

Removal of Halides from Ground Waters of Coastal Andhra Pradesh by Batch Adsorption

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Abstract- The increased presence of fluorides and chlorides in ground waters of coastal Andhra Pradesh has been a concern in the present day. Owing to its advantages, adsorption technique is selected for treating these waters. Aluminium sulphate is used as adsorbent for fluoride removal and eggshell powder is used for chloride removal. Removal of fluoride is upto a maximum of 40 percent and chloride removal is upto 75 percent. The treated water has the concentrations of fluoride and chloride within acceptable limit

Keywords- Adsorption, fluoride removal, chloride removal, ground water.

I. INTRODUCTION

Contamination of ground water with fluorides and chlorides is a commonly encountered problem across many states of India. Although the presence of fluorides in drinking water is essential in the range of 0.5 to 1.5 ppm, if the concentration of fluoride is outside this range, severe health issues are found in human beings. For chlorine, the upper limit is fixed as 250 ppm. The rapid growth in population in India in last three decades led to excessive consumption of ground water. This caused increased content of dissolved salts in these waters. Obviously there is a rise in the levels of fluorides and chlorides in ground water. Many methods have been developed for fluoride removal from water such as adsorption, ion exchange, reverse osmosis, nano filtration, electro dialysis and precipitation. Among these methods, adsorption is chosen for the present study because of the following advantages: (i) it is cheap, (ii) the adsorbent can be easily regenerated, (iii) the sludge generation is minimum, (iv) wide range of adsorbents are available, (v) simple operation, (vi) high productivity, (vii) good competitive performance and (viii) ability to produce high quality water. Adsorption technique has been employed successfully not only for removal of heavy metals such as copper[1], chromium[2] and cadmium[3], but also for anions like phosphates[4] by earlier investigators.

Due to the possibility of increase in fluoride concentration in ground water of coastal Andhra Pradesh, an attempt is made to obtain water samples from different districts of coastal Andhra Pradesh and test them for fluorides and chlorides using standard methods. In the present study, for removing fluoride, aluminium sulphate is used as adsorbent,

whereas for chloride removal and adsorbent prepared from egg shells was used successfully.

II. MATERIALS AND METHODS

Water samples from different coastal districts of Andhra Pradesh were collected during May to August in 2018. These samples were treated in batch process by using aluminum sulfate as an adsorbent for fluoride removal and eggshell powder as adsorbent for chloride removal. Aluminium sulphate is procured from market and it is used as supplied to remove fluorides from water. Waste matter from egg shells is removed and boiled in deionized water for 30 minutes and thoroughly washed with deionized water. Then the eggshells were heated in a hot air oven at 105°C for 7 hrs. After cooling, the eggshells were crushed in a laboratory electrical crusher for 20-30 seconds and were sieved several times to get a uniform fraction of eggshell powder of a specific size (-52+120 ASTM mesh). The eggshell powder was stored in a desiccator after pre-treatment with a solution of sodium hypo chloride to eliminate the dust particles. Fluoride ion concentration was estimated by a fluorometer (Hach-India make) and chloride ion concentration was estimated by argentometric titration.

To determine the effect of contact time, 50 ml of water sample was taken in each of six conical flasks with known weight of adsorbent (1.0 gram). These conical flasks were placed in orbital shaker for the purpose of agitation. After 15 minutes one of the flasks was taken from the shaker and filtered by using Whatman filter paper. The filtrate obtained was tested using fluorometer for concentration of fluoride in the water. This procedure was repeated for remaining 5 flasks at 30, 45, 60, 75 and 90 mins. To determine the effect of adsorbent dosage, five conical flasks, each containing 50 ml of water sample were taken and adsorbent with different weights viz., 0.2, 0.4, 0.6, 0.8 and 1.0 g were added to these five flasks respectively. These conical flasks were placed in orbital shaker for agitation. After 75 min all five flasks were taken out and filtered by using the filter paper. The filtrate was tested for concentration of fluoride by using fluorometer

III. RESULTS AND DISCUSSION

Figure 1 shows the effect of contact time for removal of fluorine using aluminium sulphate adsorbent. A close examination of the plots of this figure reveals that the percent removal of fluoride attained maximum value corresponding to an agitating time of 60 minutes for five of the six samples considered. For sixth sample, maximum removal was observed at 75 min. A close inspection of this plot reveals that this sample corresponded to a low initial fluoride concentration, and hence required more time for the fluoride ions to get attached to the adsorbent surface.

Figure 2 shows the effect of adsorbent dosage on removal of fluorides. A close examination of the plots of this figure reveals that maximum fluoride removal can be seen corresponding to an adsorbent dosage of 18 g/L. Nearly all samples employed in the present study had exhibited maximum removal of fluoride at this dosage. The reason is that at this dosage, the available active sites are sufficient for fluoride ion to get attached to the adsorbent.

By employing a contact time of 60 min, and a dosage of 20 g/L of adsorbent, the initial and final concentrations of fluoride ion for all six samples obtained were shown in Fig.3. One can notice that the concentration of fluoride ion in product water is within the acceptable limit of 0.5 to 1.5 ppm.

Similar study was conducted with eggshell powder as an adsorbent for the removal of chloride ion. For this investigation, only one sample was considered. For investigating the effect of contact time, about 30 g/L of adsorbent was taken and the resulting data were shown plotted in Fig.4. It is seen from the plot that 30 min is the optimal contact time. In order to obtain the optimal dosage, data on percent removal of chloride ion were obtained with different dosages and the resulting data were presented in Fig.5. it is observed from the plot of this figure that the optimal dosage was 30 g/L.

IV. CONCLUSIONS

The present study was focused on removing fluorides and chlorides from ground water of coastal Andhra Pradesh in which their concentration was found to be excessive. Using aluminium sulphate as adsorbent, the water was treated for fluoride removal and eggshell powder for chloride removal. The adsorbents were able to remove 40 percent of fluorides and 75 percent of chlorides at optimum conditions respectively. For fluoride removal, optimal contact time was found to be 60 min and optimal adsorbent dosage as 18 g/L. In case of chlorides, 30 min was the optimal contact time and 30 g/L was the optimal adsorbent dosage

V. FIGURES AND TABLES

TABLE 1. DETAILS OF SAMPLES COLLECTED

Sample number	District	Initial fluoride concentration (ppm)
1	Srikakulam	1.6
2	Vishakhapatnam	1.8
3	East godavari	1.1
4	Vizianagaram	1.0
5	Nellore	1.7
6	Prakasam	1.3

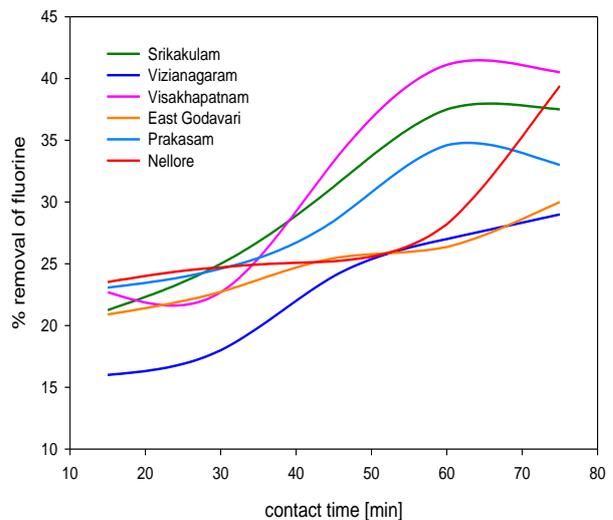


Fig.1. Effect of contact time for fluoride removal

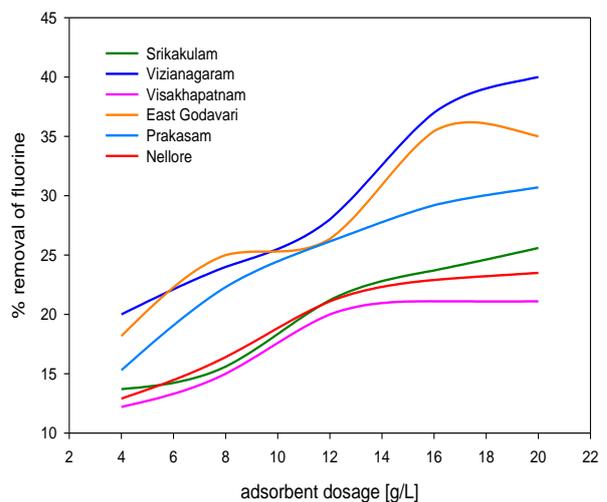


Fig.2. Effect of adsorbent dosage for fluoride removal

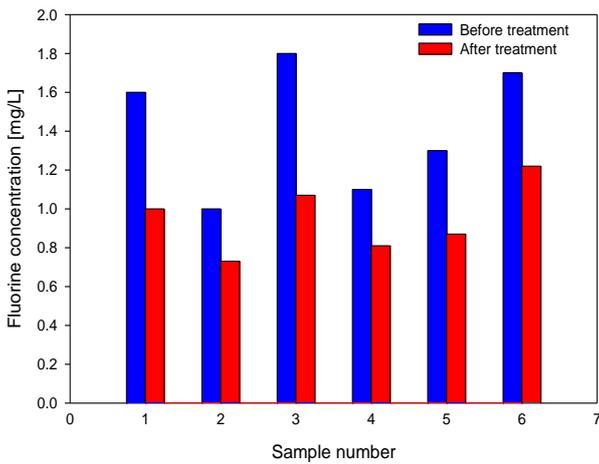


Fig.3. Fluoride ion removal by adsorption with aluminium sulphate

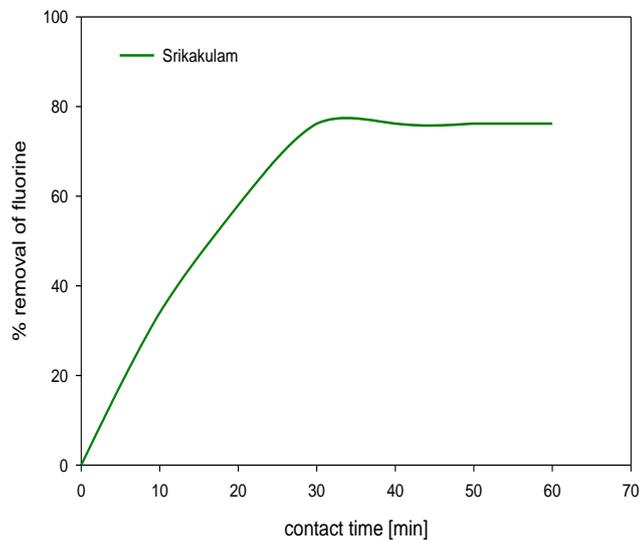


Fig.4. Effect of contact time for fluoride removal

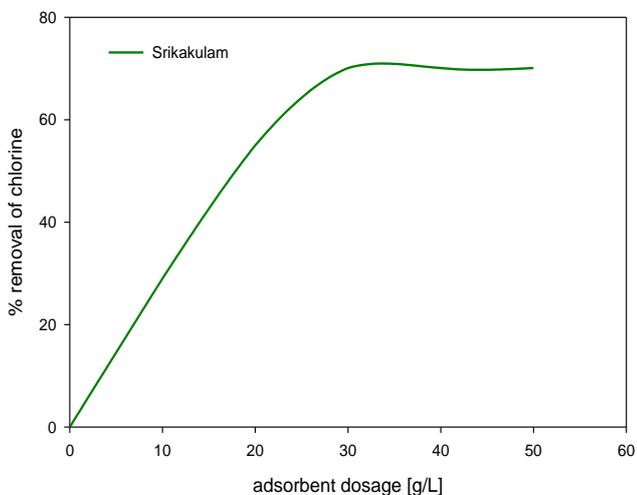


Fig.5. Effect of adsorbent dosage for chloride removal

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