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Physico-Chemical Characterization of Ground Water of Various Places in Jaipur City and Its Defluoridation by using Brick Powder: A Green Approach

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ABSTRACT

Large number of people in rural areas are dependent on ground water for drinking purpose. The present study investigates the study of fluoride in the level of groundwater of various places in Jaipur city of Rajasthan state and collecting of ten samples of different places in Jaipur city from bore wells and hand pump. In the current research paper by employing SPANDS method, fluoride ion concentrations in water were determined spectrophotometrically at 570 nm. First and then Brick powder (BP) was used as adsorbents in defluoridation of water. In this paper, dose of adsorbents, contact time and concentration of fluoride ions will be discussed with their interdependence Both the Langmuir and Freundlich adsorption isotherms fitted well for the fluoride adsorption on bricks powder with the regression coefficient of 0.99762 and 0.99766, respectively.

1. Introduction

Some new cost-effective fluoride adsorbents, such as, zeolites [1], natural adsorbent [2], low cost adsorbent [3] and biomass material, as well as other novel adsorbents [4] have been identified in last few years. The level of fluoride in the underground water of Newai region was exceeding the permissible limit (>1.5 mg/L). It was found that about ten villages of Newai region was under serious fluoride contamination than bore well and hand pump water which causes adverse effect like dental and skeletal fluorosis [5]. It has been demonstrated that bio-sorption is good at affinity and selectivity for ion removal [6]. The ground water forms a major source of drinking water in urban as well as in rural areas [7]. The effects of major parameters of adsorption like dose of adsorbent contact time and initial adsorbate concentration on fluoride removal efficiency were studied [8]. Phulera tehsil is facing the problem of groundwater pollution and determination of fluoride in ground water of Phulera tehsil [9]. The fluoride in ground water was studied in Amber tehsil of Jaipur district in 25 villages and were under surveillance [10].

A study of the water quality condition of Tonk district was carried out to assess the risk to human health and physico-chemical analysis of ground water sample [11]. The study has been focusing on the technique of defluoridation by using the process of electro-coagulation and ground water collected from Shivdaspura Jaipur [12]. The study has been carried out to assess the ground water quality and its suitability for drinking purpose in most rural habitations of Bassi tehsil of Jaipur [13].

The high fluoride levels in drinking water and its impacts on human health have increased the importance of defluoridation studies [14].

Nalgonda technique developed by NEERI is commonly preferred at all levels because of its low price and ease of handling [15]. Various processes tried so far for the removal of excess fluoride from water are adsorption, ion exchange, precipitation, and membrane process. Adsorption is the process considered to be efficient to defluoridation of the water. Researches were carried on different adsorbents, viz. activated carbon, processed bone char powder, activated alumina, magnesia, activated bauxite, fly ash, granular calcite, alum, lime, etc., [16-19].

In adsorption method, different types of adsorbents are being used for defluorination and removal of other minerals, dyes and heavy metals e.g. activated alumina [20], coconut shell carbon [21], baggase [22], chemically activated carbon [23], bone charcoal [24], natural zeolites [25], burn clay [26], crushed clay pots [27], electrodialysis [28] and other low cost bioadsorbents like saw dust [29], used tea leaves, cow dung [30] have been found to be highly effective, cheap and eco-friendly.

2. Experimental Methods

2.1 Materials

The glassware were washed off with nitric acid and distilled water before use. First, a stock solution of 100 mg/L was prepared by dissolving appropriate amount of sodium fluoride (NaF) in distilled water and desired concentrations of solutions were then prepared from stock solution. Naturally occurring and abundantly available low cost materials like Bricks powder was obtained from a local kiln and the material passing through 300 µm was used in all experiments. The Bricks powder was washed several times with distilled water till clear water was obtained and dried in oven at 105 °C for 12 h. The dried material was sieved to obtain particles, of size 300 µm for the present study.

2.2 Experimental Methodology

Adsorption studies were conducted to study the effect of controlling parameters like contact time, adsorbent dosage. All the experiments were conducted at room temperature. Fluoride concentration was estimated by SPADNS method using a spectrophotometer.

Ground water samples collected from various places of Jaipur city were studied for defluoridation under the feasible optimized conditions to check the suitability of the bricks powder adsorbent under field conditions. The physico-chemical properties of ground water samples were determined before and after treatment by Brick powder.

3. Results and Discussion

On physico-chemical characterization of the water samples collected from various location of Jaipur city, we observed interesting changes in the values of different parameter including pH, EC, TDS, total alkalinity, total hardness, chlorides ions and fluoride, after using brick powder as an adsorbent. The values before treatment and after treatment are summarized in Tables 1 and 2.

3.1 Comparison of pH of the Solution Before Treatment and After Treatment

pH is important indication of water quality and it is depend on H^+ ions concentration in ground water. The pH is maximum in main Jagatpura site (9.4) and lower level at Bajaj nagar site (8.0) (Fig. 1).

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Table 1 The values before treatment and after treatment

S. No.	Name of location	pH		EC		TDS	
		Before Treat.	After Treat.(BP)	Before Treat.	After Treat.(BP)	Before Treat.	After Treat.(BP)
1	Tebbabala Jagatpura	9.3	9.1	0.73	0.67	466	430
2	Airport	9.1	8.9	0.60	0.55	386	340
3	Main Jagatpura	9.4	9.1	0.62	0.56	398	368
4	Malviya nager	8.4	8.2	0.74	0.68	475	435
5	Sawaimansigh hospital	8.1	8.1	2.11	1.96	1373	1056
6	Taro Kikhoot	8.7	8.4	0.95	0.86	605	567
7	Lal khodi	8.3	8.2	0.58	0.50	310	296
8	Bajaj nager	8.0	7.9	1.58	1.38	990	860

Table 2 The values before treatment and after treatment

S. No.	Name of location	Total Alkalinity		Total Hardness		Chloride ion		Fluoride ion	
		Before Treat.	After Treat. (BP)	Before Treat.	After Treat. (BP)	Before Treat.	After Treat. (BP)	Before Treat.	After Treat. (BP)
1	Tebbabala Jagatpura	310	295	100	90	100	95	2.896	2.598
2	Airport	275	254	70	65	50	45	.498	.395
3	Main Jagatpura	315	295	90	85	40	35	.385	.286
4	Malviya nager	115	105	100	95	120	110	.478	.378
5	Sawaimansigh hospital	75	70	350	325	430	410	1.686	1.464
6	Taro Kikhoot	110	105	120	110	140	10	.367	.293
7	Lal khodi	80	75	70	65	100	95	.298	.210
8	Bajaj nager	60	55	150	140	350	315	1.489	1.256

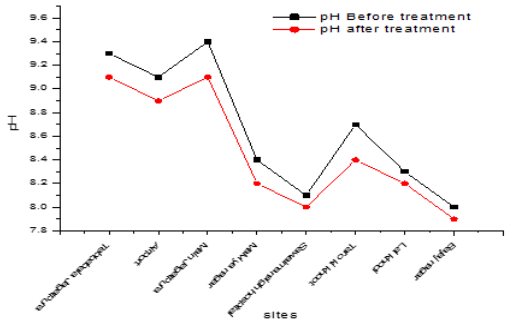

Fig. 1 Comparison of pH before treatment and after treatment with brick powder

3.2 Comparison of (EC) Present Before Treatment and After Treatment with Brick Powder

Electro conductivity depend on ions concentration and measured by electro conductivity meter. The maximum concentration of electro conductivity was observed at Sawaimansigh hospital (2.11 mho^{-}) and lower level found at Lal Khodi (0.58 mho^{-}) (Fig. 2).

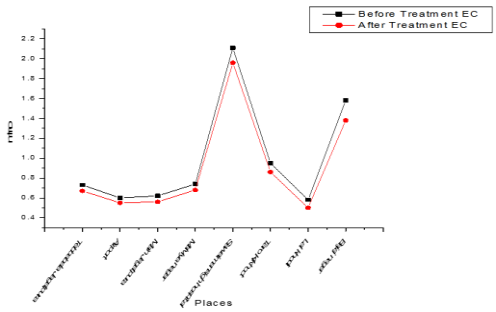

Fig. 2 Comparison of (EC) present before treatment and after treatment with brick powder

3.3 Comparison of (TDS) Present Before Treatment and After Treatment with Brick Powder

Studies of total dissolve solid (TDS) concentration were analyzed by gravimetric method. TDS are consistent with HCO_3^-, SO_4^{-2} and Cl^- of calcium, sodium and magnesium ions are major part. It is found in maximum concentration at Sawaimansigh hospital (1373 ppm) and lower level found at Lal Khodi (310 ppm) (Fig. 3).

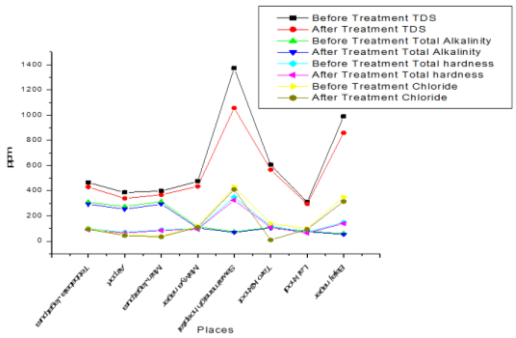

Fig. 3 Comparison of (TDS), total alkalinity, total hardness, chloride present before treatment and after treatment with brick powder

3.4 Comparison of Total Alkalinity Present Before Treatment and After Treatment with Brick Powder

The alkalinity of ground water sample was determined by titration method. The alkalinity is found to be maximum at main Jagatpura site (310 ppm) and lower level at Bajaj nager site (60 ppm).

3.5 Comparison of Total Hardness Present Before Treatment and After Treatment

The total hardness were determined by EDTA method. It is found of maximum at Sawaimansigh Hospital (350 ppm) and lower level at Lal Khodi (70 ppm).

3.6 Comparison of Chloride Present Before Treatment and After Treatment with Brick Powder

Chloride ion concentration is determined by silver nitrate titration method. The chloride concentration rang is from 40 ppm to 430 ppm. The maximum chloride ions are present at Sawaimansigh hospital site (430 ppm) and lower level at Main Jagatpura site (40 ppm).

3.7 Comparison of Fluoride Present Before Treatment and After Treatment with Brick Powder

Studies on the initial fluoride concentration were conducted by SPAND method and used of adsorbent dose of 2.0 g/100 mL, and contact time of 15 minutes. The fluoride were removal by adsorption method. Comparison of fluoride in water sample of before treatment and after treatment with brick powder is reported in Table 1 and depicted in Fig. 4. It is found in maximum concentration at Tebbabala Jagatpura (2.896 ppm) and lower level found at lal khodi (0.298 ppm).

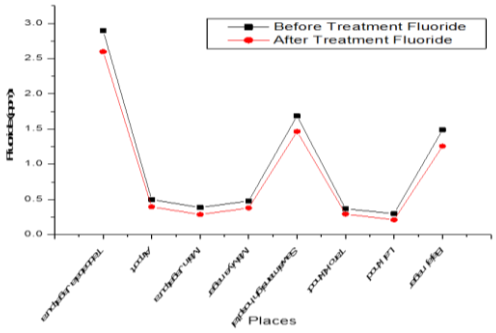

Fig. 4 Comparison of fluoride present before treatment and after treatment with brick powder

4. Conclusion

In the present study, brick powder were used as adsorbents for removal of fluoride from synthetic as well as from various ground water samples of different fluoride concentrations. The maximum fluoride is present in Tabba bala Jagatpura and lower level of fluoride is Lal Khodi sites. Fluorides are measured by SPANDS method. The main conclusions that can be drawn from the above study are given as: adsorption of fluoride on Bricks proved effective for the treatment of fluoride contaminated actual drinking water samples. It can be explained on the basis of the chemical interaction of fluoride with the metal oxides, which makes it very suitable for use in ground water treatment. Presence of others ions in groundwater did not significantly affect the defluoridation process.

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