

Assessment of Removal of Nitrate by Water using Mosambi Peel Powder as Adsorbent

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Abstract— Our life is very precious and water is one of the most important natural resource for the existence of our life. For the last two decades; there is an increased interest in the study of nitrate in the ground water. Earlier the nitrate concentration in the ground water was very low nearly 5ppm. However due to pollution the nitrate concentration in the water has increased considerably. In the environment, nitrogen is found in different forms like Nitrate (No₃-), Nitrite (No₂-), and Ammonia (NH₃) and Nitrogen gas (N₂). Nitrate pollution of water is mainly due to excessive use of fertilizers, human sewage and livestock manure. Nitrates presence in the potable water beyond permissible limits is the major issue today for the people living in the western Rajasthan. It is affecting their health badly. Infants, less than six months can be victim of nitrate poisoning “Methemoglobinemia”. (blue baby syndrome), Beside this gastric cancer, hypothyroidism, hormonal imbalance disorder, birth malformations and growing hypertension in the human beings is also attributed to the increased concentration of nitrate in the water. Therefore our prime objective was to remove nitrate from the contaminated water by an affordable and easy method.

Keywords: Mosambi Peel, Adsorbent Dosage, Biosorbent

I. INTRODUCTION

In almost all parts of the world, ground water pollution is a growing concern. In India ground water is one of the main source for potable water. The commonly observed contaminants such as Nitrates and heavy metals etc. are added to our water resources by various human activities including domestic sewerage; agricultural practices and industrial effluents. Most of the organic and inorganic contaminants of nitrogen undergo transformation into nitrates by the nature known as nitrogen cycle. [1-2]. Nitrate is essential compound for normal health & hygiene. It is normally found in food stuff, leafy vegetables & proteins including purified pyrimidine & urea. It exists in different forms viz:- Nitrate (No₃-), Nitrite (No₂-) Ammonia (NH₄⁺). The ultimate product of biological nitrification is Nitrate.

In the agricultural sector increased use of nitrogen fertilizer is the major reason for nitrate contamination [3]. In spite of this poorly treated or untreated human and animal wastes are also responsible for contamination. Non- point sources are also responsible for nitrate contamination [4-7] and which are also hard to detect. Factors such as dissolved oxygen, electron donor availability, precipitation, thickness, source availability irrigation, ground water flow etc. are also control distribution of nitrate in ground water Blue baby syndrome (Methemoglobinemia) especially occur in infants is due to increase in the concentration of nitrate in water & it is due to high solubility of nitrate in water [8-9] High concentration also causes gastric & intestinal cancer [10-11].

According To WHO 45 ppm is the permissible limit of Nitrate for human consumption. According to W.H.O. the guideline value for nitrate- nitrogen is 10 ppm (mg/L of nitrate – nitrogen) [12-13]. The Indian council of medical research has recommended a highest desirable level of 20ppm of nitrate-nitrogen in the drinking water while maximum permissible level recommended for drinking water is 50 ppm.

II. MATERIAL & METHOD

Study on Mosambi peel as a bio adsorbent for the nitrate removal was done and found out the best adsorbent for the nitrate removal.

A. Preparation of Adsorbent (Mosambi Peel Powder):

Mosambi peels were collected from juice centres in local market, were cleaned and dried under sun for 3 days. The dried peels were grounded to powder and sieved. The powder on the meshes of size 53, 75, 106 and 150 μ m was collected separately. Final sample was determined by igniting the residue at 1000oC in muffle furnace.

B. Preparation of Nitrate Sample:

Anhydrous and pure Potassium Nitrate (KNO₃) was used as a source of nitrate. All experiments were carried with water sample of 200 mg/l nitrate concentration which was prepared by dissolving nearly 0.033g of KNO₃ in 100ml water.

C. Batch Adsorbent Experiment:

Batch experiments were conducted in the laboratory by contacting the nitrate solution with banana peel adsorbents. The effect of initial concentration of Nitrate, contact time, and concentration of Adsorbent were investigated by varying any one of the parameters and keeping the other parameters constant. The experiments were conducted and nitrate nitrogen was determined using the UV-VIS absorption spectrophotometer.

III. EFFECT OF CONTACT TIME

0.1 g of mosambi peel was taken in 100 ml of nitrate sample and was allowed for stirring for different time periods of 0.5, 1, 1.5, 2, 3 hours at a speed of 120 rpm on a magnetic stirrer. The solution is filtered and adsorbent is separated from the treated nitrate sample.

A. Effect of Adsorbent Dosage:-

The effect of adsorbent dosage is studied by varying adsorbent weight. 0.025, 0.05, 0.1, 0.2, 0.3 g of Mosambi peel powder was taken in nitrate sample and allowed for stirring for a duration of 0.5 hr.

B. Effect of Nitrate Concentration

The effect of nitrate concentration is studied by varying nitrate concentration in the nitrate sample. Nitrate samples of

nitrate concentration 60, 75, 100, 150, 200, 250, 300 mg/l nitrate were prepared and 0.1g of adsorbent was taken and stirred for 0.5h.

C. Detection of Nitrate

The solutions of all the above experiments were filtered and diluted to bring them into the concentration range of standard curve. The absorbance of diluted sample was taken at 220nm in UV-Visible spectrophotometer. The removal efficiency was found out using the equation

$$\text{Removal Efficiency} = ((C_0 - C_1) / C_0) * 100$$

Where, C₀ = Initial nitrate concentration, C₁ = Nitrate concentration in water after adsorption

IV. RESULTS & DISCUSSIONS

A. Effect of Contact Time:

The highest efficiency of nearly 75 % was observed for contact time of 0.5 h; however the removal efficiency for contact time of 1h was also nearly the same.

The removal efficiency for contact time of 1.5, 2, 3 hours were nearly same and equal to 73% approximately. Hence Contact time of 0.5 h was selected as optimum contact time and used for all the other experiments.

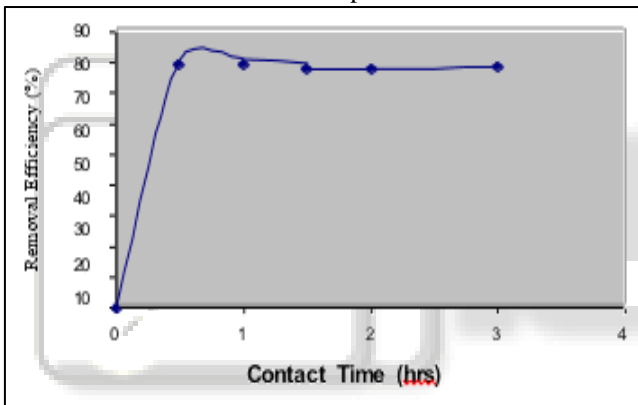


Fig. 1: Effect of contact time of adsorbent on removal efficiency of nitrate

B. Effect of Size Fraction:

The efficiency increased with size fraction with a highest efficiency when Mosambi peel powder on 106 µm mesh was used as adsorbent and decreased with further increase in size to 150 µm.

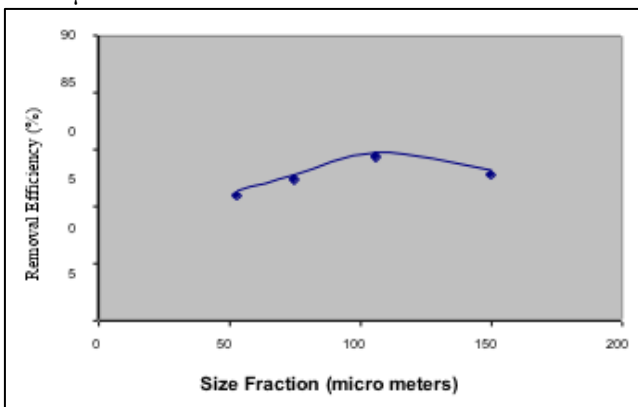


Fig. 2: Effect of size fraction of adsorbent on removal efficiency of nitrate

C. Effect of Adsorbent Dosage:

The removal efficiency increased when adsorbent dose was increased from 0.025 g to 0.05 g where it was maximum and remained nearly same at 0.1g dosage and decreased with further increase of dosage to 0.2 and 0.3g, however the difference was not more than 3%

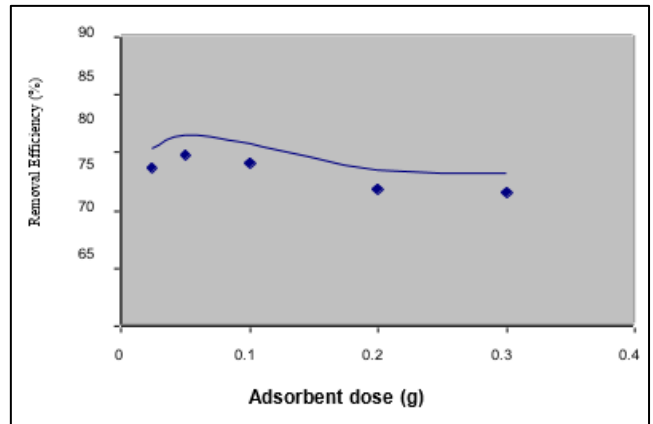


Fig. 3: Effect of adsorbent dosage on removal efficiency of nitrate

D. Effect of Nitrate Concentration:

The nitrate removal efficiency of Mosambi peel increased with increase in initial nitrate concentration. The increase in removal efficiency is a result of increase in nitrate ions in the solution which compete and adsorb to most of the sites present on the adsorbent.

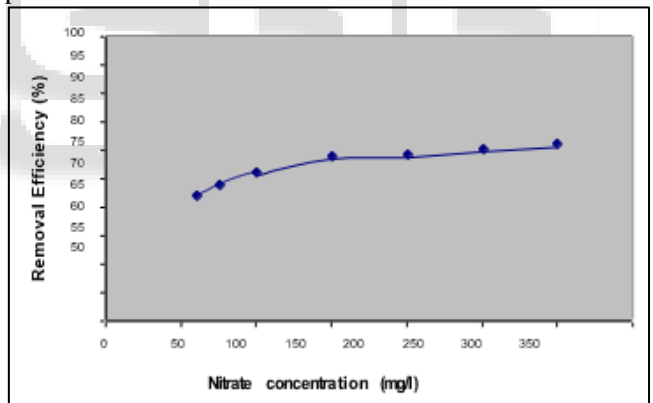


Fig. 4: Effect of nitrate concentration on removal efficiency of nitrate

V. CONCLUSIONS & FUTURE WORK:-

The contamination of nitrate in water is profound and emerging technologies are required for removal of it. The present study shows that mosambi peel can act as an efficient Biosorbent in removal of nitrate from water. The effect of different parameters like contact time, adsorbent size fraction, adsorbent dosage, nitrate concentration was studied. The removal efficiency of nearly 84% was achieved when 0.05g of mosambi peel powder of 106 µm size fraction was used as adsorbent to treat 100 ml of water sample of 200 mg/l nitrate concentration for a contact time of 0.5h. Further study of effect of parameters like pH, temperature and effect of different pre-treatment methods of adsorbent would help to increase the efficiency of nitrate removal and enhance the applicability of mosambi peel as a biosorbent.

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