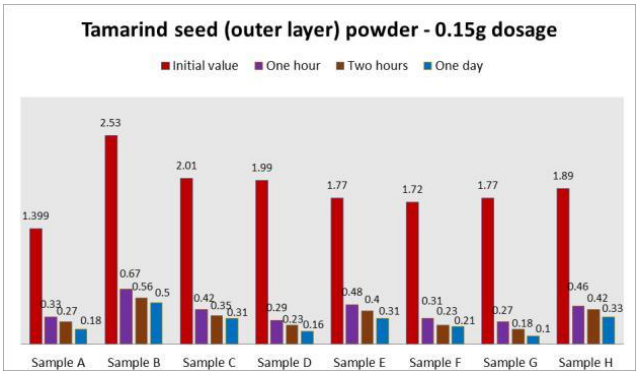

Fig. 4. Amount of fluoride after adsorption by using 0.15g dosage of Tamarind seed powder

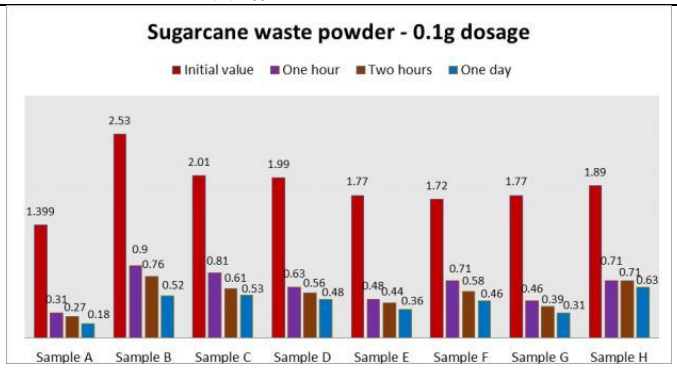

Fig. 5. Amount of fluoride after adsorption by using 0.10g dosage of Sugarcane waste powder

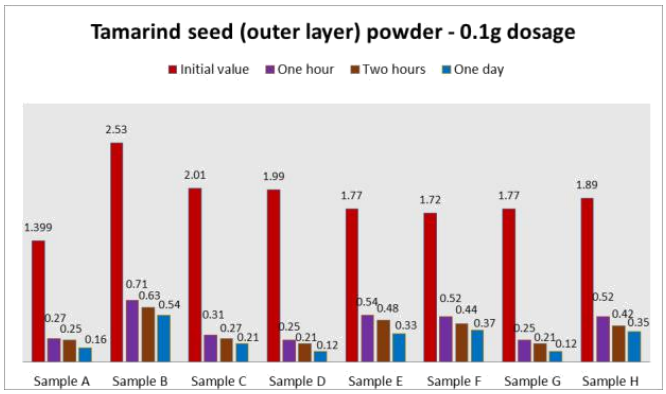

Fig. 6. Amount of fluoride after adsorption by using 0.10g dosage of Tamarind seed powder

III. Results and Discussions

1. Optimum parameter for Sugarcane waste powder

From the experimental investigation conducted for effective removal of fluoride from surface water by using Sugar cane waste powder as adsorbent, the optimum dosage is found as 1.25g/lit, the Optimum contact period is 1 day and the maximum percentage of removal of fluoride is 91.90.

2. Optimum parameter for Tamarind seed powder

From the experimental investigation conducted for effective removal of fluoride from sub surface water by using Tamarind seed powder as adsorbent the optimum dosage is found out as 1.25g/lit, the Optimum contact period is 1 day and the maximum percentage of removal of fluoride is 90.9.The comparison of the results obtained from the experimental investigations is shown in figure 5.1.

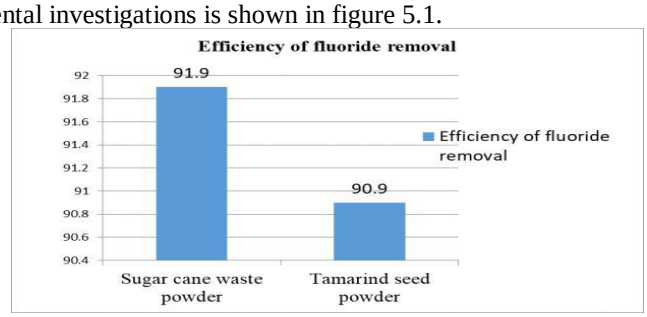

Fig 7 Efficiency of fluoride removal

3. Discussions

The chemical parameter of Fluoride contents presents in different surface samples are initially found out by traditional volumetric titration by using standard procedure. The new adsorbent technique has been derived and it was applied to the sample of water collected from various places of Thamirabarani river course. The adsorbents used in this project are Sugar cane waste powder and Tamarind seed powder. These two adsorbents are applied to the raw water sample directly. After a contact period of one to 24 hours again the treated water by the adsorbents are checked for the amount of fluoride by volumetric titration by the same

previously adopted procedure. From the results obtained, various trials of 0.10 to 0.25 percentage dosages for the efficient removal of Fluorides have been identified and those dosages are taken account in the project.

Depending upon the initial Fluoride contents presents in the raw water the various dosages from 0.10 and 0.25 percentage was applied for removing the main chemical substances. Based on the experimental investigations comparison charts and removal efficiency are identified and they are worked with the neat graph sheet form by using Microsoft Excel. In accordance with the experimental investigation the following suggestions are made for the efficient removal fluoride. Conclusions are made as per the results obtained from the experimental works and they are presented in the following subsequent pages in a neat manner. Further, the scope for future works has been explained.

IV. Conclusion

Based on the results of this study, it can be concluded that the economical materials like sugarcane waste powder and tamarind seed powder have good performance in adsorbing fluoride from drinking water especially for high concentration of fluoride. These adsorbing methods had given excellent results. From the experimental investigations conducted for effective removal of fluoride from surface water by using sugarcane waste powder and tamarind seed powder as adsorbent, the optimum dosage is found as 1.25g/lit and the Optimum contact period is found as 1 day. Sugarcane waste powder gives greater efficiency when compared with the tamarind seed powder. It can be concluded from the results of this present study the water quality of the river Thamirabarani is presently safe from physio-chemical point of view at the upstream water region and upstream areas whereas at downstream areas the quality was not desirable but within the permissible limit.

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