ISSN: 0974-2115
www.jchps.com Journal of Chemical and Pharmaceutical Sciences

Physico-Chemical Characterization of Drinking Water of Jaipur City and Its Defluoridation by using Brick Powder (An Industrial Waste): A Green Approach

Naresh kumar*, Nidhi bansal and Sanjay K. Sharma
Green Chemistry & Sustainability Research Group, Department of Chemistry,
JECRC University, JAIPUR – 303905 (Raj.) India
***Corresponding author: E-Mail: nareshamansharma@gmail.com**

ABSTRACT

In present study, fluoride ion concentrations in water were determined by employing SPANDS method. 'Green Chemistry' provides various tools and techniques including the ion-exchange, adsorption, reverse osmosis, precipitation and many more as some usual means of defluoridation. Then Brick powder (BP) used in defluoridation of water and it is use of these wastes serves two purposes solve as same time, one is low cost and eco-friendly defluoridation and other one is waste management. It is wastes found in brick area situated nearby Jaipur City of Rajasthan state. The dose of adsorbents, contact time and concentration of fluoride ions will be discussed with their interdependence. For this study, water sample taken from different zone were studied.

KEY WORDS: Fluoride, Brick powder, Analysis of study.

1. INTRODUCTION

Activated carbons and brick powder were the most important commercial adsorbents. Their high surface area (Rodriguez, 1991) together with their surface chemical structure allows them to have been used in industrial applications and some of the most important dealing with the environmental field. These are particularly with water purification and industrial wastewater cleaning (Bansal, 1988; Jankowska, 1991; Bernardo, 1997; Gaballah, 1999; El-Sheikh, 2002). In these are applications adsorption with activated carbon is most commonly used in removal of species.

The modern civilization, industrialization, urbanization are increase in population have been lead to the fast degradation of our ground water quality. As the water is the most important component of eco-system, any imbalance created either in term of amount and the presence of impurities added into whole eco-system (WHO, 1984; Kannan Krishnan, 1991; Hem, 1961).

Fluoride is a natural compound present in water, soils, plants and animals to be essential for life. A WHO experts committee (De, 2000) considered fluoride with 14 elements are essentially for animal life. WHO standards for drinking water fluoride is present range of between 0.5 – 1.5 mg/L. Fluoride concentration below and above are permissible limit have an implication related due to health and it is totally absent in water supply to cause dental carries.

De-fluoridations were reported by adsorption (Raichur, and Jyoti Basu, 2001) chemical treatment (Reardon and Wang, 2000; Saha, 1993), ion exchange (Singh et al, 1999), membrane separation (Dieye, 1998; Amer, 2001), electrolytic de-fluoridation (Mameri, 2001) and electro dialysis (Hichour, 2000; Hichour, 1999; Adikari, 1989) etc. Among various processes are adsorption reported to be effective (Venkata Mohan, 2002). Investigators reported are various types of adsorbents namely activated carbon, minerals, fish bone char coal, coconut shell carbon and rice husk carbon, with different degrees of success (Jayantha, 2004; Prabavathi, 2003; Srimurali, 1998; Muthukumaran, 1995; Killedar, and Bhargava, 1993; Sathish, 2007) reported that the fluoride adsorption by zirconium impregnated coconut fibre carbon (ZICFC). The adsorption rate is extremely rapid within 93% of the adsorption being achieved within 10 min of ZICFC contact for an initial fluoride concentration is 20mg L-1. (Saritha Sinha, 2003) reported that fluoride is removed by using the activated carbon prepared from E.crassipes. (Li, 2003) reported. The activated carbon loaded with alumina than successfully removed fluoride at a pH range of 6.0-9.0. (Gupta, 2007) reported that fluoride is removed at pH 7.58 by using carbon slurry. (Mohan, 2007) reported that fluoride is removed from the aqueous phase by absorption.

2. METHODS AND MATERIALS

Materials: The glassware are washed with nitric acid and distilled water before use. First, a stock solution are prepared by dissolving appropriate amount of sodium fluoride (NaF) in distilled water and desired concentrations of working solutions were then prepared from stock solution. Naturally abundantly available low cost materials like Bricks powder was obtained from a local kiln. The Bricks powder was washed several times with distilled water till clear water was obtained and dried in oven at 105 ºC for 12 h. The dried material was sieved to obtain particles, of size 300 μm.

Experimental: Fluoride concentration was estimated by SPADNS (Trisodium-4, 5 Dihydroxy-3-(p-sulfophenylazo) -2,7-naphthalene disulfonic acid) method using a spectrophotometer.

Ground water samples collected from various places of Zone – I of Jaipur city was 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 locations in 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. The values before and after treatment are summarized in Table-I.

Comparison of pH before and after treatment with Brick powder: Discussion: pH is an important indication of water quality and it is depends on the H^+ ion concentration present in ground water sample. On the basis of physico-chemical analysis of water sources in Jaipur city (India). The pH is maximum at Ramganj (9.8) and lower at the level Ghatgate site (8.1).

Table.1. The values before treatment and after treatment

Name of location	pH		EC		TDS		Tatol Alkalinity	
	Before Treat.	After Treat.(BP)	Before Treat.	After Treat.(BP)	Before Treat.	After Treat.(BP)	Before Treat.	After Treat.(BP)
Ramnivash Garden	9.6	9.3	0.69	0.61	446	420	150	135
Adrash Nagar	9.4	8.9	0.36	0.30	233	210	110	100
M.D.Road	8.3	8.0	2.40	1.96	1545	1220	50	45
Ghatgate	8.1	7.8	1.80	1.69	1140	1090	40	35
Galtagate	9.5	9.2	0.46	0.40	299	250	140	130
Ramganj	9.8	9.5	0.50	0.42	323	258	160	140
Sanganeri Gate	9.4	9.1	0.37	0.32	235	220	110	100

Table.1. The values before treatment and after treatment

Name of location	Total Hardness		Chloride ions		Fluoride ions	
	Before Treat.	After Treat.(BP)	Before Treat.	After Treat.(BP)	Before Treat.	After Treat.(BP)
Ramnivash Garden	140	130	110	100	0.686	0.565
Adrash Nagar	60	55	70	65	0.397	0.210
M.D.Road	540	490	650	590	1.668	1.460
Ghatgate	100	90	400	350	1.576	1.364
Galtagate	120	110	70	65	0.691	0.510
Ramganj	130	120	90	80	1.656	1.415
Sanganeri Gate	50	45	60	55	0.969	0.785

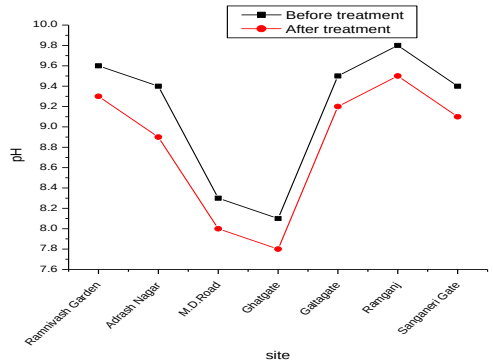

Figure.1. Comparison of pH of the solution before and after treatment with Brick Powder

A comparison of total electro conductivity (EC) before and after treatment with Brick powder: Discussion: Electro conductivity is determined by conductivity meter and it is a useful barometer of ground water quality samplesto indicate. EC depends on ions concentration present in ground water. It is maximum found at M.D.Road (2.40mho-) and lower level at Adarsh Nagar (0.36 mho^-).

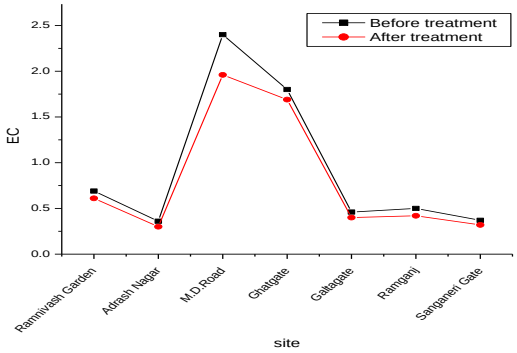

Figure.2. Comparison of total electric conductivity (EC) present before and after treatment with Brick Powder

Comparison of TDS, before treatment and after treatment with Brick powder: Discussion: Total dissolve solid (TDS) concentration were measured by gravimetric method. The removal of TDS by using adsorbent dose of 2.0 g/100 ml, and contact time of 15 minutes. TDS present in ions concentration like HCO_3^-, SO_4^{-2} and Cl^- of calcium, sodium and magnesium ions are major part. Maximum TDS found in M.D. Road (1545ppm) and lower level at Adarsh Nagar (233ppm).

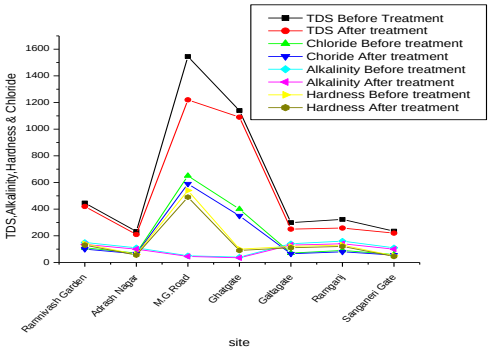

Figure.3. Comparison of TDS, Total Alkalinity, Total hardness and Chloride ions present before and after treatment with Brick Powder

Comparison of Total Alkalinity present before and after treatment with Brick Powder: The total alkalinity of ground water sample ware determined by the titration method. Maximum total alkalinity present in Ramganj site (160ppm) and lower in Ghatgate site (40ppm).

Comparison of Total hardness present before and after treatment with Brick Powder: The total hardness consist of calcium and magnesium bicarbonate, carbonate, chlorides, sulfates and heavy metal. It is determined by EDTA method**.** Maximum total hardness present in M.D. Road (90ppm) and lower in Saganerigate (50ppm).

Comparison of Total Chloride ions present before and after treatment with Brick Powder: The chloride ion concentration is determined by silver nitrate titration method. The chloride concentration rang is 60 ppm to 650ppm in the ground water. Maximum chloride present in M.D Road site (650ppm) and lower in Sanganeri Gate (60ppm).

Comparison of fluoride present before and after treatment with Brick powder: The initial fluoride concentration was removed by absorption method. The concentration of fluoride is ranging from.397 mg/l to 1.668 mg/l in the ground water of Jaipur city. Maximum fluoride present in M.D Road (1.668ppm) and lower in Adarsh Nager (.397ppm). The fluoride was determined by SPAND method.

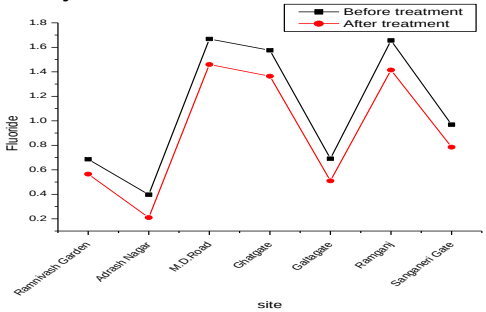

Figure.4. Comparison of fluoride present before and after treatment with Brick Powder

4. CONCLUSION

In the present study, brick powder was used as adsorbents for removal of fluoride from synthetic as well as from various ground water samples of different fluoride concentrations. Maximum fluoride present in M. D. Road and lower in Adrash Nager sites. Fluorides are measured by SPANDS method. The main conclusions that can be

drawn from the above study are given as: adsorption of fluoride by brick powder. It is proved effective for the treatment of fluoride contaminated actual drinking water. It can be explained on the basis of the chemical interaction of fluoride with the metal oxides, which makes it is very suitable for use in ground water treatment. High concentration of fluoride may also cause harm to the ecosystem and vegetation, if used for irrigation.

5. ACKNOWLEDGEMENT

Author (NK) thankfully acknowledge the scholarship given by President, JECRC University for his Ph.D. work.

REFERENCES

Adikari SK, Tipnis UK, Harkare WP, Govindan KP, Defluoridation during desalination of brakish water by electrodialysis, Desalination, 71, 1989, 301–312

Amer Z, Bariou B, Mameri N, Taky M, Nicolas S, Elimidaoui A, Fluoride removal from brakish water by electro dialysis, Desalination, 133, 2001, 215–223

Bansal DC, Donnet JB, Stoeckli HF, Active Carbon, Marcel Dekker, New York, 1988.

Bernardo E, Egashira R, Kawasaki J, Carbon, 35, 1997, 1217–1221

De AK, Environmental Chemistry, 4th Edn., New Age International Publishers(P) Ltd., New Delhi, 2000.

Determination of pH in given water sample, The International Pharmacopoeia - Sixth Edition, 2016.

Dieye A, Larchet C, Auclair B, Mar-Diop C, Elimination des fluorures parla dialyse ionicque croisee, Eur. Polym. J.34, 1998, 67–75

El-Sheikh AH, Pyrolysis, J. Anal. Appl., 71, 2004, 151–164

Gaballah I, Hager J, Solozabal (Eds.) R, Utilization of waste wood as charcoal adsorption of exhausted gas in iron and steel making process, Rewas'99 Global Symposium on Recycling, Waste Treatment and Clean Technology, San Sebastian, Spain, Mineral, Metals and Materials Society, USA, 1999.

Gupta VK, Ali I, Saini VK, Water Research, 41 (15), 2007, 3307-3316.

Hem JD, Reort A, Taft Sanitary Engr, Centre, Report WEI-5, 1961.

Hichour M, Persin F, Sandeaux J, Gavach C, Water defluoridation by Donann Dialysis and electro dialysis,Sep. Purif. Technol.18, 2000, 1–11

Hichour M, Persin F, Sandeaux J, Gavach C, Water defluoridation by Donann Dialysis and electro dialysis, Rev. Sci. Eau. 12, 1999, 671–686

Jankowska H, Swiatkowski A, Choma J, Active Carbon, Chinchester: Ellis Horwood, 1991.

Jayantha KS, Ranjana GR, Sheela HR, Modang R, Shivananni YS, Defluoridation studies using laterite material, J. Environ. Sci. Eng., 46 (4), 2004, 282–288

Killedar DJ, Bhargava DS, Effects of stirring rate and temperature on fluoride removal by fishbone charcoal, Ind. J. Environ. Health, 35 (2), 1993, 81–87

Krishnan K, Fundamental of Environmental Pollution, S. Chand & Co. Ltd., New Delhi, 1991.

Li YH, Wang S, Zhang X, Wei J, Xu C, Luan Z, Wu D, Wei B, Environmental Technology, 24 (3), 2003, 391-398

Mameri N, Lounici H, Belhocine D, Grib H, Prion DL, Yahiat Y, Defluoridation of Sahara Water by small electro coagulation using bipolar Alumi ium electrodes,Sep. Purif. Technol.24, 2001, 113–119

Muthukumaran K, Balasubramanian K, Ramakrishna TV, Removal of fluoride by chemically activated carbon, IJEP15 (7), 1995, 514–517

Prabavathi N, Ramachandramoorthy T, EdisonRaja R, Kavitha B, Sivaji C, Srinivasan R, Drinking water of Salem district—estimation of fluoride and its defluoridation using lignite rice husk and rice-husk powder, IJEP, 23 (3), 2003, 304–308

Raichur AM,Jyoti Basu M, Adsorption of fluoride onto mixed rare earth oxides, sep. Purif. Technol, 24, 2001, 121-127

Rayment GE, Higginson FR, Australian Laboratory Handbook of Soil and Water Chemical Methods, Melbourne, Inkata Press. (Australian Soil and Land Survey Handbooks, 3, 1992.

Reardon EJ, Wang Y, Limestone reactor for fluoride removal from waste waters, Environ.Sci. Technol, 34, 2000, 3247-3253

Rio S, Delebarre A, Hequet V, Le P, Blondin J, Journal of Chemical Technology and Biotechnology, 77, 2002, 382–388,.

Rodriguez F, Reinoso J, Rouquerol KSW, and Sing KK, Unger (Eds.),Characterization of activated carbon—an approach to the activation process by SAXS and optical microscopy, 2nd Symposium on the Characterization of Porous Solids, Alicante, Spain,Elsevier, UK, 1991.

Saha S, Treatment of aqueous effluent for fluoride removal, Water Res., 27, 1993, 1347–1350

Sai Sathish R, Sairam S, Guru Raja V, Nageswara Rao G, Anil Kumar K, Janardhana C, Indian Journal of Chemical Technology, 14, 2007, 350-354

Singh G, Kumar B, Sen PK, Maunder J, Removal of fluoride from spent pot liner leach ate using ion exchange, Water Environ. Res., 71, 1999, 36– 42

Sinha S, Pandey K, Mohan D,Singh PK, Ind. Eng. Chem. Res.,42 (26), 2003, 6911 –6918.

Srimurali S, Pragathi A, Karthikeyan J, A study on removal of fluorides from drinking water by adsorption onto low-cost materials, J. Environ. Pollut., 99, 1998, 285–289

Venkata Mohan S, Chandrasekhar Rao N, Karthikeyan J, Adsorptionremoval of direct azo dye aqueous phase onto coal based Sorbents—a kinetic and mechanistic study, J. Hazard. Mater., 90 (2), 2002, 189–204

Venkata Mohan S, Ramanaiah SV, Rajkumar B,Sarma PN,Journal of Hazardous Materials, 141, 2007, 465–474

WHO, Fluorine and fluorides, WHO environmental health criteria 36, Geneva, 1984.