EFFECTIVE ADSORPTION OF FLUORIDE ON LOW COST BIOADSORBENT MIXTURE OF CHARCOAL WITH *MALUS DOMESTICA PEEL* AND *COCOSNUCIFERA* HUSK.

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ABSTRACT

Fluoride is found to be one of the anionic contaminants, which are found in excess on the surface or ground water that leads to hazardous effect on the living organisms. In present work, dried apple peel powder, coconut husk powder, dried apple peel powder with charcoal and coconut husk powder with charcoal is been investigated with fluoride rich water. The study includes treatment of adsorbents on fluoride ion present in the solution, factors affecting adsorption and adsorption capacity of adsorbent with varying quantity. After adsorption, resultant fluoride ion content was estimated by calibration curve method using spectrophotometer as an instrument.

Keywords: Adsorption, fruit peel waste, bio adsorbent, activated carbon.

INTRODUCTION

The presence of naturally occurring fluoride ions in drinking water allows its easy entrance in the body via gastrointestinal tract. Heightened fluoride >1.5mg/L concentration can induce birth, reproduction as well as immunological defects, dental and skeletal fluorosis (Stanic *et al.*, 2014). The lack of fluoride in the body is can cause dental caries. The increase in the fluoride ions concentration in potable water over 1.5 mg/l causes to another dental disease – fluorosis (Martsev and Selivanov, 2020). Numbers of methods are available for removal of fluoride ions from aqueous solution which includes chemical precipitation, ion exchange, biological degradation, solvent extraction and adsorption. Among all these methods adsorption is most popular, simple and effective technique. This process can minimize or remove fluoride ion and thus have wide range of applications in waste water treatment. Conventional adsorbents and non-conventional adsorbents are two types of adsorbents. Activated charcoal is the form of carbon which is processed to have low volume pores that increases the surface area available for adsorption. Activated carbon is an example of conventional adsorbent which is commonly used for removal of various pollutants from waste water. Non-conventional adsorbents such as fruit peel waste, agricultural waste, plant waste, living and non-living mass which also referred as bio adsorbents. Our country is the

second largest producer and consumer of fruits which also indicates the generation of million tons of fruit peel waste, which can be effectively used for removal of fluoride ions. Advantages of abundantly available, Low cost fruit peels are it has good adsorption capacity and less disposal problem after absorption (Pathak *et al.*, 2015).

ADSORPTION CAPACITY OF FRUIT PEELS WASTE AND FACTORS AFFECTING IT:

Adsorption is described as a process by which solids holds molecules of gases/liquids on its thin films. Adsorption processes are of two types: physical and chemical adsorption (Patel *et al.*, 2019). The type of adsorption used in above research project is physical adsorption. Adsorption capacity of fruit peel depends on size, surface area and relative affinity towards adsorbate (Saranya and Anu, 2016).The relative affinity of adsorbent depends on:-1) Thickness 2) density of adsorbent 3) radius of fibers 4) temperature. NaF is used as an adsorbate as it reflects the properties of solution containing fluoride.

MATERIAL AND METHODS

MATERIALS

Standard measuring flask (100 cm^3, 250 cm^3), beaker (100 cm^3, 250 cm^3, 500 cm^3), pipette (25 cm^3, 10 cm^3), graduated pipette (2 cm^3, 5 cm^3, 10 cm^3), test tubes, weighing balance, wire gauze, glass rod, charcoal powder, coconut husk powder, oven, funnel, filter papers, dried apple peels powder, colorimeter.

CHEMICALS: Sodium fluoride salt, Alizarin red-S, Zirconyl nitrate, Distilled water.

METHODS

The Colorimeter worked on the principle of the Beer-Lambert's law and operated in the visible range of the spectrum. The colorimetric reagent formed during the analysis was Zirconyl Alizarin complex, for which the λ_{max} value obtained was 530 nm. The Zirconyl Alizarin complex has a deep reddish brown color. This when came in contact with fluoride ions, bleaches due to the formation of colorless fluorizirconate anions. As the concentration of fluoride increases, colorless fluorizirconate anion increases in concentration which decreases the intensity of absorbance. The Colorimetric analysis was used for its simplicity, convenience and availability in the institute

1) **STOCK SOLUTION OF SODIUM FLUORIDE (100 ppm):** Dissolved 0.055 g of sodium fluoride into 250 cm^3 of distilled water in a standard measuring flask.
2) **REAGENT A**: Dissolved 0.188 g of alizarin red-S into 250 cm^3 of distilled water.

3) **REAGENT B**: Dissolved 0.073g of ZrO $(NO_3)_2.2H_2O$ in about 150 cm^3 of distilled water. Added 8.3 cm^3 of concentrated H_2SO_4 and diluted it upto 250 cm^3.

CALIBRATION CURVE METHOD

1) 10 cm^3 of 100 ppm solution of sodium fluoride is diluted up to 100 cm^3 with distilled water to prepare 10 ppm sodium fluoride solution which was used for further dilutions.

2) Ten different standard solutions were prepared by addition of 2cm^3, 4cm^3, 6cm^3, 8cm^3, 10 cm^3, 12cm^3, 14 cm^3,16cm^3, 18cm^3 and 20cm^3 of 10 ppm solution of sodium fluoride into ten labeled100 cm^3 standard measuring flasks respectively of 0.2 ppm, 0.4 ppm, 0.6 ppm, 0.8 ppm, 1.0 ppm, 1.2 ppm, 1.4 ppm, 1.6 ppm, 1.8 ppm, 2.0 ppm as shown in Table 1.

3) 5 cm^3 of reagent Aand added25cm^3 of distilled water was added to each flask. Shaked it well. After an interval of 10 minutes 5cm^3 of reagent B was added to each flask and diluted with distilled water upto the mark and kept aside for 30 minutes in dark place. For these solutions the absorbance were measured at 530 nm and a calibration curve was plotted for concentration of fluoride ion versus absorbance measured.

SAMPLE PREPARATION AND TREATMENT ON FLUORIDE SOLUTION

The adsorbent apple peels, coconut husk and charcoal were finely chopped and then apple peels and coconut husk dried in oven at around 109ºC(air dry) for around 2 to 4 hours. The different amount and different mixture of adsorbents were added to 2.00ppm standard solution of NaF, as shown table no.2. The mixture was shaked vigorously and these samples were then allowed to stand overnight. These samples then filtered to get cleared solution. Then 5 cm^3 of reagent A was added to each flask. Then25cm^3 of distilled water was added to each flask. Shaked it well. After an interval of 10 minutes 5cm^3 of reagent B was added to each flask and diluted with distilled water upto the mark and kept aside for 30 minutes in dark place. For these solutions the absorbance were measured at 530 nm and a calibration curve was plotted for concentration of fluoride ion versus absorbance measured.

Picture (a): dried samples of Charcoal powder,apple peel powder, coconut husk powder

Picture (b): 100 cm^3 standard measuringflasks with adsorbent and fluoride solution before dilution

Picture (c): 100 cm^3 standard measuring flasks after dilution of fluorides solution (filtered from soaked adsorbent)

Picture (d): Colorimeter while performingthe experiment

OBSERVATION TABLE:

Flask no.	Type of adsorbent	Wt. of adsorbent in grams.	Vol. of NaF in 10ppm	Conc. of F^- ions (ppm)	Conc. of F^- ions (mg/100c m^3)	Absorbance
1.	Apple peels powder	0.025	20	2.0	0.2	0.10
2.	Apple peels powder	0.05	20	2.0	0.2	0.09
3.	Apple peels powder	0.075	20	2.0	0.2	0.07
4.	Apple peels powder	0.1	20	2.0	0.2	0.08
5.	Charcoal powder	0.025	20	2.0	0.2	0.14
6.	Charcoal powder	0.05	20	2.0	0.2	0.17
7.	Charcoal powder	0.075	20	2.0	0.2	0.16
8.	Charcoal powder	0.1	20	2.0	0.2	0.15
9.	Charcoal powder + coconut husk powder	0.025	20	2.0	0.2	0.15
10.	Charcoal powder + coconut husk powder	0.05	20	2.0	0.2	0.17
11.	Charcoal powder + coconut husk powder	0.075	20	2.0	0.2	0.18
12.	Charcoal powder + coconut husk powder	0.1	20	2.0	0.2	0.18
13.	Charcoal powder + apple peels powder	0.025	20	2.0	0.2	0.18
14.	Charcoal powder + apple peels powder	0.05	20	2.0	0.2	**0.21**
15.	Charcoal powder + apple peels powder	0.075	20	2.0	0.2	**0.23**
16.	Charcoal powder + apple peels powder	0.1	20	2.0	0.2	**0.21**

Different concentration of solution shows variable absorbance for different types of adsorbent.

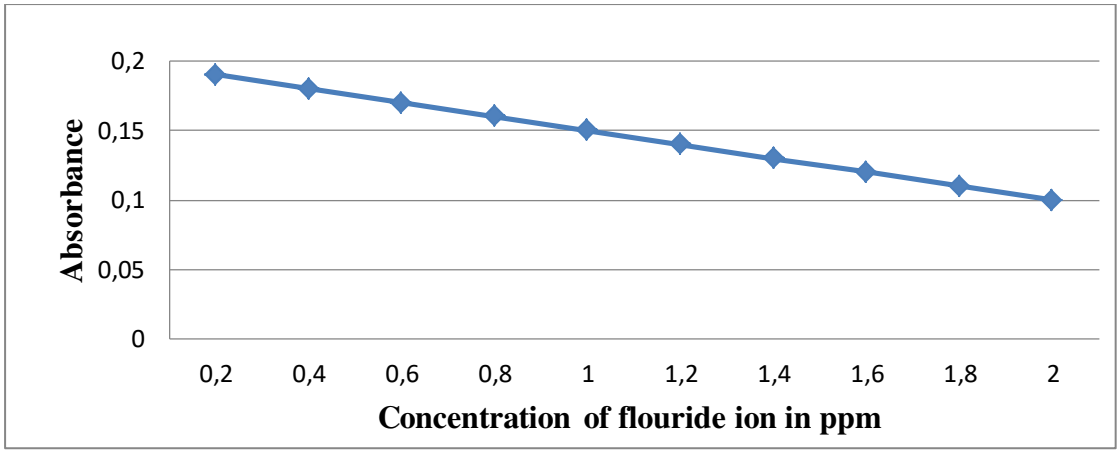

Figure 1: Calibration curve plot for concentration of fluoride ions in ppm against absorbance

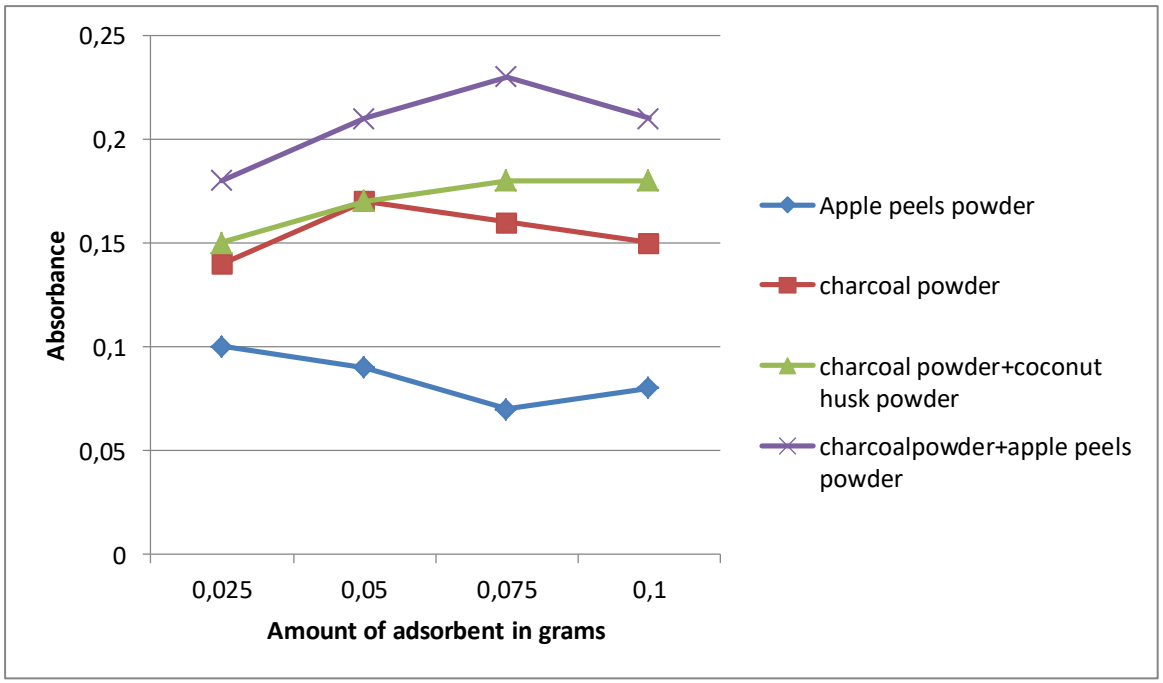

Figure 2: Relative plot for different amounts of adsorbent in grams for various mixtures of adsorbents against absorbance

RESULTS AND DISCUSSION

The above method was based on absorbance property at specific wavelength of light for the colored complexes. The absorbance of the sample was determined by colorimeter and concentration of fluoride ion after adsorption with different adsorbents was found out by using calibration curve method. Apple powder as well as charcoal has also shown noticeable adsorption. The results have shown that charcoal powder with coconut husk powder and

charcoal powder with apple peels powder is effective for adsorption of fluoride ions on its surface. About 2.0 ppm of fluoride is reduced to less than0.2 ppm fluoride.

CONCLUSION

Activated carbon/charcoal is a good adsorbent in extraction of fluoride ion.

Addition of apple peels powder and coconut husk powder increases the adsorptivity of charcoal towards fluoride ion. This provides an alternate method for adsorption of fluoride ion in cheap and effective manner. The study can be continuing by extracting fluoride ion from waste water, helps in waste water management.

ACKNOWLEDGEMENT

Authors are thankful to Chemistry Department of VPM's B. N. Bandodkar College of Science, Thane, for providing laboratory facilities, required chemicals and instruments. We would also express our gratitude towards Miss. Smita Sonawane and Miss. Trupti Londhe for their support and guidance in elaboration of this study.

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