

## REMOVAL OF FLUORIDE FROM WATER USING MARBLE SLURRY AND FLY ASH

Mala Mathur<sup>1</sup>, Praveen Kumar Navin<sup>2</sup>

Department of Civil Engineering, Vivekananda Institute of Technology, Jaipur

**Abstract** - Fluoride is a ubiquitous element present in earth's crust and is also being added to the environment anthropogenically. In lower concentrations, fluoride is an essential nutrient which aids in the formation of bones, prevents tooth decay, etc whereas in higher concentrations it causes fluorosis, curvature of bones, dwarfishness, brittling of bones, mental derangements, cancer, etc. and in extreme cases even death. In India, the states of Rajasthan, Gujarat and Andhra Pradesh have a large number of villages where ground water contains excessive fluorides. During the past few years, intensive interest in the problem of excessive fluorides in drinking water is a matter of serious concern around the world. Present study aimed to assess selected industrial waste materials (marble slurry and fly ash) for removal of fluoride from drinking water in order to find cost effective adsorbent. The influence of various operational parameters viz. effect of adsorbent dose, pH, initial concentration and contact time were studied by a series of batch adsorption experiments. This study revealed that marble slurry and fly ash adsorbent are easily available and could be easily applied in order to reduce the fluoride pollution from drinking water.

**Keywords** - Marble Slurry, Fly ash, Drinking water fluoride removal

### I. Introduction:

Nature of drinking water is a major task now days because of expansion in pollution of water bodies [1]. Fluoride is one such pollutant that affects living life forms, specially human beings [2]. Fluoride ion exists in natural waters and it is an essential micronutrient in humans in preventing dental caries and in facilitating the mineralization of hard tissues if taken at a recommended range of concentration. Higher level of fluoride in groundwater is a worldwide problem [3-5]. According to World Health Organization (WHO) the permissible limit of fluoride is 1.5 mg/L in potable water [6]. Higher concentration of fluoride leads to several problems such as fluorosis, curvature of bones, dwarfishness, brittling of bones, mental derangements, cancer, etc. [7]. However, the measured fluoride concentrations in many regions are higher than that prescribed by the WHO. Removal of fluoride ions from wastewater is important for environmental conservation and human health. Hence fluoride removal from water is a big challenge.

TABLE I

Effect of prolonged use of drinking water on human health, related to fluoride content [8]

Fluoride Concentration(mg/l)	Health Outcome
<0.5	Dental caries
0.5–1.5	Optimum dental health
1.5–4.0	Dental fluorosis
4.0–10	Dental and skeletal fluorosis
>10.0	Crippling fluorosis

Therefore, Many Technologies such as adsorption [9], ion exchange [10], reverse osmosis, nanofiltration [11], electrodialysis [12], and precipitation [13] etc have been used for removal of Fluoride from water. Out of these techniques, adsorption is widely used because of its simplicity and effectiveness. It is relatively low in cost, robust and environmental friendly[14]. Different adsorbents such as activated alumina [15], bleaching earth [16], iron oxide [17], activated titanium rich bauxite [18], activated carbon [19], red mud [20], and clay [21] were utilized as defluoridating agents.

Economic sustainability is the major factor in process designing and optimization. The key cost of developing an adsorption system is governed by the adsorbent material and its synthesis. The marble waste powder used as an adsorbent in the present study being a byproduct of marble processing industry is available in huge quantities at no cost. Moreover the current improper handling of this waste that has caused severe environmental problems can be alleviated by its direct utilization as an adsorbent for fluoride water treatment. The application of fly-ash and Kota stone (lime) slurry in synthesis of a low cost adsorbent and a noble way to utilize these abundant waste materials whose indiscriminate disposal pose a threat to the environment.

Present study aimed to assess selected industrial waste materials (marble slurry and fly ash) for removal of fluoride from drinking water in order to find cost effective adsorbent. The influence of various operational parameters viz. effect of

adsorbent dose, pH, initial concentration and contact time were studied by a series of batch adsorption experiments. This study revealed that marble slurry and fly ash adsorbent are easily available and could be easily applied in order to reduce the fluoride pollution from drinking water.

## II. Materials and Method

Basically there are two methods for removal of excess amount of fluoride present in water, namely, flocculation and adsorption.

- 1) *Flocculation method:* Flocculation method includes addition of chemical agents to precipitate the excess fluoride content present in water.
- 2) *Adsorption methods:* Adsorption method involves the adsorption of fluoride ions using activated agents such as activated alumina, activated carbon, bone char etc. Since these active agents are costlier, alternative adsorbents such as Marble Slurry, Fly Ash, corn cobs, crushed tamarind seed, laterite soil, moringa olifera etc., can also be used. In this present study Marble Slurry and Fly Ash are used as adsorbing agent.
- 3) *Details of samples*

All drinking water samples collected from Jaipur, Rajasthan. These areas are as follows:

Sample No. 1	VIT Campus
Sample No. 2	Partapnagar
Sample No. 3	Model Town
Sample No. 4	Income tax colony
Sample No. 5	Hasanpura
Sample No. 6	Sanganer
Sample No. 7	Lal Kothi
Sample No. 8	Ajmeri gate

- 4) *Methods to remove fluoride from drinking water*

The fly ash and marble slurry are an effective adsorbent of fluoride. The following methodology was adapted to remove fluoride from different drinking water samples as shown in fig.1.

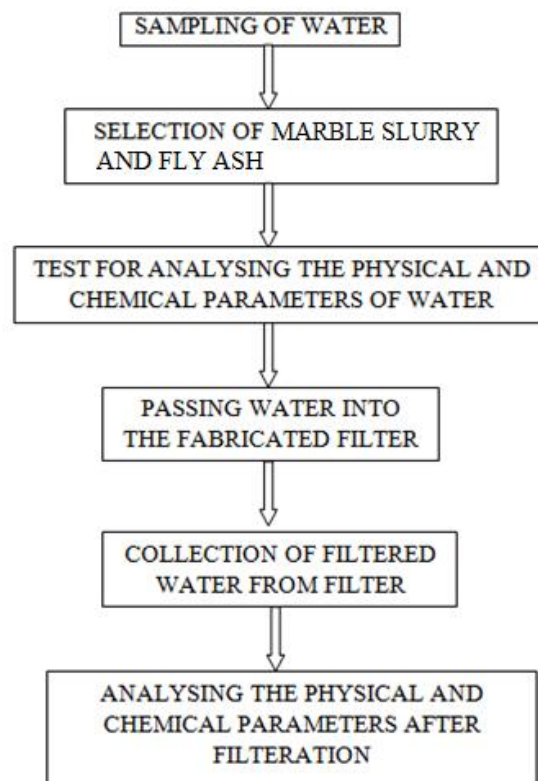


Fig. 1 Procedure of fluoride removal from drinking water

### III. RESULTS AND DISCUSSIONS

The experiment was conducted with an aim to find the significant removal of fluoride with Marble Slurry and Fly Ash. The physical and chemical parameters are tested before filtration. From the observation Table II showed that the fly ash and marble slurry are good adsorbent for the removal of fluoride from drinking water. Result shows that these adsorbents can change the fluoride concentration satisfactory. Permissible limits of fluoride in drinking water are 1.15 ppm according WHO.

TABLE II  
Removal of fluoride from drinking water

S. no.	Areas	Fluoride concentration (ppm)	
		Water sample	After treatment
1	VIT Campus	2.27	0.75
2	Partapnagar	1.91	0.65
3	Model Town	1.51	0.67
4	Income tax colony	2.4	0.72
5	Hasanpura	2.87	0.76
6	Sanganer	2.79	0.82
7	Lal Kothi	1.64	0.66
8	Ajmeri gate	1.57	0.64

### IV. CONCLUSIONS

The raw material are easily available, low cost and none any other expenditure with this method. The results show that the samples have fluoride content more than the desirable limits, so it is processed to reduce fluoride content. Usage of fly ash and marble slurry efficiently reduced fluoride content; hence the natural low cost adsorbent can be used fruitfully for the removal of fluoride over wide range of concentration.

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