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Experimental study on water quality assessment and improvement of Thamirabarani 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 water samples were collected from various locations. 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. To study the techniques involved in the collection of samples from surface water. The main aim of this study is to remove the impurities present in the Thamirabarani River Course effectively.
Keywords : Water Quality, Thamirabarani, Flouride removal, Adsorbents**.**

1.0 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 increase salinity of groundwater due to seawater intrusion in coastal aquifers as a cause of high water demands and overexploitation.

1.1 Objectives of the Study

The aim of the project is to identify the areas having the current and future problems of fresh water quality in Thamirabarani river course. The main objective is to propose and evaluate the policy for addressing water pollution. To remove the impurities effectively from drinking water sources.

1.2 Turbidity

If a large amount of suspended matter such as clay, silt or some other finely divided organic materials is present in water, it will appear to be muddy or cloudy or turbid in appearance. The turbidity depends upon the fineness and concentration of particles present in water [1]. Although, the clay or other inert suspended particles may not be harmful to healthy, yet they are to be removed or reduced for aesthetic and psychological reasons. Permissible limits of 5 to 10 units of turbidity for drinking water.

1.3 Colour

The colour in water can be easily detected naked eye. For precise determination of small colour intensities, compact instrument properly lighted from inside, called tonometer, is generally used. The instrument contains an eye piece with two holes. A slide of standard coloured water is seen through one hole, and the slide of water to be tested is seen from the other hole. The standard coloured slide is replaced by another, till a matching will represent the intensity of colour of the sample. For public supplies, the colour number on cobalt scale should not exceed 20, and should preferably be less than 10.

1.4 Temperature

Testing the temperature of water has usually no practical significance in the sense that is not usually possible to give any treatment to control the temperature of water. However, from the academic point of view, it may be mentioned that for potable waters, temperatures of about 10oC are highly desirable, while temperatures above 25oC are considered objectionable.

1.5 Chemical Parameters

pH value of water indicates the logarithm of reciprocal of hydrogen ion concentration present in water. pH is one of the important parameters of water and determines the acidic and alkaline nature of water. The pH of the good quality water ranges from 7 to 8.3.

1.6 Chloride

Chlorides are generally present in water in the form of sodium chloride and may be due to leaching of marine sedimentary deposits, pollution from sea water, brine or industrial and domestic wastes, etc. The presence of high quality of chloride in river or stream waters may indicate pollution of water due to sewage and other human or industrial wastes. The chloride content of water can be measured by titrating the water with standard silver nitrate solution using potassium chromate as indicator. The permissible limit of chloride content is 1000 ppm and a desirable limit is 250 ppm.

1.7 Total Hardness

Total hardness is defined as the sum of the calcium and magnesium concentrations, both expressed as calcium carbonate, in mg/lt. originally water hardness was understood to be a measure of the capacity of eater to precipitated soap. Soap precipitated chiefly by calcium and magnesium ions present. Other prevalent cations also precipitate soap but they often are in complex forms and minimal concentration. Permitted limit for total hardness in drinking water is 600mg/lt.

1.8 Sulphate

Sulphate ions are precipitated as BaSO4 in acidic media with barium chloride. Barium chloride added to the water sample white precipitate formed by using oven dried the water. Finally calculated the sulphate present water. A permissible limit of sulphate in drinking water 400 ppm and a desirable limit is 200 ppm.

1.9 Dissolved Oxygen(D.O.)

D.O is the dissolved gaseous form of oxygen. It is essential for respiration of fish and other aquatic organisms. D.O enters water by diffusion from the atmosphere and as by product of photosynthesis by algae and plants. The concentration of oxygen to maintain 100% D.O. saturation. Excessive algae growth can over-saturate the water with D.O. when the rate of oxygen diffusion to the atmosphere. Hypo limnetic D.O. concentration is typically low as there is no mechanism to replace oxygen that is consumed by respiration &

decomposition. Fish need at least 3-5 mg/l of D.O. to survive drinking, domestic, agricultural, irrigation and fishing etc. The permissible limit of dissolved oxygen in drinking water is 2000 ppm and a desirable limit is 500 ppm.

1.10 Fluoride

Fluoride is found naturally in soil, water, foods and several minerals such as Fluor apatite and fluorite. Fluoride concentration in seawater averages 1.3ppm. While in fresh water supplies the natural range is typically between 0.01 to 0.3ppm. In some parts of the world, fresh water contains fluoride levels which are dangerous and can lead to health problem. Fluoride is also synthesized in laboratories synthesized fluoride is commonly added to drinking water, tooth paste, mouth washes and various chemical products. Water authorities add fluoride to tap water because they say it reduces the prevalence of tooth decay in the local population.

2.0 Scope/Objective

The aim of the project is to identify the areas having the current and future problems of fresh water quality in Thamirabarani river course .The main objective is to propose and evaluate the policy for addressing water pollution. To remove the impurities effectively from drinking water sources.

To avoid the health care issues related with excess amount of impurities present in the water.

2.1 Sample Collection

Samples are collected from Thamirabarani river of various location.The locations are, Papanasam, Cheranmahadevi, Gopalasamudram, Kokkirakulam, Authoor ,Earal , Srivaikundam and Punnaikayal.

2.2 Testing of Parameters

The samples are tested against physical & chemical parameters .

1. Physical parameter:
2. Turbidity
3. Colour
4. Temperature
5. Chemical parameter:
6. pH
7. Nitrate
8. Chloride
9. Sulphate
10. Fluoride
11. Hardness
12. Dissolved oxygen

From this investigation, it is found that the above parameters are within the permissible limit except fluoride.

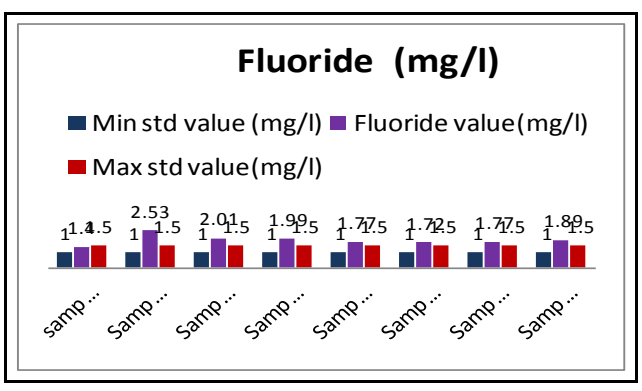

Figure 1 Amount of Fluoride present in the water sample

3.0 Experimental Investigation

3.1 Material Used

- Sugarcane waste powder
- Tamarind seed (outer layer) powder

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 110^0C. 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 'Sugar cane waste powder' contact with water sample for one to 24 hours.

Sample Treated by Using 'Tamarind seed (outer layer) powder'

The batch adsorption method is used for adsorption. The collected Tamarind seed (outer layer) are dried in hot air oven for 72 hours at 110^0C. 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.

3.2 Experimental Investigations and Dosage details

Although membrane methods have successfully reduced fluoride concentration to acceptable levels, surface adsorption retains a major place in De fluoridation research and practice because of its general greater accessibility and lower cost[2,3]. 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[4,5]. 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 [6,7,8]. 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 90^0C in calcinations 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) [9,10]. 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.

3.3 Removal of fluoride

From the test results we have found that almost in all the samples, the amount of fluoride present is slightly higher than the permissible limit. We are going to treat the samples by Adsorption method by effectively using the adsorbents.

3.4 Treatment of samples by Adsorption method

Table 1. 0.25g dosage of Sugarcane powder and Tamarind seed (outer layer) powder

Sample	Amount of fluoride (0.25g of Sugarcane power)			Amount of fluoride (0.25g of Tamarind seed (outer layer) power)		
	1 hour	2 hour	1 day	1 hour	2 hour	1 day
A	0.3824	0.112	0.1124	0.2953	0.168	0.126
B	0.9389	0.636	0.2105	0.6960	0.632	0.569
C	0.8434	0.661	0.4215	0.2953	0.210	0.126
D	0.7689	0.120	0.1205	0.2101	0.189	0.147
E	0.7351	0.489	0.2434	0.4892	0.442	0.358
F	0.9809	0.759	0.5318	0.3796	0.316	0.253
G	0.5926	0.268	0.0959	0.2975	0.274	0.210
H	0.7130	0.531	0.4215	0.5273	0.464	0.379

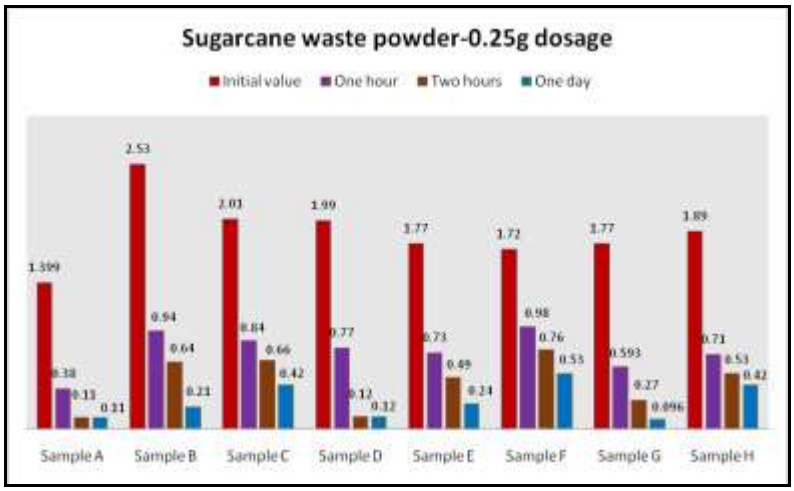

Figure 2 Amount of fluoride after adsorption by using 0.25g dosage of Sugarcane waste powder

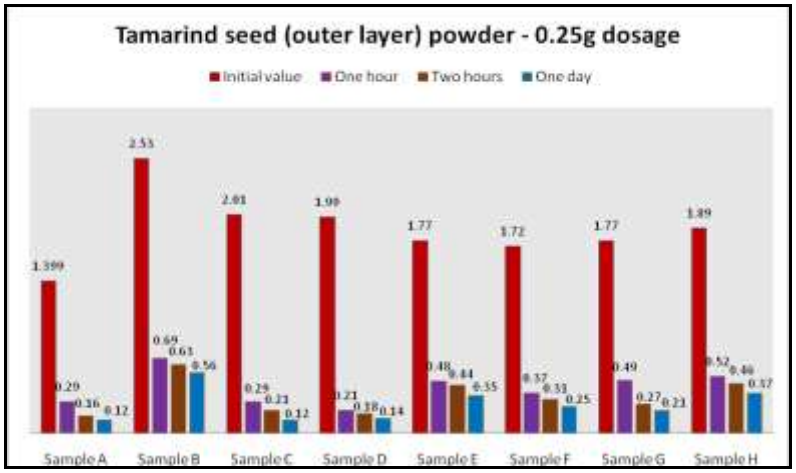

Figure 4 Amount of fluoride after adsorption by using 0.25g dosage of Tamarind seed (outer layer) powder

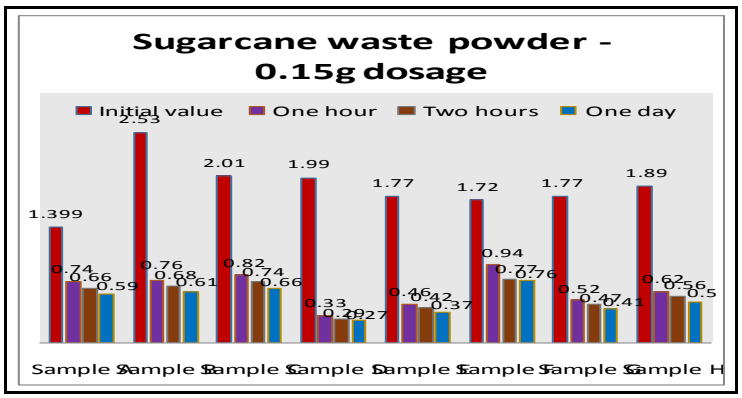

Figure 3 Amount of fluoride after adsorption by using 0.15g dosage of Sugarcane waste powder

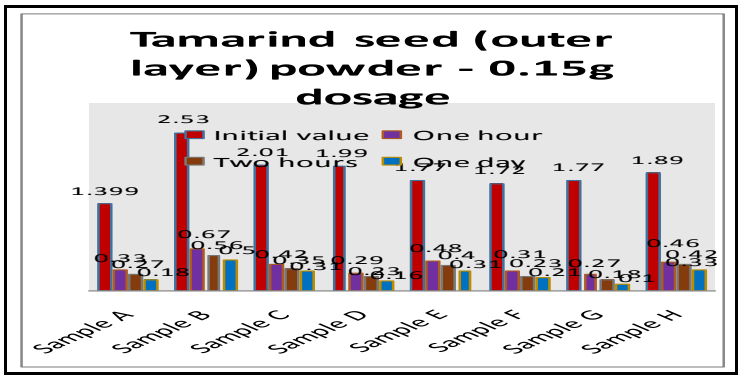

Figure 5 Amount of fluoride after adsorption by using 0.15g dosage of Tamarind seed (outer layer) powder

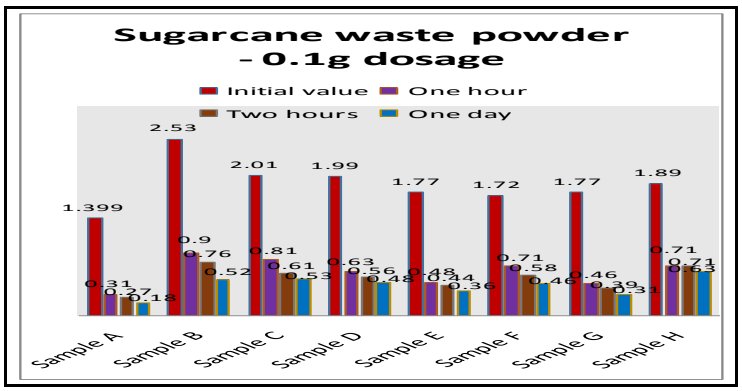

Figure 6 Amount of fluoride after adsorption by using 0.1g dosage of Sugarcane waste powder

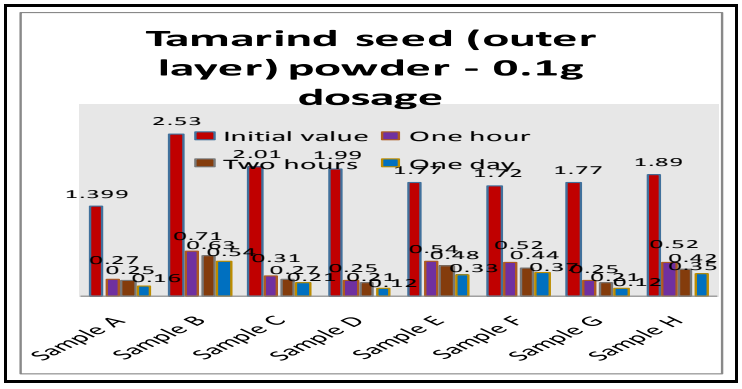

Figure 8 Amount of fluoride after adsorption by using 0.1g dosage of Tamarind seed (outer layer) powder

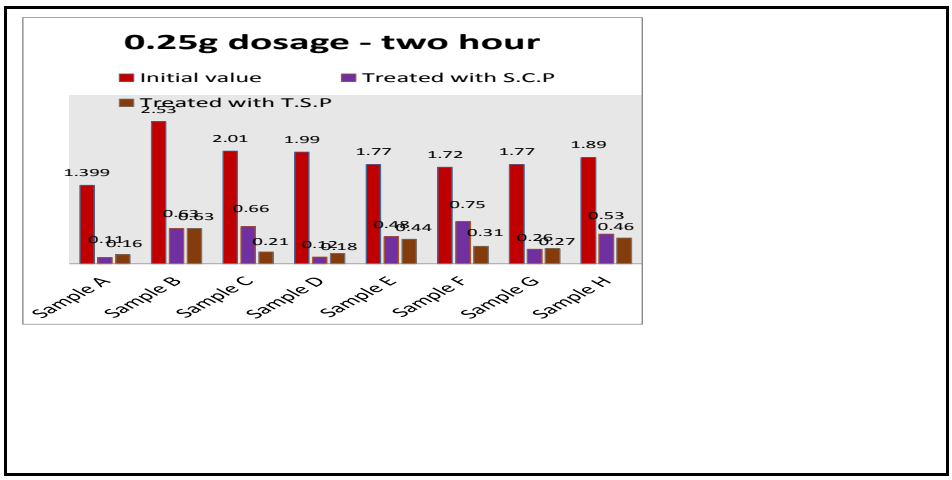

Figure 7 Comparison of 0.25g dosage of Sugarcane waste powder Vs Tamarind seed powder after two hour treatment

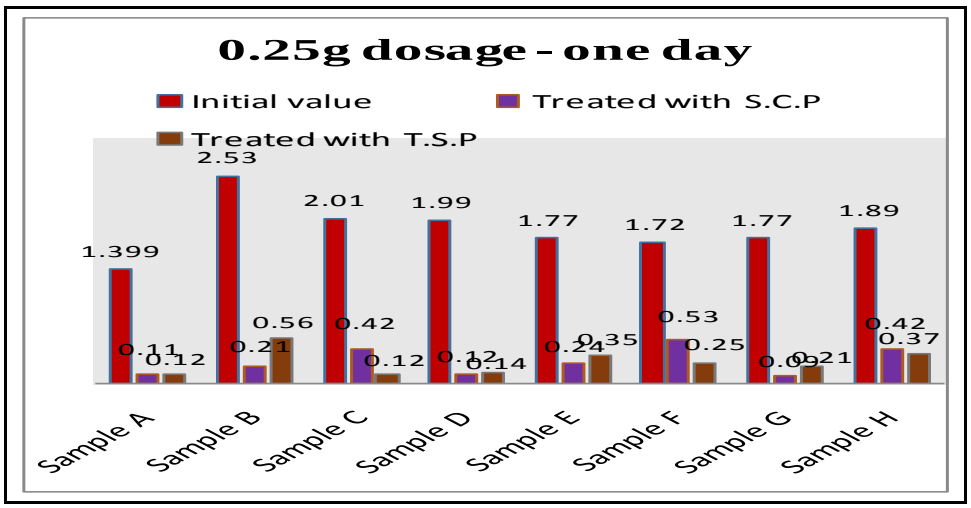

Figure 9 Comparison of 0.25g dosage of Sugarcane waste powder Vs Tamarind seed powder after one day treatment

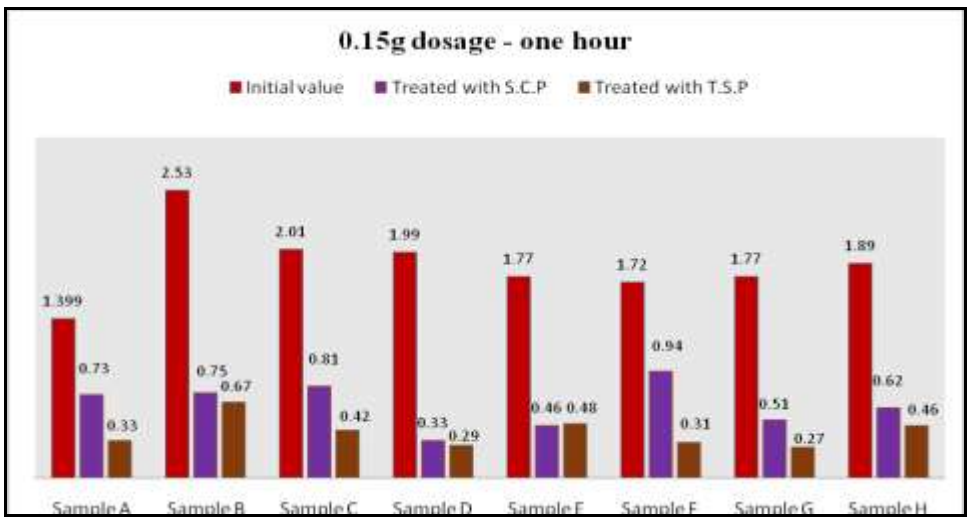

Figure 10 Comparison of 0.15g dosage of Sugarcane waste powder Vs Tamarind seed powder after one hour treatment

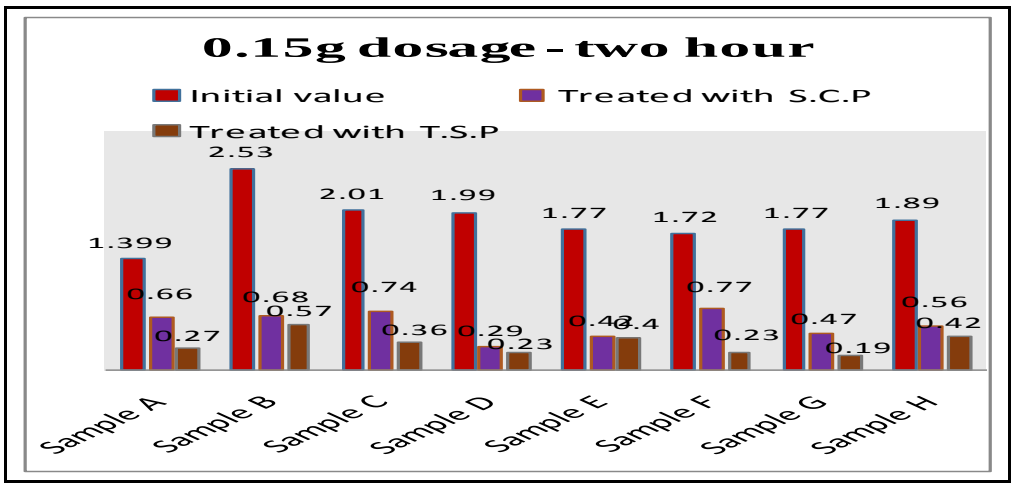

Figure 12 Comparison of 0.15g dosage of Sugarcane waste powder Vs. Tamarind seed powder after two hour treatment

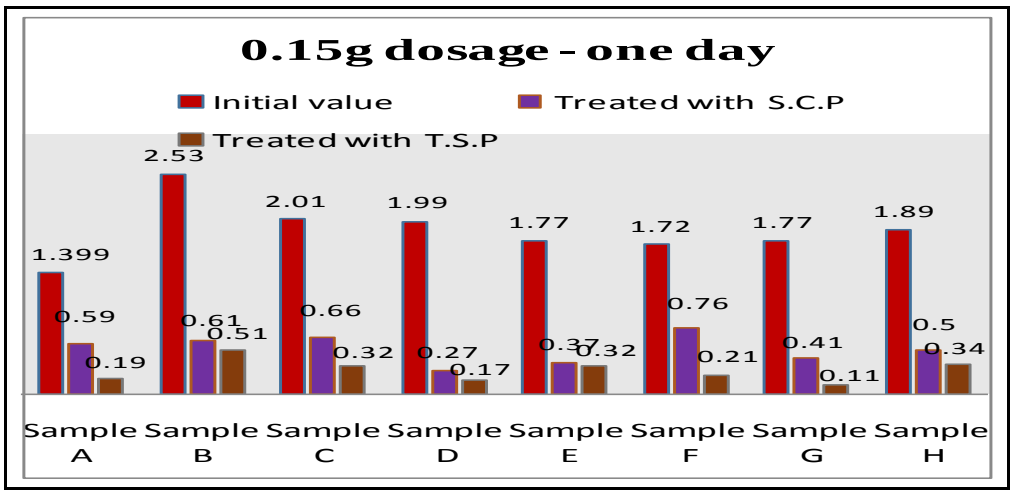

Figure 11 Comparison of 0.15g dosage of Sugarcane waste powder Vs. Tamarind seed powder after one day treatment

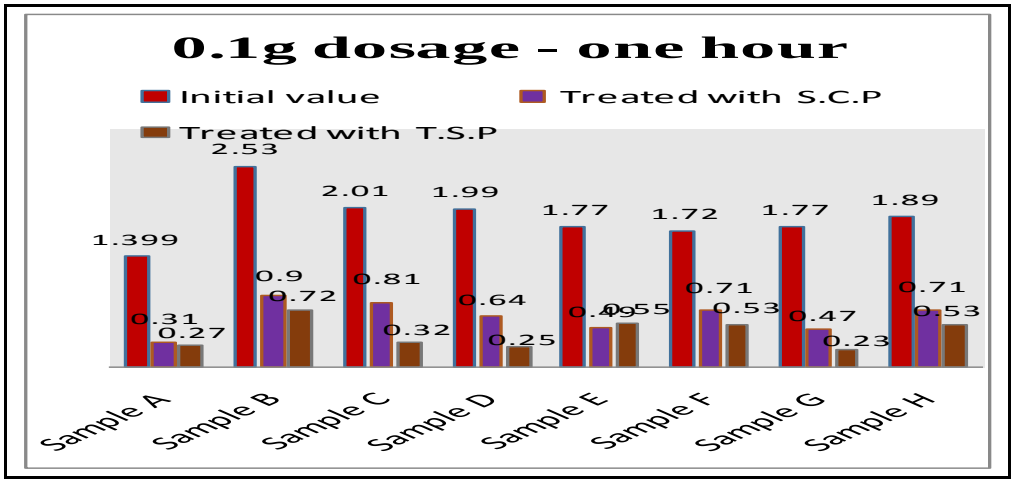

Figure13 Comparison of 0.1g dosage of Sugarcane waste powder Vs. Tamarind seed powder after one hour treatment

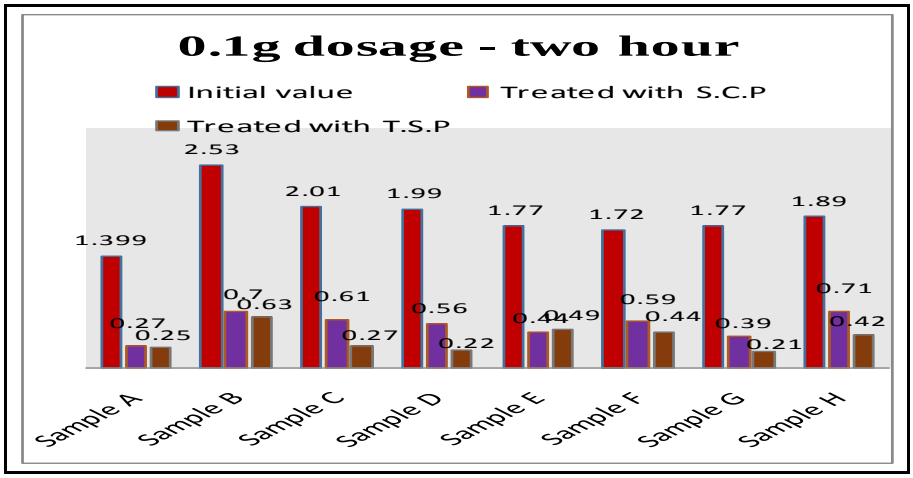

Figure 14 Comparison of 0.1g dosage of Sugarcane waste powder Vs. Tamarind seed powder after two hour treatment

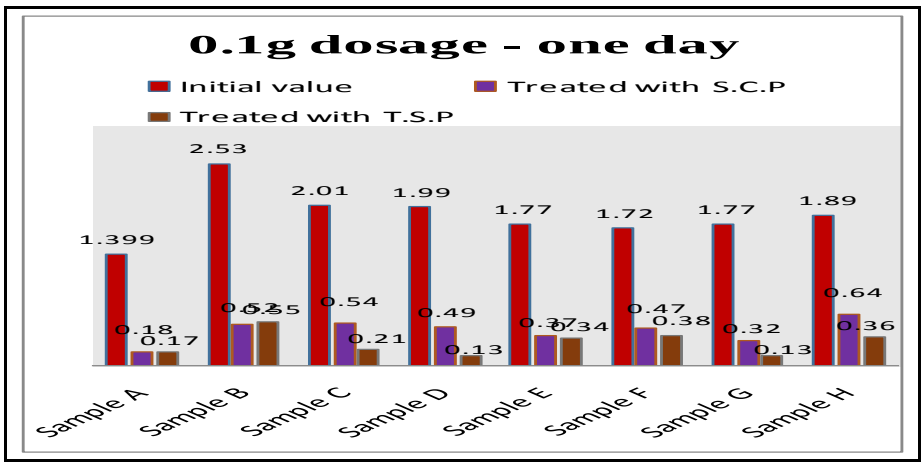

Figure 15 Comparison of 0.1g dosage of Sugarcane waste powder Vs. Tamarind seed powder after one day treatment

4.0 Results & Discussions

4.1 Comparison of Removal of Fluoride by Using 'Sugarcane Waste Powder & Tamarind Seed 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 out as 1.25g/lit, the Optimum contact period is 1 day and the maximum % of removal of fluoride is 91.90%. 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 % of removal of fluoride is 90.9%.

The comparison of the results obtained from the experimental investigations is shown in figure 5.1.

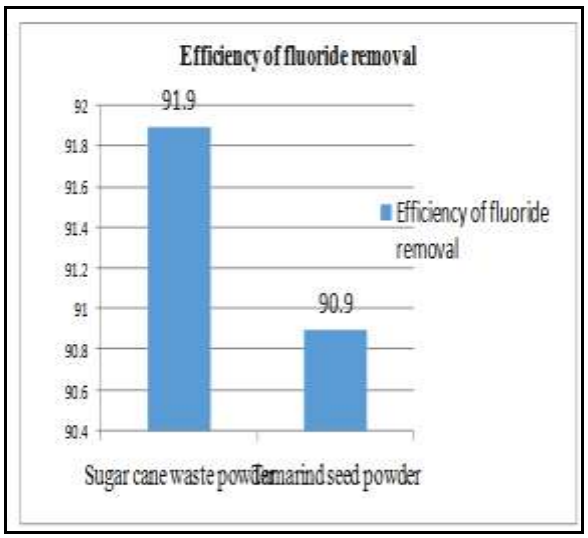

Figure 3.1 Comparisons of Results

4.2 Comparison of Results

1. Sugar cane waste powder, the maximum removal efficiency of fluoride was 92 % at 1.25 g/lit in1 day.
2. Tamarind seed powder, the maximum removal efficiency of fluoride was 91 % at 1.25 g/lit in1 day.

4.3 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.

4.4 Conclusions

The following conclusions are made with the results obtained from the experimental investigations of this project work. The adsorbent methods are most suitable for the removal of Fluoride since they do not need any form of machinery or pre preparation works. When compared to other chemical treatments these adsorbent methods are quite simple and economically.

Here in our project for the removal of fluoride, Sugar cane waste powder and Tamarind seed powder are used. These two adsorbents are naturally available materials with free of cost and also those materials can easily taken all over the nearby surroundings. If we are using these materials for the removal of fluoride we will reduce environmental pollution also.

1. Results are arrived based on the Experimental values

2. A new medium, waste material has been developed for fluoride removal in this study.
3. Waste materials act as an excellent adsorbent for removal of fluoride from the water sample has been proved.
4. Removal of fluoride has been carried out using cheaper material.
5. Among the three adsorbents, Sugar cane waste powder has been found to be more efficient with the removal percentage of 92% at shorter treatment period of 2 hours.

4.5 Scope for Future Work

This project work leaves the following scope for the future works. By increasing the dosage of the adsorbent more the 0.25%, one can do the experiments and the same time for the change of physical parameters can be taken care. With respect to various contact periods with the adsorbents the removal efficiency can be determined. Both the adsorbents can be combined with different percentage combinations and results can be studied.

5.0 References

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