



e-ISSN: 2319-8753 | p-ISSN: 2347-6710

IJRSET

International Journal of Innovative Research in
SCIENCE | ENGINEERING | TECHNOLOGY



INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 11, Issue 11, November 2022

ISSN INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA

Impact Factor: 8.118

 9940 572 462

 6381 907 438

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A Review: Removal of Nitrate from Water by Absorption

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ABSTRACT - Waste water, also spelled waste-water, is any water that has been adversely affected in quality by anthropogenic influence. It comprises liquid waste discharged by domestic residences, commercial properties, industry, and/or agriculture and can encompass a wide range of potential contaminants in a wide range of concentrations. Usually, the term "Domestic Sewage" refers to the Municipal Waste water that contains a broad spectrum of contaminants resulting from the mixing of wastewater from homes, businesses, minor industrial areas and often storm drains, especially in older sewer systems. Municipal wastewater is usually conveyed in a combined sewer, sanitary sewer, effluent sewer, etc. Sewage includes domestic, municipal, or industrial liquid waste products disposed of, usually via a pipe or sewer (sanitary or combined), sometimes in a cesspool emptier. Ujani dam has a very bad quality of water. Ujani dam contains hazardous pollutants from Pune and many other small cities located on the banks of Bhima River or its tributaries. According to recent surveys the water from ujani dam is not potable and should not be used for agriculture also. the survey found high level of nitrates , chemical oxygen demand (COD) and biochemical oxygen demand (BOD) in the water which makes it unfit for consumption.

KEYWORDS: Waste Water, Domestic Sewage, Potable, B.O.D., C.O.D., Nitrate.

I. INTRODUCTION

More than 70 % of the area of earth is covered by water. However, availability of fresh water is a major problem across the world. Only 3 % of total water on the earth is useable. Safe drinking water is essential to humans and other life. One of these Ujjani Dam, also known as Bhima Dam or Bhima Irrigation Project, on the Bhima River, a tributary of the Krishna River, is an earthfill cum Masonry gravity dam located near Ujjani village of Madha Taluk in Solapur district of the state of Maharashtra in India. The Bhima River, which originates in Bhimashankar of the Western Ghats, and forms the Bhima Valley with its tributary rivers and streams, has twenty-two dams built on it of which the Ujjani Dam is the terminal dam on the river Ujani dam has a very bad quality of water. Ujani dam contains hazardous pollutants from Pune and many other small cities located on the banks of bhima river or its tributaries. According to recent surveys the water from ujani dam is not potable and should not be used for agriculture also. Dissolved oxygen is also below standard of 8 ppm. Resident of Indapir taluka in solapur district have been suffering from various ailments for the last four or five years the reason was unearthed during recent survey and testing of water at ujani dam which residents dependent on .the survey found high level of nitrates , chemical oxygen demand (COD) and biochemical oxygen demand (BOD) in the water which makes it unfit for consumption . bombay high Court judge B G Kolse Patil who has also taken up this issue said ,"people in solapur filter the water three times ,but the illness do not stop. There are 700 chemical companies polluted water directly into rivers there is no system in place to keep a check on these."

II. LITERATURE REVIEW

1. Claudio Della Rocca et al (2005) carried out the study on "Cotton supported eterotrophic denitrification of nitrate-rich drinking water with a sand filtration post treatment". The biological denitrification (BD) process represents an interesting solution to remove nitrate from water and as well as to close the natural nitrogen cycle. Potential applications are related to both groundwater denitrification and treatment of nitrate rich effluents from reverse osmosis



and ion-exchange processes. This paper presents the results obtained from a pilot-scale cotton- supported heterotrophic denitrification reactor (HDR) where cotton acts as both organic carbon source and supporting material for the growth of a denitrifier biofilm. A trickling sand filter (TSF) was inserted as post-treatment to remove TOC released by the HDR and to reoxygenate the treated water. The system is evaluated for drinking water treatment. Nitrate removal efficiency of the HDR was over 90% for 85 mg/ℓ of inlet nitrate concentration which is a mean groundwater value in many EU countries. The process maintained its high performance up to 358 mg of daily nitrate inlet with a maximum specific volumetric ratio of 24.5 gN/m³·d. A first- order kinetic value was shown for sequential nitrate-nitrite and nitrite-nitrogen gas transformations. For that, the kinetic constants of 2.6 ℓ/d (K1) and 15.9 ℓ/d (K2) were assumed. The TSF provided additional nitrificationaerobic denitrification at a rate of 20.7gN/m³·d. Although both reactors showed high performances in terms of nitrogen removal, this plant configuration cannot assure an adequate TOC outlet concentration (>3 mg/ℓ).⁽¹⁾

2. C. Martínez-Navarrete, A. Jiménez-Madrid, I. Sánchez-Navarro, F. Carrasco- Cantos and L. MorenoMerino, Int. J (2011) A conceptual framework is defined to establish safeguard zones in groundwater bodies intended for drinking water according to the requirements of the Water Framework Directive. For this, the foundations of a three-phase methodology within a dynamic process are proposed. The results of the first two phases are presented, which contemplate the distribution of groundwater body abstraction points as well as hydrogeological criteria, evaluation of pressures and aquifer vulnerability, in addition to the defined wellhead protection areas of abstraction points. As a final proposal, it will be necessary for competent authorities to create a recommendations and restrictions guideline, which should be integrated into the rest of the policies related to land-use planning in order to protect groundwater adequately.
3. LizmolA.Peechattukudy et al (2017) carried out the study on “ Removal of Nitrate from water by adsorption”. In this study Nitrogen is present in atmosphere and is essential for all living things. However excess nitrate-nitrogen present in water can lead to adverse effects on living beings. Nitrate is the most common anion to be found in groundwater. Water quality monitoring in various states and countries conducted in groundwater survey around the world showed varying concentrations of nitrate. Most of the places, the concentration is within USEPA standards of 10mg/L nitrate-nitrogen (45mg/l nitrate according to Bureau of Indian Standards). However, some isolated cases showed spike in nitrate concentration in water mostly due to presence of wastewater disposal sites, landfills and septic/solid disposals. Consumption of nitrate contaminated water can affect livestock and humans especially babies and pregnant women such as methenaglobemia in infants. Various treatments have been found for removing ground nitrate from groundwater. Most cost effective and efficient method is adsorption. Keywords: nitrate, water, adsorption, zeolites, removal.⁽³⁾
4. Mortezamohsenpour et al (2014) carried out the study on “Removal Techniques of Nitrate from water”. In this study Nitrate pollution of water is a major environmental problem all over the world. Consequently, numerous techniques have been developed to remove or reduction of nitrate in water. A review of removal techniques of nitrate from water has been carried out in this paper. Recent literatures related to various techniques including reverse osmosis, ion exchange, electrodialysis, biological denitrification, chemical denitrification, adsorption methods using different adsorbents like carbon base, agricultural waste, natural materials are systematically review to assess their performance. The paper reveals that adsorption could be the most promising technique of removal of nitrate from water in near future.⁽⁴⁾
5. Pushpendrakumar Sharma (2008) et al carried out the study on “ Household Nitrate Removal Technologies”. In this study the removal of nitrate from potable waters has received increased attention as the health effects of nitrate have been studied. This paper reviews the health effects due to nitrates in human beings. Environmental protection agency has prescribed its limits for drinking water. Nitrate removal methods include the biofilter system, which employ denitrifying bacteria converting wastewater nitrates into nitrogen gas. This system is also beneficial for activated sludge process as energy consumption for aeration can cut down by using nitrates for bacterial respiration. Some strains of Cyanobacteria were also found helpful for nitrate uptake from nitrate rich ground waters.⁽⁵⁾



6. S.P.Burghate et al (2013) carried out the study on “ Biological denitrification”. In this study nitrogen is present most of the water resources. It exists in various oxidation states. Out of these NH_3 , N_2O_3 Combine with water and from water soluble species-ammonium , nitrate respectively. These will cause the problems like toxicity , oxygen depletion , diseases , eutrophication , chlorine demand etc. Considering these problems it is necessary to remove nitrogen species from water. For the removal of nitrogen , various processes are available .Viz ion exchange , reverse osmosis , breakpoint chlorination , nitrification and denitrification Nitrogen is seen to be an essential component of all living things excessive concentrations of certain nitrogen species in some compartments of the environments can lead to significant environmental problems. This is true of some nitrogen species in the atmosphere as well as in terrestrial and aquatic environmental .Nitrate has become one of the key environmental issues because of its implications on human and animal health.⁽⁶⁾
7. Vit Mateju et al (1992) carried out the study on “ Biological water denitrification”. Different methods of biological denitrification of drinking water as well as the microbiology and stoichiometry of the process are reviewed. Autotrophic bacteria oxidizing anorganic compounds or heterotrophic species oxidizing organic materials can perform denitrification . generally autotrophic bacteria grow slowly and denitrification rates are lower whereas contamination of denitrified water with organic materials requires extensive post treatment in the heterotrophic processes. Most full scale applications make use of heterotrophic processes due in situ using soil infiltration , but underground phenomena remain difficult to control .⁽⁷⁾
8. T.S. Thompson, Bull. Environ. Contam. Toxicol.(2001) Nitrogenous materials, such as organic matter and ammonia, may be oxidized to nitrate by micro-organisms in soil, plants and water. Natural sources of nitrate in the environment include decaying matter (both plant and animal) as well as leaching from geological formations. Anthropogenic activities resulting in the release of nitrate into the environment include the disposal of domestic sewage, livestock operations, and the use of nitrate-based fertilizers. Nitrate is highly water-soluble and therefore tends to migrate from soil into groundwater. The consumption of well water containing elevated concentrations of nitrate was first linked to a condition known as methemoglobinemia in young infants in 1945 (Comly 1987). Ingested nitrate is reduced to nitrite which subsequently hinders the ability of blood to transport oxygen to body tissues. This condition has been reported to be fatal in numerous cases (Johnson et al. 1987). Methemoglobinemia resulting from the consumption of nitrate- contaminated water has been observed almost exclusively in infants under three months of age (Craun et al. 1981). The presence of elevated concentrations of nitrate in rural drinking water supplies continues to have potential public health implications related to the occurrence of methemoglobinemia in infants (Shearer et al. 1972; Johnson and Kross 1990). The consumption of drinking water

III. CONCLUSION

Ever increasing of nitrate in aqueous media and its adverse effect on human health and ecology has led intensive research on cost effective and efficient nitrate removal techniques. Consequently, numerous methods have been developed for nitrate removal. The review of the methods indicates that Ion exchange, reverse osmosis, Biological denitrification and electro dialysis are the most effective methods of nitrate removal from water. However, the major limitation of these methods is the disposal concentrated waste stream to environment and risk of nitrite formation (potential incomplete denitrification). Adsorption methods absorb pollutant therefore are free from some limitations; however, the full-scale application of adsorption options is currently limited.

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Impact Factor: 8.118



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