Removal Of Fluoride From Drinking Water Using Red Mud

Ranjeeta Soni, Dr. Shikha Modi

Abstract: Red Mud is a very fine material (particle size of which is generally below 75μ) and high specific surface area (around10 m2/gm). It is mainly composed of iron oxides and has a variety of elements and mineralogical phases. The variation in chemical composition between different red muds worldwide is high. The removal of fluoride from aqueous solution by using the original and activated red mud forms has been studied by many researchers (Lopez et al., 1998). The fluoride adsorption capacity of activated form has been found to be higher than that of the original form. The adsorption is highly dependant on PH. Researches have revealed that the maximum adsorption of fluoride is at pH 5.5.For pH greater than 5.5 fluoride removal decreases sharply. The sufficient time for adsorption equilibrium of fluoride ions is 2 hrs. The possibility of removal of fluoride ion by using red mud is on the basis of the chemical nature and specific interaction with metal oxide surfaces (Yunus et a1. 2002).

Keywords: Fluoride, Fluorosis, Drinking water, Defluoridation, Red mud, adsorption, P^H.

Introduction:

Fluoride is frequently encountered in minerals and in geochemical deposits and is generally released into subsoil water sources by slow natural degradation of fluorine contained in rocks. Fluorine is an important element for human beings, as it helps in growth and prevents the enamel of the teeth from dissolving under acidic conditions. Various dietary components influence the absorption of fluorides from gastrointestinal tract and the absorbed fluorides are distributed throughout the body. Drinking water and sea food are good sources of fluoride. Fluoride is beneficial to health if the concentration (CF) of the fluoride ion (F-) in drinking water is less than 1.5 mg/L (WHO 1994).A higher concentration causes serious health hazards. The disease caused manifests itself in three forms, namely, dental, skeletal, and non-skeletal fluorosis.

Defluoridation of drinking water:

Defluoridation means the removal of excess fluoride from water. 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-

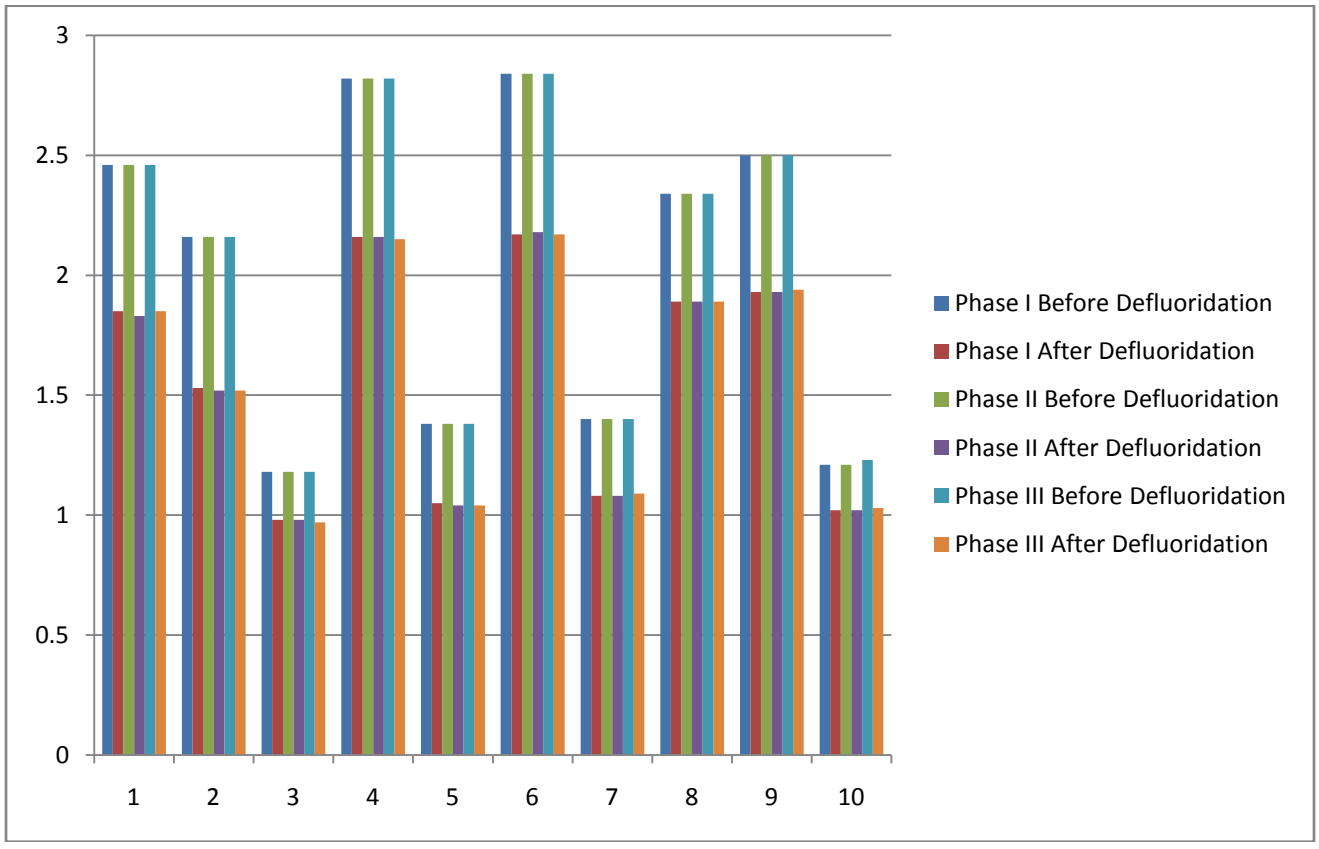
Sample No. 1	Genus power Infrastructure
Sample No. 2	Chevrolet industries
Sample No. 3	Ratan Textiles
Sample No. 4	Bharat patrol pump
Sample No. 5	Hotel Amrapali
Sample No. 6	JNIT College
Sample No. 7	Sitapura Residential Area
Sample No. 8	Near Chokhi Dhani
Sample No. 9	Sachiwalaya Nagar
Sample No. 10	Laxhmipura

Materials and methods: Removal of fluoride by Red Mud (based on adsorption process): - The experimental red mud was collected from Hanumangargh district. The 100 gm red mud is mixed with 1 liter fluoridated water and stir 5 to 10 minutes then left for settling time for 2 hr. After 2 hour this solution was filtered with G-3 crucible in a filtration unit. The possibility of removal of fluoride ion by using red mud is explained on the basis of the chemical nature and specific interaction with metal oxide surfaces (Yunus *et a1*. 2002).

Observation Table: 1

S.No.	Phase I (Concentration of fluoride mg/lit.)		Phase-II (Concentration of fluoride mg/lit.)		Phase III (Concentration of fluoride mg/lit.)	
	Before Defluoridation	After Defluoridation	Before Defluoridation	After Defluoridation	Before Defluoridation	After Defluoridation
1	2.46	1.85	2.46	1.83	2.46	1.85
2	2.16	1.53	2.16	1.52	2.16	1.52
3	1.18	0.98	1.18	0.98	1.18	0.97
4	2.82	2.16	2.82	2.16	2.82	2.15
5	1.38	1.05	1.38	1.04	1.38	1.04
6	2.84	2.17	2.84	2.18	2.84	2.17
7	1.40	1.08	1.40	1.08	1.40	1.09
8	2.34	1.89	2.34	1.89	2.34	1.89
9	2.50	1.93	2.50	1.93	2.50	1.94
10	1.21	1.02	1.21	1.02	1.23	1.03

Figure:1
Comparative Fluoride concentration in water samples by Red Mud defluoridation methods



Result and Discussion:

From the above observation we found that the red mud is also a good adsorbent for the removal of fluoride from drinking water. From the above observation Table No.1 results show that red mud can change the fluoride concentration satisfactory according to the permissible limit of WHO (1.15 mg/l.) as well as like other adsorbent.

Conclusion:

The raw material are easily available, free of cost and no one any other expenditure with this method. This technology is very much cheapest and after the defluoridation from red mud the effects on water quality will not disturbed like chemical adsorbent because it is a natural adsorbent.

References:

[1]. G. Karthikeyan, A. Shunmuga Sundarraj, “Defluoridation Processes”, 1999.

[2]. Pranab Kumar, Rakshit, “A report on Studies on estimation of fluoride and defluoridation of drinking water”, 2004.

[3]. Raj Kumar Daw, Raj Kumar “Experiences with domestic defluoridation in India”, 30th WEDC International Conference, 2004.

[4]. A. V. Jamode, V. S. Sapkal, V. S Jamode, “Defluoridation of water using inexpensive adsorbents”, September 24, 2004.

[5]. A. K. Vaish & P Vaish, “A Case Study of Fluorosis Mitigation in Dungarpur District, Rajasthan, India” 2001.

[6]. Eli Dahi, Felix Mtalo, Balthazar Njau, Bregnhj Henrik, “Defluoridation using Nalgonda Technique in Tanzania”,22nd WEDC Conference, New Delhi, India,266-268, 1996.

[7]. Yunus Çengelo lu, Esengül Kir and Mustafa Ersöz “Removal of fluoride from aqueous solution by using red mud, Separation and Purification Technology”, 28 (1), 81 86, 2002.

[8]. Debasis Goswami and Arabinda Das, “Removal of fluoride from drinking water using modified fly ash adsorband”, Journal of Scientific and Industrial Research, Vol.65, January 2006, pp.-77-79.

[9]. Shrikant S. Patil, Nitin W. Ingole, T.S. Bhakumi and N.N. Sharma, “Studies on Defluoridation-A Critical Review” Studies on defluoridation Bulletin, 07:77-80, 1970.

[10]. A.K. Vaish and K.C. Gyani, “Management of fluoride contaminated drinking water – A successful approach of defluoridated at domestic level in Dungarpur District of Rajasthan’’ Proceeding of Int. workshop on “Fluoride in drinking water’’ organized by Govt. of Madhya Pradesh at Bhopal, 22-24 Jan 2001, p 71-74. 2001.

[11]. A.K.Susheela, “Defluoridation of drinking water merits of alternative technologies”, July 1992

[12]. Rani, Bina, “Fluoride and fluorosis in Rajasthan: An Overview, A project Report” [IGNOU], ND, DNHE, 2006.