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EXPERIMENTAL INVESTIGATION OF GROUNDWATER BY USING ADSOBENT FOR NITRATE REMOVAL

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ABSTRACT
Nitrate adulteration is one of the major problems in groundwater, which is increasingly becoming a threat to groundwater supplies. The removal of Nitrate is indispensable for water adulterated with Nitrate before being utilized since a large amount of Nitrate in drinking water often causes a disease called Methemoglobinemia and other health disorder such as hypertension, thyroid disorder, birth defects. Available technical data, experience, economics specify that activated carbon is more justifiable for Nitrate removal than other processes. A vast array of activated carbon has been widely used for de-nitrification due to its good performance, low cost and large available quantities. This paper presents an removal of nitrate from groundwater by using adsorbent.

KEYWORDS: Nitrate, Groundwater (Namakal), Adsorbent, Physical and Chemical characteristics.

I.INTRODUCTION

GENERAL

Nitrogen concentration in Groundwater has increased in many areas of the world. This causes serious concerns because of the link between Nitrate and Blue-Baby syndrome Methemoglobinimia. In India Andhra Pradesh, Bihar, Delhi, Haryana, Himachal Pradesh, Karnataka, Rajasthan, west Bengal, and Tamil Nadu are suffered by Nitrate contamination in Groundwater. In Tamil Nadu the concentration of Nitrate is located on Salem, Namakal and Nilgiri. Nitrate compound are very soluble in water. The nitrate part (ion) is negatively charged, and since soil is also negatively charged, it is repelled by soil surfaces and stays in the solution. When excess water drains through soil, Nitrate is washed out (leached). Nitrogen in the form of Nitrate in surface and groundwater pollution arising from both rural and urban areas. The raw water to be denitrified is fed into a bio reactor(with the presence of denitrifying bacteria-Innoculum). Most waste water to be denitrified contains enough carbon source for the process and thus with the right conditions, Nitrates are converted to N2 gas through a number of reduction steps.De-nitrification is an assembly of Nitrate reduction, Nitrite reduction, Nitric oxide reduction and Nitrous oxide reduction.

GROUNDWATER

Water, the best of all things is the nature's free gift for living organisms. It is bound up with man's evolution and doubtless destiny in countless ways. Water has been used for drinking, domestic purpose, industry, agriculture and recreation; it shows the extent to which it is an integral part of our

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life. Water is absolutely essential not only for human beings, but also for animals, plants and all the other living beings. The basic condition for life on earth is that water should be available in the liquid form. Three-fourth of the earth's surface is covered with water of the total water resource available, about 97.25% is salt water, which is mainly in ocean and 0.68% is available as groundwater. 2.05% as ice caps, 0.001% of atmospheric moisture, 0.005% of soil moisture, 0.01% in lakes, 0.0001% in rivers and 0.00004% in the biosphere. The rapid urbanization, industrialization as well as agricultural activities has made environmental pollution a growing concern globally. Off all the receptor systems exposed to the contaminants, groundwater has aspect received little attention of in present the past because days of common belief that groundwater was pristine. Ground water provides drinking water for more than one-half of the nation's population, and is the sole source of drinking water for many rural communities and some large cities. In India, the groundwater contamination with respect to nitrate has been observed in few areas of Andhra Pradesh, Bihar, Delhi, Haryana, Himachal Pradesh, Karnataka,Rajasthan, Tamil Nadu and West Bengal.

Importance of groundwater

Groundwater is important to those who have limited prescription each year. Groundwater is the primary source of water for 50% of the American population and 90% of those people in rural areas. In India, 58% of the total population uses groundwater. It plays an important role in the hydrologic cycle. Groundwater is the safest and most reliable source of available freshwater. Only 3% of earth 's freshwater are located in streams, lakes, and reservoirs. The remaining 97% of freshwater is underground. Of the public supply systems in India, 43% use groundwater and of the people who live in rural areas in India, 87% use groundwater. About 500,000 individual homes, 425 public water systems and 2,500 non -community water supplies are dependent on groundwater. Groundwater isvital for Indian's industrial and agricultural growth and development. According to reports in 1985 for India, industry uses an average of 190 million gallons per day during the growing season and livestock operations depend on an average of 45 million gallons per day.The availability and quality of groundwater varies widely across the states of India. In general, well yields range from less than five gallons per minute in bedrock aquifers in Southwest in India to several thousand gallons per minute well in aquifers beneath and adjacent to India's major rivers. Most freshwater or portable groundwater in India occurs at depths of 40 feet to 300 feet. Highly mineralized waters are usually found at greater depth.

Nitrate ($NO3^-$)

Nitrate compounds are very soluble in water. The nitrate part (ion) is negatively charged, and since soil is also negatively charged, it is repelled by soil surfaces and stays in the solution. When excess water drains through soil, nitrate is washed out (leached). Nitrogen in the form of nitrate in surface and groundwater can be an Important consequence of groundwater pollution arising from both rural and urban areas. Nitrate leaching to the water environment is contributed from the application nitrogen fertilizer in agriculture, wastes from grazing animals and soil erosion. If high rainfall occurs after ammonium nitrate fertilizer has been applied, much of the Nitrate will be leached, but otherwise nitrate is taken up by plants very quickly.

ADSORPTION

Adsorption is the process in which the atoms, ions or molecules from a substance adhere to a surface

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of the adsorbent. Adsorption is a surface based process where a film of adsorbateis created on the surface while adsorption involved the entire volume of the absorbing substance

II.MATERIALS AND METHODS

ACTIVATED CARBON

Activated carbon has been frequently used as an absorbent for removal of heavy metals from aqueous solution. Since its first introduction for heavy metal removal, Activated carbon undoubtedly had been the most popular and widely used adsorbent III wastewater treatment application , throughout the word. In spite of its prolific use , activated carbon remains an expensive material since higher the quality of activated carbon , the greater its cost. Activated carbon also requires completing agents to improve its removals performance for inorganic matters . [Yadav et al , 2004] used Granular Activated Carbon (GAC) and powder activated carbon (PAC) as adsorbent to remove the trace metal arsenic from aqueous solution. Their results show that adsorption capacity of GAC was much more than that of activated carbon.Most of these methods suffer from some drawbacks: The reduction followed by precipitation by precipitation technique has a problem on solid –liquid separation and disposal of toxic sludge.Above the seven methods - we choose the Activated carbon filteration method.

CHARACTERISTICS AND GENERAL REQUIREMENTS

ADSORBING MATERIAL

Adsorbents are used usually in the form of spherical pellets, rods, moldings, or monoliths with a hydrodynamic radius between 0.25 and 5 mm. They must have high abrasion resistance, high thermal stability and small pore diameters, which results in higher exposed surface area and hence high capacity foradsorption. The adsorbents must also have a distinct pore structure that enables fast transport of the gaseous vapors. Activated carbon nitrogen isotherm showing a marked micro-porous type I behavior.Activated carbon can be manufactured from carbonaceous material, including coal (bituminous, subbituminous, and lignite), peat, wood, or nutshells (e.g., coconut). The manufacturing process consists of two phases, carbonization and activation. The carbonization process includes drying and then heating to separate by-products, including tars and other hydrocarbons from the raw material, as well as to drive off any gases generated.

Fig no: 1 Activated carbon is used as an adsorbent

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The process is completed by heating the material over 400 °C (750 °F) in an oxygen-free atmosphere that cannot support combustion. The carbonized particles are then "activated" by exposing them to an oxidizing agent, usually steam or carbon dioxide at high temperature.

Most industrial adsorbents fall into one of three classes:

- Oxygen-containing compounds –Are typically hydrophilic and polar, including materials such as silica gel and zeolites.
- Carbon-based compounds –Are typically hydrophobic and non-polar, including materials such as activated carbon and graphite.

METHOD OF TREATMENT

In the treatment process horizontal flow method is used. The 1m Poly Vinyl Chloride-(PVC) pipe is used as a treating chamber. The adsorbing materials are filled into the horizontal pipe. The wastewater is inserted into the pipe without using any pump. The flow of the wastewater is gravitational flow. The wastewater is treated in the pipe for ten days continuously. The parameter of the wastewater is check continuously before and after the treatment. The samples are collected from the containers properly. The prepared tannery waste used for the test is kept without any organic degradation before treatment. Sufficient quantities of waste water samples was taken from the container periodically. The initial effluent characteristics such as pH, DO and COD were determined in the raw effluent.After the initial characterization the synthetic tannery waste were treated with Activated Carbon as adsorbent which is mixed with uniform size sand in the ratio of **1:26** (1part activated carbon-26 part sand) for the reduction of chemical oxygen demand. The burned coconut shell is used as an adsorbent.

MATERIALS

- Treating Equipment
- Groundwater
- Adsorbing material

SETTING OF TREATING CHAMBER

The pipe is fixed in horizontal position. The diameter of the pipe is 4 inches. At the two ends there are two ¾ inch reducers are fixed to reduce the dia of the pipe. From that point the ¾ inch pipes are fixed with the help of the elbow. There are two regulating valves are fixed at the two sides of the ¾ inch pipe for the steady flow of wastewater into the pipe. The wastewater is inserted into the pipe by the use of the funal. The treated wastewater is collected by a storage tank.

PREPERATION OF ADSORBING MATERIAL

The sieved sand and powdered coal of burned coconut shell is used as adsorbing material. The sand is sieved by using 800 micron sieve. For maintaining the uniform size the sand is sieved. The activated carbon is prepared by using the burned coconut shell. The coconut shell is burned and ground well. And then the burned powdered coconut shell is sieved like sand.

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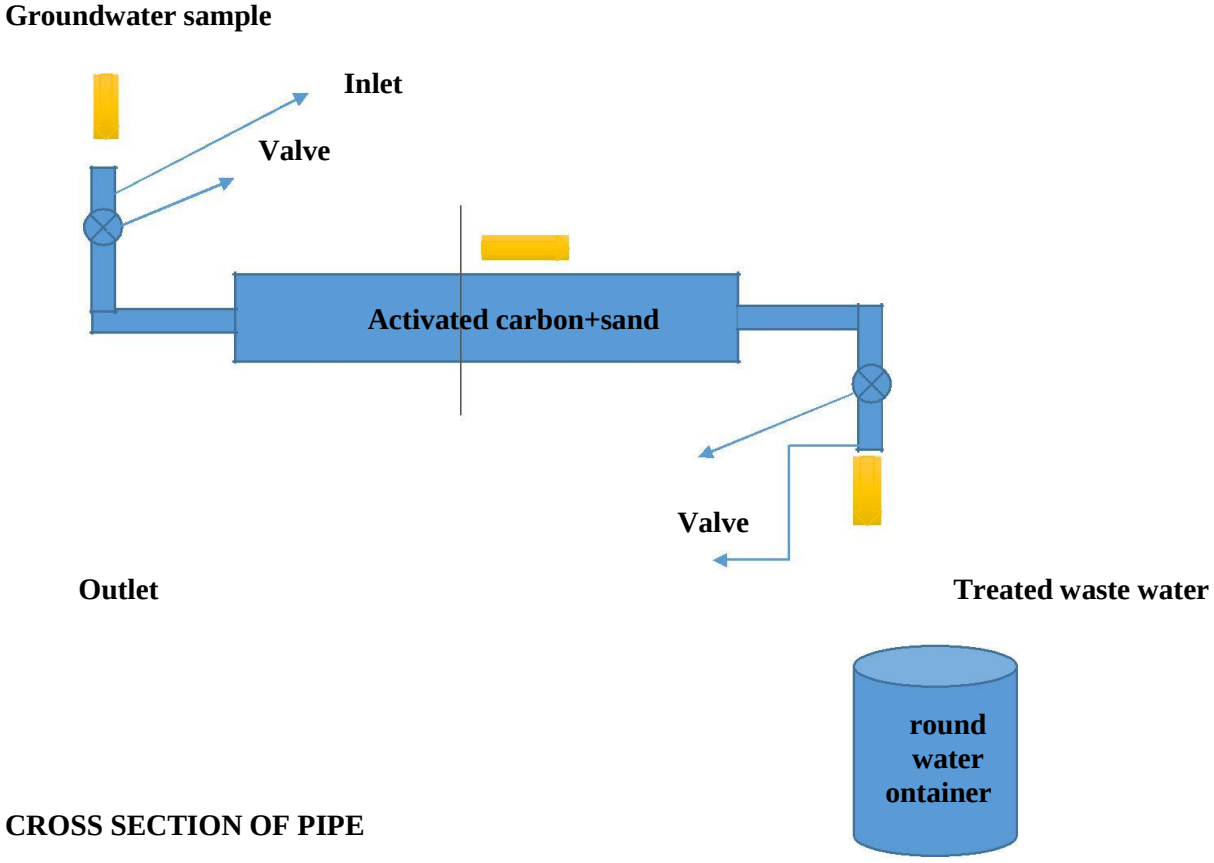

FIG .N Flow Diagram for Treatment Process

RESULTS AND DISCUSSION

The treated groundwater is carefully collected and tested day-to-day for 10 days. Treatment is carried out by the help of activated carbon as adsorbing material. At the end of the 10^{th} day, Nitrate present in the waste water will be removed partially. This process of removing Nitrate present in the Groundwater.

The Below tabulated values are the values of raw Groundwater parameter values prepared in the laboratory.

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S.No	Parameter	Values
1.	Ph	6.417
2.	DO	16.8(mg/l)
3.	TS	2831(mg/l)
4.	TDS	2560(mg/l)
5.	TSS	270(mg/l)

TABLE:1 PARAMETER VALUES OF COLLECTED GROUNDWATER SAMPLE

	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10
Ph	6.417	6.532	6.645	6.777	6.851	7.134	7.146	7.154	7.194	7.2
DO (mg/l)	16.1	17.56	17.87	18.43	18.98	19.64	19.72	20.26	20.45	20.9
TDS (mg/l)	2178	2045	1775	1574	1452	1208	932	679	474	340
TSS (mg/l)	654	545	405	387	280	178	162	158	143	109
TS (mg/l)	2832	2590	2180	1865	1696	1365	1107	730	573	460
NO^{3-}	57.08	50.87	49.05	41.18	35.52	30.38	27.21	14.85	7.19	0

Table: 2 STUDY OF TREATMENT PROCESS

III. CONCLUSION

This study illustrates the possibility of a removal of Nitrate from groundwater by biological De-nitrification. The significant contribution from industry has increased the Nitrogen load discharged to receiving waterways. The effectiveness of the biological de-nitrification is very huge and can almost 100% which is not complemented by any other methods accessible for nitrate reduction. The many full scale biological nitrate removal process, heterotrophic as well as autotrophic in developed countries.Hetrotrophic process required carbon sources externally but Autotrophic process does not require organic carbon source, some inorganic substance such as hydrogen gas and sulphur for electron donor and bicarbonate or carbon di oxide in the water as a carbon source. The well effluent can be achieved by providing a zone in that contact with biomass like Hetrotrophic bacteria with aerobic treatment process at anoxic environment. Important progress has been made in enough of the de-nitrification process inhibitory effects of reaction intermediates and By-products.

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