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Removal of Nitrate From Drinking Water Using Tea Waste as Adsorbent

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Abstract : Nitrate concentration above 45 mg/l in drinking water can cause serious health hazards. The inexpensive and highly effective adsorbent was prepared using waste tea and its ability to remove nitrate from drinking water was tested. Tea waste is cleaned and chemically treated with sulfuric acid and formaldehyde then digested in alum. Nitrate removal research was carried out using the adsorption method using tea waste. The effect of adsorbent size is considered in batch study. The considered adsorbent size is 150 µm and 300 µm.

IndexTerms **- Nitrate, Adsorption, Batch, Tea Waste, Removal**

1. INTRODUCTION

For removal of nitrate from water, various purification technology were applied such as denitrification, electro-dialysis, reverse osmosis, ion exchange, adsorption, etc. Among them adsorption technology is the most effective and easy to perform [2]. Nitrogen in the form of nitrate does not bind immediately to the soil due to its higher solubility in water, which is primarily leaching rather than adsorption to the soil. This leads to an increase in nitrate pollution in groundwater and surface water. Various sources of nitrate pollution include unsafely treated industrial waste, urban and agricultural wastewater, landfill leachate, untreated wastewater treatment, and septic tank leaks [4].

2. NEED OF THE STUDY

The denitrification process must be easily accessed, simple and economic in use so that even the common men may initiate the usage of it. This eventually contributes to a pollution-free environment. Tea waste could be fruitfully used for the removal of nitrate over a wide range of concentration. Tea waste is a better adsorbent compared to number of alternative low cost adsorbents. Utilisation of tea waste has many environmental benefits for example waste recycling and resolve disposal problems.

3. RESEARCH METHODOLOGY

3.1 Adsorbent Used

It's a species of evergreen shrub named Camellia sinensis. which an aromatic bevarage called tea is made. It is It originated in the borderlands of China and the north of Myanmar. Tea consumption in the world has been growing lately. Which leads to waste of tea leaves being produced industrial scale extraction of tea leaves to produce instant Bottled tea and tea drinks.

3.2 Adsorbent Preparation

In this study waste tea dust from the restaurant is used to carry out the experiment. The waste tea dust is collected and washed properly to remove the milk and sugar. Then boiled twice in order to remove the colour. The tea waste is sun dried to remove moisture. The dried tea waste is sieved to get the particles having different sizes. The oversized particles are grounded by mortar and pestle and again sieved.

For chemical treatment take 50 g of tea leaves and add 500ml of 0.4N H_2SO_4 and 100 ml of 30% formaldehyde. This mixture is kept at a constant temperature of 50° C for 3 hours. Then tea leaves washed with distilled water to remove the acid and formaldehyde. Then it is kept in hot air oven to remove moisture. Tea waste is then digested in 10% alum solution. This is designated as tea leaves chemically treated with sulphuric acid and formaldehyde.

3.3 Collection of Sample

The sample was collected from Kozhikode district and various parameters such as pH, Turbidity, TDS, Total hardness, Electrical conductivity, Alkalinity, Chloride, BOD, COD, DO and Nitrate are tested.

3.4 Preparation of Nitrate Solution

The synthetic solution which is a representative of the sample collected from the site was prepared for the initial analysis by diluting KNO3.

3.5 Batch Study

Batch study is conducted in order to study the effects of adsorbent size. The samples of 1000ml were taken and agitated in a reciprocating shaker.

4. RESULTS AND DISCUSSION

4.1 Testing of Raw Water

The collected sample of water is tested for various parameters. The values had been compared with the drinking water standards IS 10500:2012. All the parameters except nitrate is within the desirable limit as per Drinking water standards IS 10500:2012. The value of nitrate in the sample collected from Kozhikode district is 54.2 mg/l which is above the desirable limit of 45 mg/l.

4.2 Batch Study

Batch study is conducted in order to study the effects of adsorbent size. The samples of 1000ml were taken and agitated in a reciprocating shaker for 15 minutes. The detailed result of these parameter is included in following section.

4.2.1 Effect of Adsorbent Size

The study of the effect of adsorbent size on nitrate removal efficiency was carried out by using 150 µm and 300 µm sized tea waste.

Table 4.1: Effect of Adsorbent size on Nitrate Removal

Adsorbent Size (Micron)	Adsorbent Dosage (g/l)	Initial Nitrate Concentration (mg/l)	Final Nitrate Concentration (mg/l)	Nitrate Removal Efficiency (%)
150	3	52	49.925	3.99
		54	52.486	2.81
		56	54.912	1.94
	5	52	48.512	6.70
		54	51.209	5.16
		56	53.381	4.67
	7	52	45.310	12.86
		54	47.925	11.25
		56	50.363	10.06
	9	52	44.013	15.35
		54	46.628	13.65
		56	48.934	12.61
300	3	52	50.214	3.43
		54	52.901	2.03
		56	55.571	0.77
	5	52	49.621	4.57
		54	52.891	2.05
		56	55.021	1.74
	7	52	47.156	9.31
		54	49.358	8.59
		56	52.296	6.61
	9	52	44.981	13.49
		54	48.351	10.46
		56	51.174	8.61

Table 4.1 shows the effect of adsorbent size in nitrate removal. The considered adsorbent dosage is 3 g/l, 5 g/l, 7 g/l and 9 g/l and also the considered initial nitrate concentrations are 52 mg/l, 54 mg/l and 56 mg/l. Here the removal efficiency of nitrate is decreasing with increasing initial nitrate concentration and also the removal efficiency is increasing with increasing adsorbent dosages. A maximum of 15.35 % removal is obtained for 150 µm sized particles of adsorbent and 13.49 % is obtained for 300µm sized adsorbent with an adsorbent dosage of 9 g/l and initial nitrate concentration 52 mg/l. The maximum nitrate removal efficiency is obtained for 150 µm adsorbent size with 15.35 % removal efficiency.

Chart-1 shows the comparison on the effect of Adsorbent size on the removal efficiency of nitrate at different initial concentrations and adsorbent dosages.

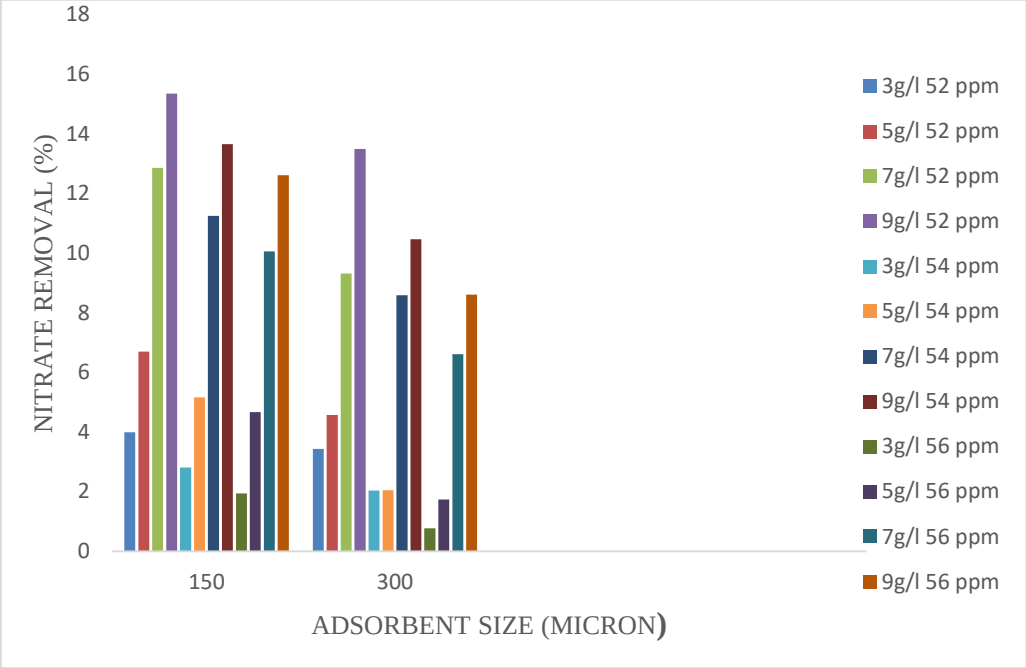

Chart-1 Effect of Adsorbent size

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