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: nareshmansharma@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; Kiledar, 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.craspifles. (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 adsorption.

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 °C 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 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

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

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

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 samples to indicate. EC depends on ions concentration present in ground water. It is maximum found at M.D.Road (2.40mho⁻¹) and lower level at Adarsh Nagar (0.36 mho⁻¹).
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 HCO₃⁻, SO₄²⁻ 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).

Comparison of TDS, Total Alkalinity, Total hardness and Chloride ions 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 Sanganerigate (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.

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


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


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


