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Removal of Fluoride from Drinking Water Using Fly Ash after Pre Treatment

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Abstract

The adsorption capacity of fly ash is much higher than the other adsorbents. The Fly ash was an effective adsorbent especially at high concentration of fluoride. This may be because of the presence of unburnt carbon particles in the fly ash which are known to be very efficient adsorbing materials. The main components of fly ash are silica, alumina, iron oxides, calcium oxide and residual carbon. The presence of unburnt carbon and surface area of ash make it a good candidate for utilization as an inexpensive adsorbent. In this method we use fly ash, generate from Chula. The 100 gm ash is mixed with 1 liter fluoridated water and stirs 45 to 60 minutes then leave it for settle down. After 2 hour this solution filters with G-3 crucible in a filtration unit. The fluoride was analyzed by using ions selective electrode method. This method removes fluoride satisfactory from drinking water but also increases some other parameters of water like alkalinity, chloride, TDS, nitrates etc.so after the view of side effects pre treatment of fly ash have been done with distilled water. The results were found very much satisfactory.

Keywords: Fluoride; Drinking water; Fluorosis; Defluoridation; Fly ash; Adsorption; pH

Introduction

In the absence of perennial rivers, surface and canal system, groundwater remains the main source of drinking water. Fluoride is more common in ground water than in surface water. It contains 2 to 20 mg/L of fluoride [1-5] .The main sources of fluoride in ground water are different fluoride bearing rocks In Rajasthan all 32 districts are affected from fluoride. Fluoride ions are important in water supplies because of their peculiar characteristics. They cannot be tolerated in too or low or too high concentration. A Fluoride concentration of approximately 0.5 mg/l to 1 mg/l in drinking water effectively reduces dental caries or tooth decay without any harmful effects on health [2]. Excess concentration of fluoride (more than 2 mg/l) causes dental fluorosis (disfigurement of the teeth) and harm to bony structures.

Defluoridation of drinking water

Defluoridation means the removal of excess fluoride from water [6]. The National Environment Engineering Research Institute in Nagpur, India (NEERI) has evolved an economical and simple method of defluoridation, which is referred to as the Nalgonda technique.

UNICEF has worked closely with the Government and other partners in defluoridation programmes in India, where excessive fluoride has been known for many years to exist in much of the nation's groundwater. In the 1980s, UNICEF supported the Government's Technology Mission in the effort to identify and address the fluoride problem: the Government subsequently launched a massive programme, still under way, to provide fluoride-safe water in all the areas affected.

The removal of fluoride from potable water is not adequate when initial concentration of fluoride in the water is very high and the pH of the untreated water is alkaline.

Defluoridation methods can be broadly divided into three categories according to the main removal mechanism:

Chemical additive methods

Chemicals include lime used alone or with magnesium or aluminum salts along with coagulant aids (Nalgonda technique).

Contact precipitation

Contact precipitation is a recently reported technique in which fluoride is removed from water through the addition of calcium and phosphate compounds.

Adsorption/ion exchange methods

In the adsorption method, raw water is passed through a bed containing defluoridating material. The material retains fluoride either by physical, chemical or ion exchange mechanisms. These materials like, Fly ash bone char, activated alumina and clays have been successfully used in the field.

Time of sample collection

Phase-I (Samples collection in August)

Phase-II (Samples collection in December)

Phase-III (Samples collection in March)

Details of samples

All drinking water samples collected from Sitapura Industrial Area, Jaipur (Rajasthan).These areas are [7]

Sample No. 1	Genus industries
Sample No. 2	Chevrolet industries
Sample No. 3	Ratan Textiles

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Sample No. 4	Bharat patrol pump
Sample No. 5	Hotel Amrapali
Sample No. 6	JNIT College
Sample No. 7	Residential Area
Sample No. 8	Near Chokhi Dhani
Sample No. 9	Sachiwalaya Nagar
Sample No. 10	Laxhmipura

Materials and Methods

The fly ash is an effective adsorbent of fluoride .In this method we have used fly ash, generate from Chula. Due to increase in some physico-chemical parameters during the research, it was observed that pre treated fly ash could address these problems without hindering the fluoride removal efficiency of fly ash therefore fly ash was pretreated before defluoridation.

For the pre treatment of fly ash, it is washed by distilled water. For this 100 gm fly ash washed with 1 liter distilled water, washing it twice [8-10]. For this process we were used an ordinary filter paper, funnel and beaker. Dried, Crushed and powered fly ash before use for fluoride removal.

After the pre treatment this 100 gm ash was mixed with 1 liter fluoridated water and stirs 5 to 10 minutes then left for settling time of 2 hr. After 2 hour this solution was filtered with G-3 crucible in a filtration unit [11].

Results and Discussion

From the observation (Table 1 and Figure 1) we found that the fly ash is good adsorbent for the removal of fluoride from drinking water. Results shows that fly ash can change the fluoride concentration satisfactory according to the permissible limit of WHO (1.15 mg/l.)

Conclusion

The raw material are easily available, free of cost and none any other expenditure with this method. For Rural areas, this method can easily use because cooking is done by Chulhas in villages and the fly ash is a waste after burning of fuel [12]. By this method we can also show one of the reuse of fly ash. This technology is very much cheapest from the other defluoridation methods. But due to some side effects of fly ash on water parameters we applying the pre treatment of fly ash before it use for fluoride removal [13].

S.No	Phase I (Concentration of fluoride mg/lit.)		Phase I (Concentration of fluoride mg/lit.)			Phase I (Concentration of fluoride mg/lit.)
	Before Defluoridation	After Defluoridation	Before Defluoridation	After Defluoridation	Before Defluoridation	After Defluoridation
1	2.46	0.75	2.46	0.75	2.45	0.76
2	2.15	0.68	2.16	0.69	2.16	0.69
3	1.17	0.56	1.18	0.55	1.19	0.55
4	2.84	1.01	2.82	1.01	2.80	1.01
5	1.38	0.62	1.38	0.63	1.38	0.63
6	2.83	0.88	2.84	0.89	2.84	0.89
7	1.40	0.65	1.40	0.65	1.40	0.65
8	2.33	0.70	2.34	0.70	2.32	0.69
9	2.51	0.75	2.50	0.76	2.50	0.75
10	1.20	0.60	1.21	0.60	1.21	0.61

Table 1: Observation.

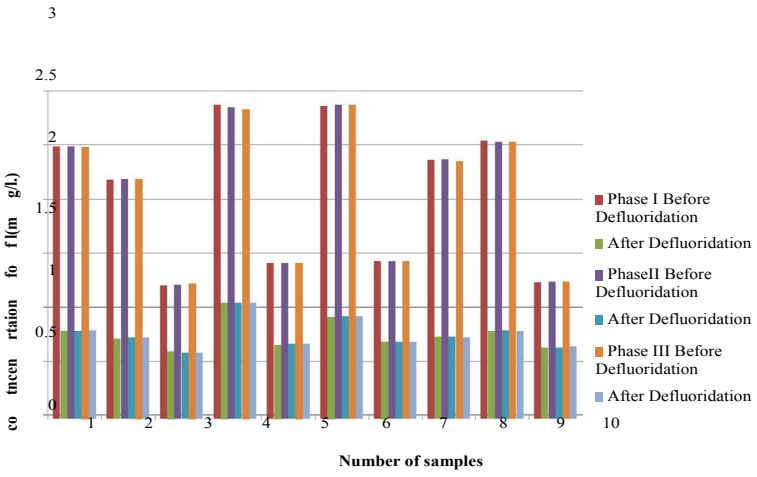

Figure 1: Fly ash observation

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