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DEFLUORIDATION OF WATER USING ACTIVATED COFFEE HUSK AND ACTIVATED TEA WASTE

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Abstract - : The natural bio adsorbent have very good efficiency in Defluoridation of water. This method is cost effective and also utilization of waste materials as the raw material. In our study we utilize coffee husk and activated tea waste as the adsorbents. The coffee husk is acid activated before physical activation. Tea waste was activated by physical activation. This is mainly depending on the adsorption phenomenon. This will help utilization of bio adsorbent for removal of fluoride from water.

Key Words: Defluoridation, Adsorption, Activated Coffee Husk, Activated Tea Waste, Bio Adsorbent

1. INTRODUCTION

The fluoride is the most abundant mineral available in the earth crust. This will be in the form of sodium fluoride or hydrogen fluoride. This is a mineral of Fluorospar, Fluorapatite, Topaz and Cryolite. The fluoride will get in contact with water also through the artificial source i.e. by the discharge of industrial effluent. The fluoride content in the water is very harmful for the humans. This is termed as the double edged sword since it both enrichment and deficiency will have its harmful effect on human health. So the world health organization prescribed a limit for its concentration. The prescribed limit for fluoride is 0.7 mg/l to 1.5 mg/l. below this concentration will cause dental caries and above this limit will cause dental and skeletal fluorosis. There are various methods for Defluoridation. Such as Nalgonda technique, Bone Charcoal method, Nano Filtration, Membrane filtration process etc. Along with this adsorption process one of the best methods to remove fluoride from water. The adsorbent that can be utilized are Clay, Alum Sludge, Fly ash, Rice husk ash, Aluminum Treated Bagasse Fly ash, Maize ash, Tea ash, Coal mining waste, cashew nut sheath, corn cobs, coconut shell, groundnut shell, garlic peel and coffee husk.

2. MATERIALS AND METHODS

In our study we use coffee husk and tea waste as the adsorbent.

Preparation of adsorbent:

Coffee husk: Coffee husk is washed with water and it is sun dried for 5 days. Then it is washed with hot distilled water to remove dust particle and it is oven dried at 100±5^{o}C for 1 hour. Then the coffee husk is treated with concentrated Sulphuric acid to activate it chemically.50ml of concentrated Sulphuric acid is added for 100g of adsorbent. Then it is washed with double distilled water till it gets neutralized. Then it is physically activated by keep it in oven at 150^{o}C for 3 hour. The adsorbent particle passing through 600 micro meters is collected. The pH of the adsorbent is maintained at 7.

Tea waste: The used tea powder is collected from local shops. Then they were washed with distilled with water until the entire residual color and milk content is removed. After washing it is dried and kept in muffle furnace at 500^{0}C for 30 minutes. Then the activated tea waste grounded and sieved in 600µm sieve and stored in the container.

Preparation of stock solution: The stock solution is prepared by dissolving 0.221g of Sodium fluoride in 1000ml of double distilled water to get 100mg/l concentrated stock solution.

Preparation of samples: The samples of 5mg/l, 10mg/l, 15mg/l and 20mg/l were prepared from stock solution.

Method:

To study the effect of various parameters we will vary pH, contact time, adsorbent dosage and initial concentration of the fluoride. The pH effect is studied at 2, 4, 6, 8 and 10. The adsorbent dosage are 5g, 10g, 15g and 20g for activated coffee husk and activated tea waste are 0.25g, 0.5g, 0.75g and 1.0g. The analysis was done at the time interval of 30min, 60min, 120min, 180min and 300min.

The analysis of fluoride is done by using ion meter. The ion meter is calibrated at 0 to 10 mg/l and the required TISAB solution was prepared according to standards.

3. RESULT AND ANALYSIS

Adsorbent used: Activated Coffee Husk

1. Variation of pH:

Table-1: Variation of pH for activated Coffee Husk adsorbent

pH	Adsorbent Dosage (g)	Contact time (min)	Initial concentration (PPM)	Final concentration (PPM)	% of removal
2	10	120	10	7.63	23.7
4	10	120	10	6.824	31.76
6	10	120	10	6.504	34.96
8	10	120	10	6.56	34.4
10	**10**	**120**	**10**	**4.612**	**53.9**

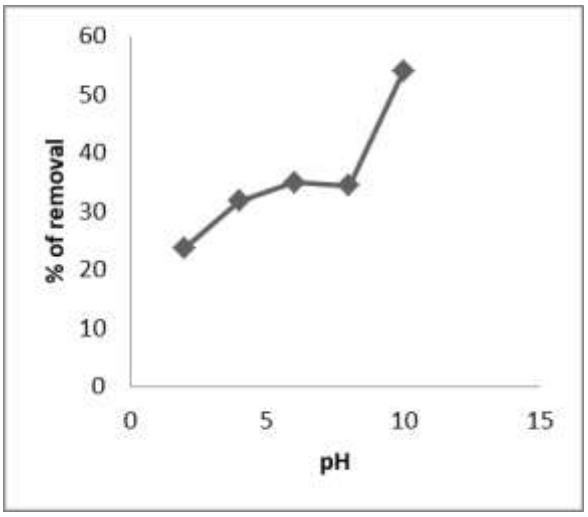

Chart-1: Variation of pH

The adsorption of Fluoride by activated coffee husk is found to be efficient at pH 10 and adsorbent dosage of 10g and of contact period of 180 minutes and initial concentration was kept constant of 10mg/l and RPM is set to 150 in the shaker. Percentage of removal is found to be 53.9% and decrease in pH will decrease the percentage of adsorption. For next trials the pH is kept constant of 10.

2. Variation of contact time

Table-2: Variation of Contact Time for activated Coffee Husk adsorbent

Contact time (min)	Adsorbent dosage (g)	pH	Initial concentration (PPM)	Final concentration (PPM)	% of removal
30	10	10	10	2.981	70.19
60	10	10	10	2.731	72.69
120	10	10	10	1.552	84.48

180	10	10	10	1.370	86.30
300	10	10	10	1.359	86.41

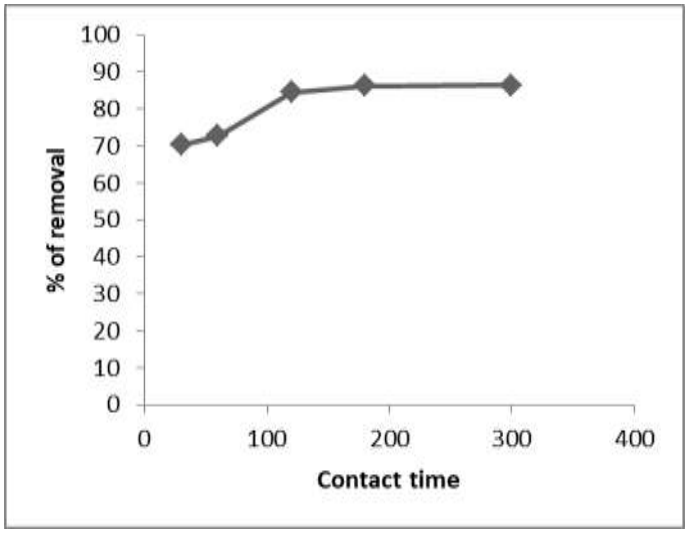

Chart-2: Variation of contact time

The variation of contact time such a way that keeping all other parameter constant viz. pH of 10, adsorbent dosage 10g, initial concentration 10 mg/l and RPM of 150. The percentage of adsorption of fluoride is found to be 86.3% for 180 minutes of contact time. Further increase in the contact time will not effect on the adsorption of fluoride and it will be equal to the contact time of 180 minutes.

3. Variation of adsorbent dosage:

Table-3: Variation of adsorbent dosage for activated Coffee Husk adsorbent

Adsorbent dosage(g)	pH	Contact time (min)	Initial concentration (PPM)	Final concentration (PPM)	% of removal
5	10	180	10	1.867	81.33%
10	10	180	10	1.368	86.32%
15	10	180	10	1.384	86.16%
20	10	180	10	1.390	86.10%

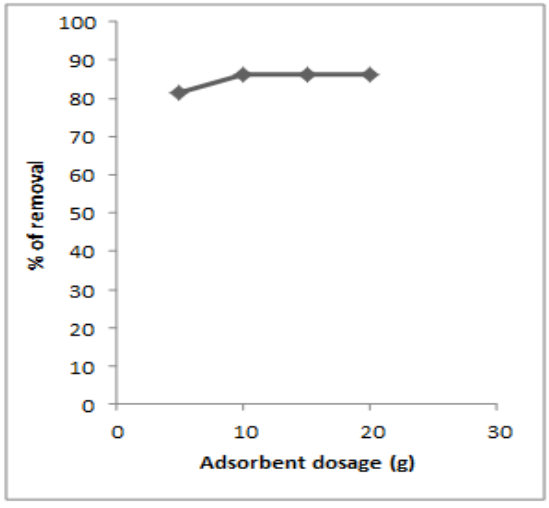

Chart-3: Variation of Adsorbent dosage

The study of variation of adsorbent dosage by keeping all other parameter such as pH, contact time, initial concentration and RPM constant as the previous study dosage is varied from 5 to 20g with 5g increase in each trials and adsorption efficiency is found to be maximum at dosage of 10g and it is 86.32% and it will be same if the adsorbent dosage increased.

4. Variation of initial concentration:

Table-4: Variation of initial concentration for activated Coffee Husk adsorbent

Initial concentration (PPM)	pH	Contact time (min)	Adsorbent dosage (g)	Final concentration (PPM)	% of removal
5	10	180	10	0.778	84.44%
10	**10**	**180**	**10**	**1.381**	**86.19%**
15	10	180	10	4.185	72.10%
20	10	180	10	6.285	68.57%

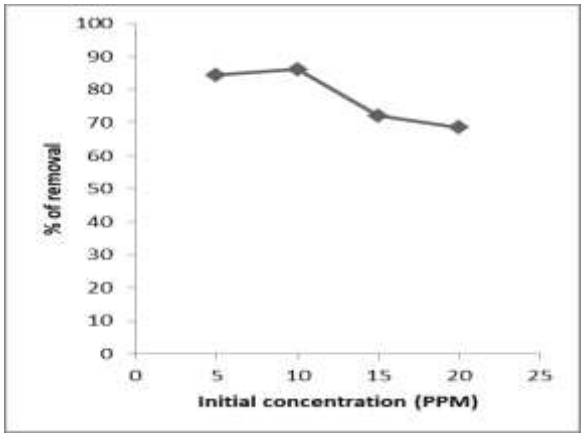

Chart-4: Variation of initial concentration

For the initial concentration of 10mg/l the adsorption and it is about 86.19% efficient. The adsorbent dosage was 10g, contact time was 180min and pH was maintained at 10. The agitation was kept constant at 150RPM

Adsorbent used: Activated Tea Powder

1. Variation of pH:

Table-5: Variation of pH for activated Tea Powder adsorbent

pH	Adsorbent dosage (g)	Contact time (min)	Initial concentration (PPM)	Final concentration (PPM)	% of removal
2	**1.0**	**60**	**10**	**0.430**	**95.7**
4	1.0	60	10	4.704	52.96
6	1.0	60	10	5.100	49.00
8	1.0	60	10	3.804	61.96
10	1.0	60	10	4.562	54.38

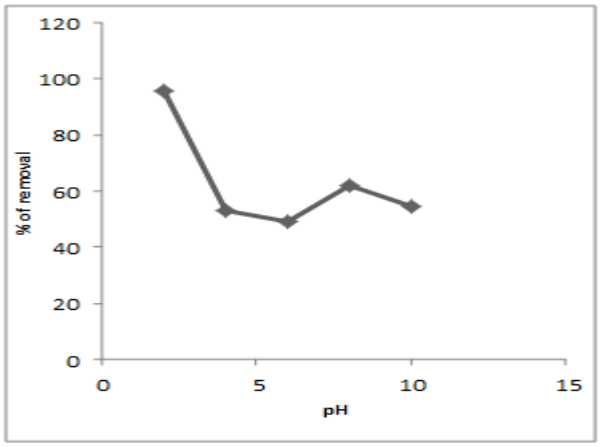

Chart-5: Variation of pH

The adsorption of Fluoride by activated tea powder is found to be efficient at pH 2 and adsorbent dosage of 1.0g and of contact period of 60 minutes and initial concentration was kept constant of 10mg/l and RPM is set to 150 in the shaker. Percentage of removal is found to be 95.70% and decrease in pH will decrease the percentage of adsorption. For next trials the pH is kept constant of 2.

2. Variation of contact time:

Table-6: Variation of contact time for activated Tea Powder adsorbent

Contact time (min)	Adsorbent dosage (g)	pH	Initial concentration (PPM)	Final concentration (PPM)	% of removal
30	1.0	2	10	2.639	73.61
60	**1.0**	**2**	**10**	**0.311**	**96.89**
120	1.0	2	10	0.314	96.86
180	1.0	2	10	0.384	96.16
300	1.0	2	10	0.328	96.72

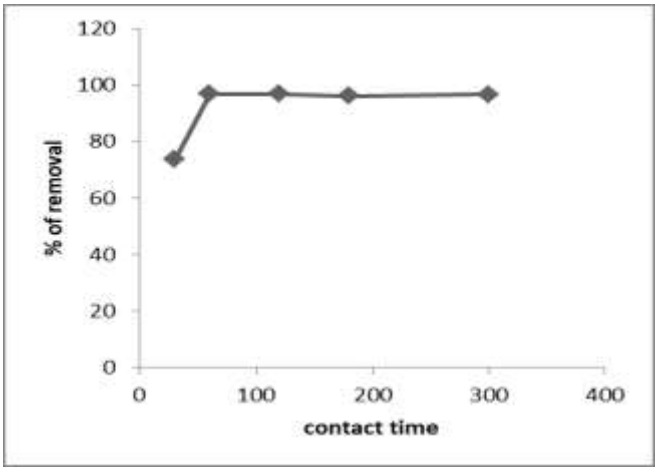

Chart-6: Variation of Contact Time

The variation of contact time such a way that keeping all other parameter constant viz. pH of 2, adsorbent dosage 1.0g, initial concentration 10 mg/l and RPM of 150. The percentage of adsorption of fluoride is found to be 96.89% for 60 minutes of contact time. Further increase in the contact time will not effect on the adsorption of fluoride and it will be equal to the contact time of 60 minutes.

3. Variation of adsorbent dosage:

Table-7: Variation of Adsorbent Dosage for activated Tea Powder adsorbent

Adsorbent dosage (g)	pH	Contact time (min)	Initial concentration (PPM)	Final concentration (PPM)	% of removal
0.25	2	60	10	1.930	80.76%
0.50	2	60	10	1.680	83.20%
0.75	2	60	10	1.098	89.02%
1.00	**2**	**60**	**10**	**0.316**	**96.84%**

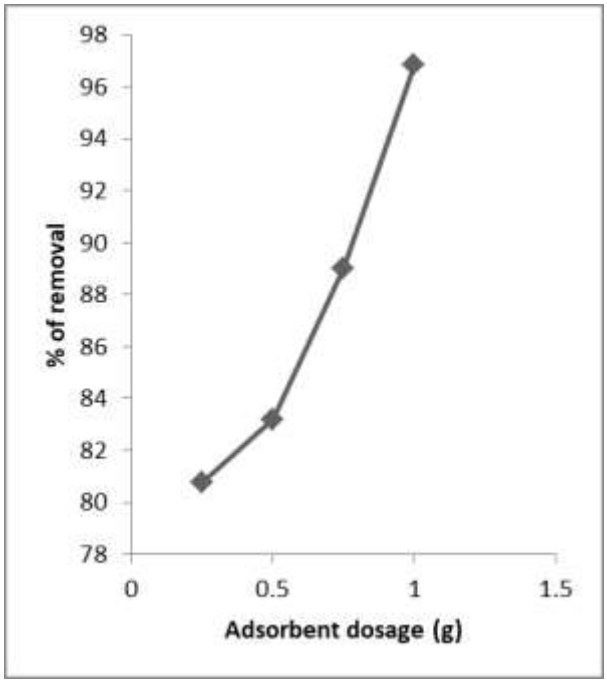

Chart-7: Variation of Adsorbent Dosage

The study of variation of adsorbent dosage by keeping all other parameter such as pH, contact time, initial concentration and RPM constant as the previous study dosage is varied from 0.25 to 1.0g with 0.25g increase in each trials and adsorption efficiency is found to be maximum at dosage of 1.0g and it is 96.84% and it will be same if the adsorbent dosage increased.

4. Variation of initial concentration:

Table-8: Variation of initial concentration for activated Tea Powder adsorbent

Initial concentration (PPM)	pH	Contact time (min)	Adsorbent dosage (g)	Final concentration (PPM)	% of removal
5	2	60	1.0	0.302	93.96%
10	**2**	**60**	**1.0**	**0.317**	**96.83%**
15	2	60	1.0	1.572	79.04%
20	2	60	1.0	5.064	74.68%

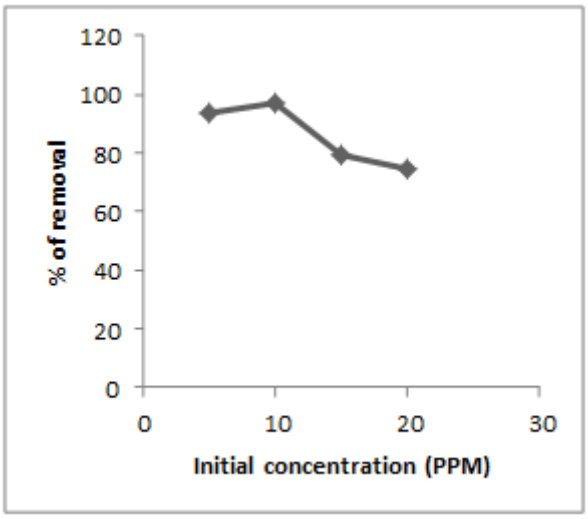

Chart-8: Variation of Initial concentration

For the initial concentration of 10mg/l the adsorption and it is about 96.83% efficient. The adsorbent dosage was 1.0g, contact time was 60min and pH was maintained at 2. The agitation was kept constant at 150RPM. Further increase in initial concentration will reduce the efficiency of adsorption.

Comparing the adsorption capacity of the activated coffee husk and the activated tea waste:

Table-9: Comparison between adsorption capacity of Activated Coffee Husk and Activated Tea Waste

Varying Parameter	Activated Coffee Husk		Activated Tea Waste	
	Result obtained At	% of removal	Result Obtained At	% of Removal
pH	10	53.9	2	95.7
Contact Time	180 min	86.30	60 min	96.89
Adsorbent Dosage	10g	86.32	1.0 g	96.84
Initial Concentration	10 PPM	86.19	10 PPM	96.83

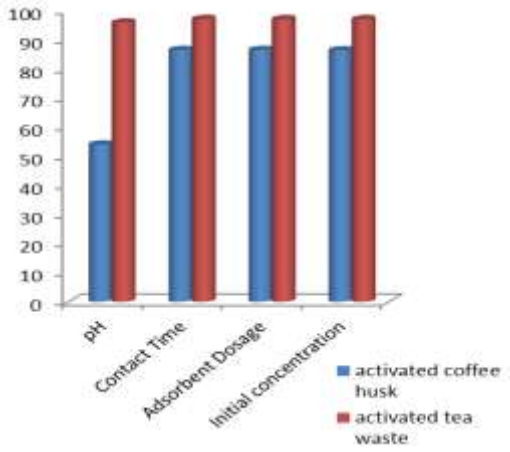

Chart-9: Comparison between adsorption capacity of activated coffee husk and activated tea waste

4. CONCLUSION

By this study we found that activated tea waste more efficient in Defluoridation than the activated coffee husk. The coffee husk showed the efficiency of 86.30% at the contact time of 180 minutes with pH 10 and initial concentration of 10mg/l and adsorbent dosage was 10g. On other hand activated tea waste showed the efficiency of 96.89% for the contact time of 60 min at pH 2 and initial concentration of 10 mg/l and adsorbent dosage was 1.0g.

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