# NITRATE ELIMINATION FROM GROUNDWATER WITH THE UTILIZATION OF ACALYPHA INDICA -A REVIEW

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**Abstract -** Inadequate treatment of groundwater before consumption can be harmful to human health and the environment. We use a lot of water and produce a lot of trash, both of which can be harmful since they include various microorganisms, inorganic substances, and organic compounds. Unsafe ground water effluent results from a variety of physiochemical processes. The soil and water are degraded when chemically polluted ground water mixes with these natural resources and the ecosystems they rely on. The goal of this research is to identify the most efficient strategy for purging toxins from underground water supplies. Effluent guidelines and laws for wastewater treatment plants have been implemented by a number of protection authorities across the world based on performance and control technologies. There are three phases of Treated Waste Water (TWW). TWW treatment that can be distinguished from one another. In the past, TWW removal from water supplies was accomplished using adsorption, flotation, ozone, ion exchange, and crystallization. No longer are these methods often used. Water from the ground can be gathered and possibly reused in manufacturing processes utilizing cutting-edge wastewater treatment techniques. This review artlicle provides a literature overview on the common and actual features of ground water, including its ingredients such the chemicals used to create simulated ground water with dust and the treatment techniques used to deal with the effluents. This evaluation examines the literature to determine the most efficient absorbent method for detoxifying ground water of nitrates. Activated carbon derived from Acalypha indica, it is found, is a very effective absorbent.

**Key words**: Ground water, Effluent, Treated Waste Water (TWW), Activated carbon and Acalypha indica

## 1. INTRODUCTION

Ground water, nitrogen (N), nitrate (NO3), and nitrite (NO2) are likely to come up in conversations about our project. All known forms of life depend on water as an important chemical element. The oceans on Earth contain the vast majority of the planet's water, which is salty. There is 3% fresh water left. The ice cap and glaciers hold onto about 68.9% of the world's fresh water, while ground water holds 30.1%, surface water holds 0.3%, and other forms of fresh water hold 0.9%. Like salt, nitrate is a chemical. Nitrate is ingested with our food and drink. Nitrates in water are typically very low. However, when nitrate levels in water are particularly high, it becomes a major source. Foods like carrots and spinach contain nitrates naturally. The molecule nitrate (NO3) consists of nitrogen and oxygen and is water soluble. It is produced when oxygenated water interacts with nitrogen (from ammonia or elsewhere).

The rising demand for water in semi-arid regions around the world has increased the urgency with which contaminants, notably dangerous cationic heavy metals and anions, must be eliminated. Since pollution affects so many facets of daily life, it must be considered one of the most pressing issues we face today. Due to population growth, the need for clean water will grow as the pollution problem worsens over the years. As a result, demands on both the availability and purity of extracted water will rise [23]. Nitrate anion is a major contributor to water pollution problems. Nitrate occurs naturally as a result of the breakdown of organic nitrogen compounds and is found in low to moderate amounts. The majority of their occurrences in nature were in inorganic materials like rocks and soil. Natural nitrate pollution is also caused by the presence of decaying organic matter at great depths in the soil [24].

Nitrate is a normal component of plant matter, and its concentration in harvested vegetables varies with the quantity of fertilizer used and other factors. Nitrate-nitrogen is found primarily in vegetables including lettuce, celery, beets, and spinach, and the average adult consumes 20–70 milligrams per day, as reported by the World Health Organization. Nitrates are not toxic when consumed in moderation as part of a healthy diet. Nitrate is produced when oxygenated water interacts with nitrogen from ammonia or another source. Vegetables have different amounts of nitrate due to factors including the type and quantity of fertilizer used, among others.

### 1.1 SOURCES OF NITRATE POLLUTION IN GROUND WATER

Nitrate concentrations in groundwater increase as a result of human activities like agriculture, industry, home effluents, and emissions from combustion engines, despite naturally low nitrate levels (usually less than 10 mg/l NO3). It takes around 20 years from the time pollution begins until it is detected in groundwater because nitrates travel so slowly in soil and groundwater. Nitrate concentrations are expected to remain affected by existing polluting operations for several decades. However, if the aquifer pressure is high, transit within the saturation zone can be quite quick.

Cultivation in areas with thin soil layers, poor nutrient buffering capacity, or where land use changes;

• Over fertilization of crops to increase agricultural activity;

• Widespread cultivation of crops that need a lot of fertilizer and leave the soil bare for long periods of time (maize, tobacco, and vegetables);

• Drainage systems that wash fertilizers away;

• Intensive agricultural rotation cycles that involve crops that are grown in the same place year after year.

Among other sources, it's hard to find scattered sources. These sources include organic fertilizer from animal husbandry, ground water pollution from septic and sewage discharges, leakage of industrial corrosion inhibitors into the ecosystem, farming in areas where the soil layer is thin or where land use is changing, over-fertilization of crops to increase agricultural activity, and more people living in cities. Most of the water that goes back into aquifers under many towns around the world comes from sewage and water supply systems that leak. Figure 1 shows the estimated annual amounts of nitrogen fixed from different sources.

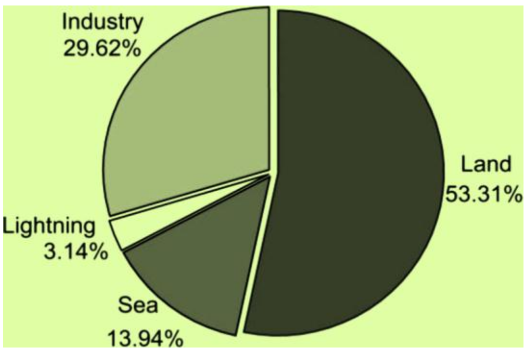


**Figure 1 Annually estimated amounts of nitrogen fixed from various sources [11]**

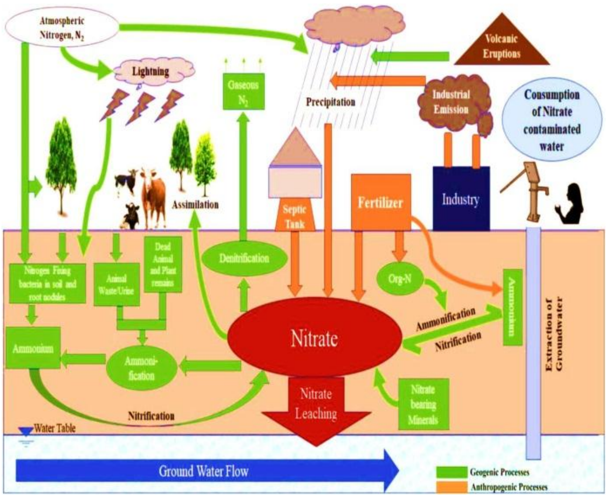


**Figure 2 Nitrate deposition and groundwater contamination [12, 13]**

### 1.2 HUMAN HEALTH RISK

Overshooting the allowable amount of 100mg/l for nitrates in drinking water has been linked to numerous adverse health effects. The water table is replenished by ground water, which originates deep below the surface of the planet. Nitrate levels were once low, but poisoning of the aquifer has greatly increased them. Nitrate contamination of drinking water is increasing as a result of the discharge of domestic and industrial wastewater, as well as agricultural fertilizers, into the ground. Nitrate in water is a leading cause of methemoglobimia, often known as blue baby syndrome, an illness affecting infants in which the iron in their haemoglobin is oxidized to a ferric form, rendering the blood cells unable to transport oxygen. Nitrate poisoning is more common in infants less than six months because harmful bacteria thrive in their immature digestive systems.

Mathemoglobin is a molecule formed when nitrite combines with oxygen-carrying haemoglobin in the blood. Therefore, the blood's ability to transport oxygen is diminished. Mathemoglobin, a disease caused by a lack of oxygen, manifests itself in neonates in the form of suffocation symptoms. Bluish skin, especially around the eyes and lips, is the most obvious symptom of mathemoglobin. Methylene blue, when injected intravenously, successfully converts mathemoglobin to haemoglobin, allowing for successful treatment. If the patient does not receive therapy, they will die. Only after 70% of haemoglobin is transformed to matheglobin will death occur.

Goitre has been linked to increased nitrate consumption, according to certain studies. Nitrate levels in drinking water have been linked to an increased risk of goiter, albeit this link has not been definitively established [25]. Nitrates in drinking water have been linked to a higher risk of having a child born with abnormalities [26]. Neither has this been demonstrated, and studies in animals have failed to find a link (25] Additionally, hypertension non-Hodgkin's lymphoma and higher infant mortality have all been linked to cigarette smoking [27,28]

Water having dangerous levels of nitrate should not be utilized as drinking water, as the best course of action is prevention rather than treatment. This is in addition to the prudent use of water and fertilizers in agricultural fields. This can be achieved through routine monitoring of water quality to determine nitrate concentrations. Wells that are poorly built or situated may allow nitrate-contaminated groundwater to seep in, making the water unsafe to drink. This is especially true for unlined, shallow wells that allow a lot of percolation from the surrounding region and can become contaminated by floodwaters carrying high levels of nitrate from agricultural fields. Contamination of wells is commonplace due to the proximity of feedlots, barnyards, and septic tank systems. It has been hypothesized that wells deeper than 30 meters (100 feet) are quite secure. Decontaminating water with a high nitrate content using standard in-line filters is inefficient. Deionization, desalination, reverse osmosis, biological denitrification, electrodialysis, etc., are all viable methods for removing nitrate from water.

Nitrate toxicity has been linked to a number of other health issues, including but not limited to the following: oral cancer, cancer of the colon, cancer of the rectum, and other gastrointestinal cancers Alzheimer's disease, vascular dementia of the biswanger type or the multiple small in fact type, absorptive and secretive functional disorders of the intestinal mucosa, and changes in maturation, differentiation, and apopto Hypertension, increased infant mortality, goiter, thyroid condition, and birth deformities are all related to excessive nitrate in drinking water. The requirement for vitamin A in the diet may rise if nitrates are included. New evidence suggests that this kind of connection may not be all that useful under typical eating situations. Table 1 lists the concentrations of nitrate in groundwater from various sources.

**Table 1 Nitrate concentration in groundwater from different sources**

| Origin | Range | Remarks |
|---|---|---|
| Agricultural performs [15,16,17] | 5 to 800 mg/l | Extremely variable |
| Septic tanks/discharge pits[18,19] | Not detected – 300 mg/l | Slightly variable |
| sewers [20] | 10 to 50 mg/l | Depending upon soil profundity |
| Deforestation [21,22] | 3 to 15 mg/l | Extremely variable |

## 2. ISSUE OF NITRATES CONTAMINATION IN WATER

Nitrate is naturally present in water below 10mg/l. The activities the recent times have increased nitrate level in the ground water which has exceeded the required limit (45mg/l) as per BIS. This undesired nitrate level in water also causes many nuisances to animals and to other industrial operations. The inconveniences caused by excess nitrate are, 1) Eutrophication is an ecosystem response to the addition of natural or artificial substances like nitrate and phosphate, through fertilizer or sewage to aquatic system like lake, pond etc.

During Eutrophication, the 7 increase of phytoplankton takes place so that it leads to hypoxia conditions, where oxygen depletion takes place which induce in decrease in fish and animal population. 2) Indirectly animals ingested with infected will face severe problems due to transition of nitrate to nitrite where haemoglobin where oxygen carrying capacity is reduced. In such cases animal undergo death due to deprivation3) Plants with a high nitrate uptake would presumably have nitrate-rich fruit. Without sufficient water, energy from sunlight, and temperature suitable to rapid chemical reactions, any person or animal consuming such fruit or crop would confront the problem due to excess nitrate through root and accumulate them in the lower portion of the leaf and stalk. 4) Nitrate is colourless, soluble in water so that its presence can be identified after chemical analysis of water. It can be observed that the presence of nitrate will lead to addition of other contaminant to water. This implies that nitrate removal is necessary since nitrate can be used to detect the presence of other ions in water that could potentially disrupt the manufacturing process.

The primary function of on-ground nitrogen loading is nitrate contamination in groundwater. However, identifying and differentiating sources is difficult and therefore a framework is needed to narrow down the possibilities. Although Almasri [14] has presented a comprehensive conceptual management framework, it focuses solely on management approaches and avoids addressing the issue of root cause isolation. It is possible that not all research will be able to make use of the framework with mathematical modelling because it is time-consuming, requires specialized people, and places a premium on careful data collecting (both qualitative and quantitative). Time is of the essence, as many of these areas will already be exploring other potential sources of water supply. Informational variation

### 2.1 NITRATE ERADICATION METHODS

Nitrate removal from ground water can be accomplished in several ways. Treatment method is selected based on quality of the raw water, extend of treatment given to water, availability of resource, financial resource availability.

The following are the methods to control nitrate in water,

1. Denitrification process
2. Filtration technique
3. Electro dialysis
4. Reverse osmosis
5. Catalytic reduction
6. Adsorption
7. Ion exchange process
8. Electro reduction/coagulation process
9. Biological reaction

### 2.2 ADSORPTION METHOD FOR ELIMINATION OF NITRATE BY USING ACALYPHA INDICA

Phytostabilization, as described by Fritioff and Greger [1], is the process by which plants prevent pollutants from spreading or leaking into the ground or other media by accumulating them in their root zones. The plants were shown to be effective at phytostabilizing Pb rather than phytoextracting it, as evidenced by the larger concentration in the root region observed for both treatments and for both species.

The young saplings of Amaranth sps proved the most effective in sequestering Pb, as reported by Ziarati and Alaedini [2], who measured the % Pb accumulation over the course of three harvests and found it to be 32.1%, 33.6%, and 35.1%. Therefore, the data suggest that, despite the fact that both plant species have low TF values, A. viridis is a better translocator of Pb than A. thaliana.

According to Reeves and Baker [3], a species is considered a Cu hyperaccumulator if its aboveground biomass contains at least 1000 mg/kg of the heavy metal.

Ancona et al. [7] classified heavy metals and found Pb and Cr to be the least bioavailable. This data supports the current findings that at elevated levels of Pb in the soil, the uptake in the shoot of A. indica increased in the 100% treatment, i.e., 63.87% Pb accumulation in total biomass compared to 32.78% deposition in the 50% treatment.

Zhao and Duo [4] observed in a study that some plants operate as excluders by not allowing pollutants into their metabolic pathways to protect themselves as a self-defensive mechanism and restricting the concentration in the root zone from exceeding by selectively removing its entry.

Higher TF values in plant species are noticed when high metal concentration is present in the soil, making it available to the root region, and then consecutively translocating a good quantity to the shoot section, as described by El-Mahrouk et al. [8]. For phytoextraction, plants with more than one TF are preferable.

According to Ndeda and Manohar [5], the bioconcentration factor (BCF) of a plant determines how much of a pollutant is stored in its tissue relative to its concentration in the medium in which it grows. Similarly, a translocation factor (TF) greater than 1 indicates that the plant has a mechanism for transporting heavy metals from the soil to the plant's aboveground parts, making it an ideal candidate for remediating polluted land and later extracting the metals from the air.

Gunwal et al. [6] reported that Pb is a heavy metal with low solubility. This means that even at high amounts, it moves slowly, and if it builds up in the root, it moves very little to other parts of most plants' bodies.

Rehman et al. [9] collected and studied A. indica growing wild in an industrialized environment, finding Pb concentrations of 2.5 mg/kg in the shoot and 2.9 mg/kg in the root zone, with a TF value of 0.9. Besides the affinity of the plant species, the type of metal ion being phytoextracted also plays a role in the translocation from the root to the shoot.

Acalypha indica was found to be a Pb accumulator with a defense mechanism to detoxify the Pb-induced toxic effect on it by Venkatachalam et al. [10], while very high accumulations of Cd, Cu, and Zn were observed in Amaranthus viridis growing in locally heavily polluted soils.

## 3. CONCLUSIONS

The study is carried to remove nitrate from drinking water. The efficiency of two different AC prepared from leaf and stem from a same plant, acalypha indica, a ropical weed is made use in study. The potential of different activated carbon (AC) is found with different pH values, adsorbent dosage, concentrations and temperature.

Drinking water is contaminated by nitrate in many parts of the world. Because of the complexity of the biogeochemical mechanisms that drive the occurrence of elevated nitrate concentrations in groundwater, determining their origin is a difficult task. Statistics and isotopic analysis have been used by several scientists to determine the origin of nitrate contamination in groundwater and to distinguish between human activities and natural processes. However, there are certain restrictions to these approaches, and a more thorough methodology is need to be adopted when investigating the process and origin of leaching.

Furthermore, geogenic aspects and detailed studies for the same are somewhat overlooked, despite their relevance. Perhaps isotopic analysis will perform better in determining where nitrate in groundwater comes from, but statistical methods will be more useful for figuring out how it gets there. Therefore, the proposed framework and differentiation techniques should be applied on a case-by-case basis, with a focus on the potential role of geogenic factors in driving the increased nitrate levels. This comprehensive strategy could also be used as a guide for creating new methods to get rid of nitrates in water. Nitrate-contaminated drinking water is more likely to include additional contaminants. The purified, bacteria-free water that remains in the supernatant after treatment is ideal for consumption. Since Acalypha indica is commonly used for its antibacterial property (Krishna krishna et al., 2010), employing AC for nitrate removal ensures contaminant-free water while also being simple and toxic-free.

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