

Nitrate Removal By Activated Carbon Prepared From Prosopis Cineraria Bark

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Abstract

In nature, inorganic nitrogen exists in the form of various types of metal nitrates, nitrites and ammonia nitrogen. Among them, nitrite and ammonia nitrogen are very unstable comparative to nitrate and their concentration is low and easily converted to nitrate in climatic conditions. Nitrate is the major inorganic ion which naturally found in groundwater. Nitrate ion in least quantity is an essential chemical ion for normal human being to decrease blood pressure and to function as antimicrobials in the digestive system. Since then noticeable work has been done in disparate parts of world and India to explore the Nitrate contaminated water resources and their impacts on human being as well on various kind of animals. The safe limit of fluoride in drinking water is 45 mg/litre. Groundwater with high nitrate ion concentration is generally has high pH and contains large amount of silicate and other inorganic chemical ions. In groundwater, the concentration of nitrate ion rely on the geological presence of various types ions and physicochemical characteristics of the aquifer, alkalinity and acidity of the soil and types of soil and rocks of earth crust, temperature, the porosity, the reaction of other chemicals and the depth of tube wells or hand pumps and other water sites. The solution to the problem is removing the excess of nitrate from contaminated groundwater. There are various techniques that are used for the removal of nitrate. Some of these methods used for denitrification are negative and positive ion exchange, Precipitation methods, and microbial methods, Reverse osmosis, adsorption and absorption techniques. Some of these are more effective. Predominantly used technique is absorption either with the microbial, chemical or physical adsorbents. These bio-adsorbents have the physical property of adsorbing different type of negative ions like nitrate ion and various metal ions. Here different type of naturally occurring adsorbents are used which have appeared a desirable amount of degradation in nitrate ion concentration of groundwater samples. In this experimental study, we present a novel cost effective defluoridation method using Prosopis Cineraria bark charcoal as the adsorbent. The data obtained reveals that Prosopis Cineraria bark are highly efficient in nitrate ion removal by contaminated ground water.

Keywords: Prosopis Cineraria, Bio-Adsorbents, De-Nitrification, Fluoride Ion.

Introduction

Water is free gift of nature for all living beings. It is an essential natural resource for all creatures and plants to alive. It is also beneficial for climatic situations of our earth. We have always thought to be available in abundance and waste water without any type of tension. Chemical composition of surface soil or earth crust is one of the prime factors on which the appropriateness of water for domestic, industrial or agricultural and other purposes depends. The High concentration of nitrate ion in drinking water is a matter of concern in various parts of the world. Nitrate ion is considered valuable in drinking water at levels of about 45.0 mg/lit. But hazardous once it exceeds 100 mg/lit.[1,2].The Bureau of Indian Standards (BIS) has prescribed a permissible limit and desirable limit of nitrate ion concentration in portable water is 100 mg/lit and 45.0 mg/lit respectively. It is estimated that 50 percent district populace of India are suffering from various type nitrate affected diseases. Rapid surveys conducted by the PHED (public health engineering department in the state of Rajasthan have revealed nitrate in the groundwater samples of which the worst affected districts of Rajasthan are Nagaur, Churu, Sikar, Ajmer, Bhilwara [3]. The extent of nitrate ion contamination in groundwater which is varies from 40 mg/lit to 1000 mg/litre in Rajasthan [4,5]. Nitrate ion with other ions is one of the most important chemical for both human being and other creatures. Nitrate ion serves to maintain digestion of human being and antibacterial function in body within permissible limit. On the other hand, at high level of nitrate ion concentration can cause diseases such as gastrointestinal cancers, methaemoglobinaemia vascular dementia. The most soberly affected states in India are Tamilnadu, Uttar Pradesh, Haryana, Punjab, Andhra Pradesh. The higher concentration observed in various district of most of states in India



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[6-8].Removal of nitrate ion from contaminated water is done by several methods such as membrane separation, electrolytic decomposition , sedimentation , precipitation but found expensive and non suitable for third world countries.[9-11]. The biomass from shrubs, plants and agricultural wastes can be used for removal of nitrate ion from ground water as well as solving their disposal problem[12-14].A variety of adsorbents have been tried to find out an economical and efficient de-nitrification agent[15,16].Different bio-adsorbents such as coconut husk, leaves of Neem etc. may be used as a de-nitrification agent[17,18.]

The present work involves collection of water samples from five tube wells of different villages of Churu block of Churu district in Rajasthan and de-nitrification was done using simple water filter prepared using Prosopis Cineraria activated charcoal as an adsorbent.

Materials and Methods

Prosopis cineraria barks used in the present work was collected from the dry land area of Churu block of Churu district in Rajasthan, India. Charcoal prepared from collected bark of this plant. Fluoride contaminated water samples were collected from different villages and city of Churu block. All chemicals and reagents used are all of AR grade.

Preparation of Prosopis Cineraria bark charcoal

Collected Prosopis Cineraria barks were washed with water to remove dust and other different types of impurities. These were dried in the sunlight and then burnt in a muffle furnace at 360 °C for 3 hours. After this, bark material were washed with one percent formaldehyde solution to remove the colour. The dried material was ground and sieved through sieve to obtain particle of sizes up to 0.5 and 1.7 mm. After it, the material were again dried in an oven maintained temperature range of 100-150°C for a period of 10 hours- 14 hours.

Estimation of Nitrate

The continuous down flow column as an equipment was used to study the practical applicability of Prosopis Cineraria bark charcoal (PCBC) for removal of fluorides from water.All the experiments were conducted at one atmospheric pressure and room temperature. Nitrate ion concentration was estimated by spectrophotometer. A filter was constructed with double layer of PCBC. It was packed with layers of sand and gravel sandwiched between two layers of PCBC.

Result and Discussion

Different samples collected at random from various locations of potable water from villages of Churu block of Churu district were initially analysed for ground water physicochemical parameters pH, TDS and concentration of nitrate ion. The results (Table-A) showed that though there was not more variation in pH and TDS but very high nitrate ions concentration was observed in the water samples.

Table-A : Physicochemical parameter of contaminated water.

S.No.	Samples	pH	TDS	Nitrate ion concentration(mg/l)
1.	M35	7.25	335	105
2.	M36	7.55	420	207
3.	M37	7.49	528	152
4.	M38	7.50	544	127
5.	M39	7.24	432	99

All samples were passed through the column prepared with PCBC.The results obtained were indicated in table B. The Nitrate ion concentration was reduced dramatically by using PCBC as adsorbent

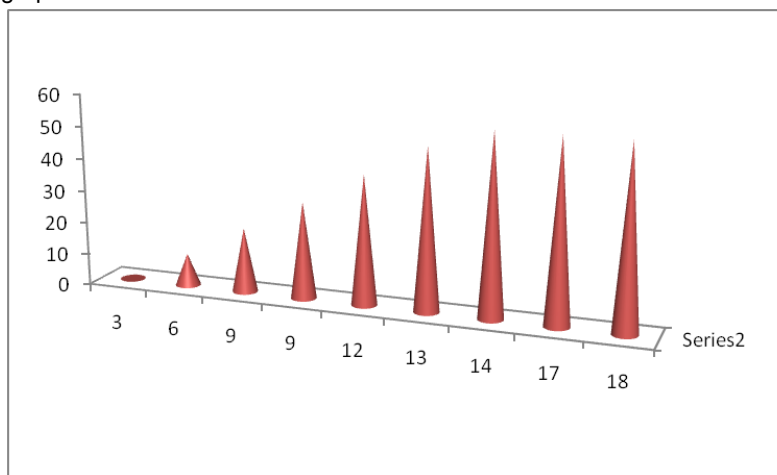
Table-B : Nitrate ion concentration after passing through the PCBC filter.

S.No.	Sample	Initial Nitrate ion concentration(mg/l)	Nitrate ion concentration after passing through PCBC (mg/l)
1	M35	105	45

2	M36	207	90
3	M37	152	78
4	M38	127	62
5	M39	99	42

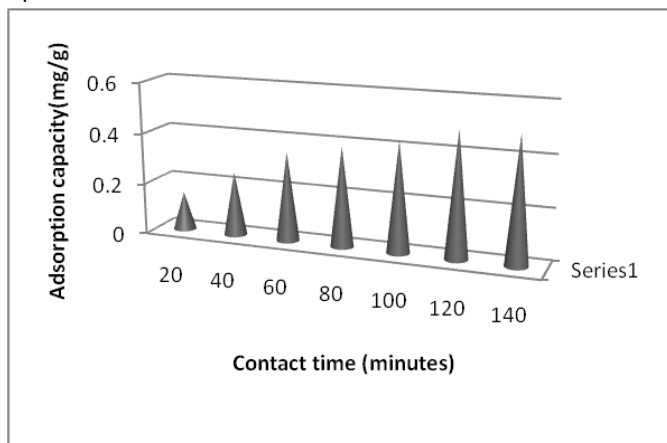
Effect Of Adsorbent Dose

The effect of activated charcoal (PCBC) dose on the Nitrate adsorption was carried out at 20 °C. Figure 1 demonstrate that there was an increase in nitrate ion percentage removal by increasing dose of the PCBC. It is due to increase in surface area and more active sites of adsorbent were available for Nitrate ion adsorption. But after a specified amount ,the percentage removal did not increase. The optimum amount was 14 g/l for adsorbent with nitrate ion removal efficiency 56 % for PCBC. It may be represented by following graph. After a specified dose graph flattened due to saturation.



Effect of contact time

The effect of contact time on nitrate ion adsorption is shown in figure 2.As the contact time with adsorbent increased the adsorption capacity also increased.The increase in adsorption efficiency of PCBC in the first 60 minutes was very fast.This might to be diffusion of ions into surface pores of PCBC.This adsorption reached equilibrium after one hour and 50 minutes.



Objective of the Study

The study area is highly affected by nitrate contamination in ground water. To solve the health issues caused by nitrate contamination in ground water in study area.

Conclusion

The study area affected by various health hazards such as gastrointestinal cancers, methaemoglobinaemia, vascular dementia due to high concentration of nitrate ions. The low cost filter performed by PCBC is very useful for rural areas of this region which is highly effected by nitrate contamination. The filter is able to remove high content of nitrate ion from ground water and has an efficiency of 56 %. The study indicates that removal of nitrate ion from water sample depends on quantity of PCBC and contact time.

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