

PAPER • OPEN ACCESS

Presence of nitrate NO_3 affects animal production, photocatalysis is a possible solution

To cite this article: Heli Barba-Molina *et al* 2016 *J. Phys.: Conf. Ser.* **687** 012019

View the [article online](#) for updates and enhancements.

You may also like

- [Efficient Electrochemical Nitrate Reduction to Ammonia Via Electrolyte Engineering](#)
Sarah J. Blair, Joshua M McEnaney, Adam C. Nielander et al.
- [\(Invited\) Probing the Reaction Mechanism of the Electrocatalytic Reduction of Nitrate](#)
Zixuan Wang, Danielle Richards, Samuel Young et al.
- [Rhodium Sulfides \(\$\text{Rh}_2\text{S}_7\$ \) as a Halide-Resistant Nitrate Reduction Electrocatalyst for Wastewater Remediation](#)
Danielle Richards, Samuel Young, Bryan R. Goldsmith et al.



ECS
The
Electrochemical
Society
Advancing solid state &
electrochemical science & technology

DISCOVER
how sustainability
intersects with
electrochemistry & solid
state science research

Presence of nitrate NO_3 affects animal production, photocatalysis is a possible solution

Heli Barba-Molina¹, J Barba-Ortega² and M R Joya²

¹ Universidad Cooperativa de Colombia, Bucaramanga, Colombia.

² Universidad Nacional de Colombia, Bogotá, Colombia.

E-mail: mrinconj@unal.edu.co , jjbarbao@unal.edu.co

Abstract. Farmers and ranchers depend on the successful combination of livestock and crops. However, they have lost in the production by nitrate pollution. Nitrate poisoning in cattle is caused by the consumption of an excessive amount of nitrate or nitrite from grazing or water. Both humans and livestock can be affected. It would appear that well fertilised pasture seems to take up nitrogen from the soil and store it as nitrate in the leaf. Climatic conditions, favour the uptake of nitrate. Nitrate poisoning is a noninfectious disease condition that affects domestic ruminants. It is a serious problem, often resulting in the death of many animals. When nitrogen fertilizers are used to enrich soils, nitrates may be carried by rain, irrigation and other surface waters through the soil into ground water. Human and animal wastes can also contribute to nitrate contamination of ground water. A possible method to decontaminate polluted water by nitrates is with methods of fabrication of zero valent iron nanoparticles (*FeNps*) are found to affect their efficiency in nitrate removal from water.

1. Introduction

The water resources in Colombia have always suffered indifference by government, due to the absence of attention to development plans and the environmental policies of government in power, the same happens in the scientific field. Water is the essential element of the life, all living beings need it for survival; therefore, its quality has a major influence on the development of plants, animals and humans, any alteration in the composition of this molecule effects on different levels to each of these entities. Water should also be considered as dynamic element that interacts to different levels with millions of organisms, in the case of livestock production, the water takes a special importance because it impacts directly on two levels, first as a source of life and nutrition of forage plants that are consumed by livestock, and the second as an essential element of nutrition and maintenance of animals. Thus, if the water reached farms, is not the top quality, the affection generated on animals is twofold due to consumption of contaminated plants and water directly. This problem of water pollution has been highly studied during recent years, as scientists around the world have realized the strong impact on the human health when poor quality of water used in agricultural work [1–3].

Nitrate pollution on groundwater and surface water has become a serious environmental problem over the world, due to indiscriminate use of urea ($CO(NH_2)_2$) as a fertilizer of the soil in the production of fooder to feed animals. Nitrate is an inorganic compound having a nitrogen atom and three oxygen atoms, is one of the chemical with the highest concentration in the atmosphere, however animals and plants are unable to absorb directly from the air. The plants



must absorb from the soil and animals meanwhile they get their dietary intake and drinking water [2,3].

The most common source of poisoning by nitrate and nitrite in animals are plants. The toxic principle existing in plants is always nitrate. Nitrates are absorbed by the roots and normally incorporated in tissues as amino acids, proteins and other nitrogen compounds. These nitrates may also be present in high concentrations in some foods, especially in broad leaf plants, fertilized with large quantities of nitrogen [1,3]. In a published paper the authors write: the photocatalytic degradation method is fast, effective, ecofriendly, economically viable and efficient method in the waste water treatment. Figure 1 shows the schematic representation of the advantages of photocatalysis in the treatment of organic pollutants in waste water [4].

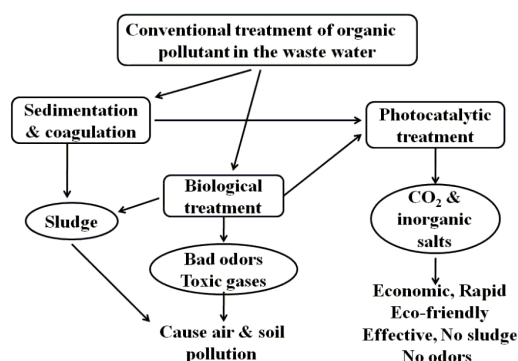


Figure 1. Schematic diagram showing the advantages of photocatalysis in the treatment of organic pollutants in waste water [4].

The objective of this work is expound about the effect of nitrites and nitrates in animal nutrition and toxic effects of these compounds in animals, as a result of the indiscriminate use of these elements in production systems. This article reviews advances in the field of nitrate removal processes.

2. Theoretical formalism

Research into semiconductor photocatalysis has largely focused on the removal of organic pollutants from water, since a wide range of organic substrates can be completely mineralized in the presence of dissolved oxygen photosensitized. One of the very attractive features of semiconductor photocatalysis is its effectiveness against a broad range of pollutants, including those that are recalcitrant to other water treatment processes [5,6].

Nitrate is the main form of nitrogen associated to water pollution, it is also the most abundant form of nitrogen in the soil, this ion has a high solubility being easily dragged by rainwater and often causing pollution water. Mineral nitrogen fertilizers and animal manures handled inappropriately are the mayor contaminant sources for existing nitrates [7].

Heterogeneous photocatalysis is a process of great potential for pollutant abatement and waste treatment. In order to improve the overall performance of the photo process, heterogeneous photocatalysis is being combined with physical or chemical operations [8]. Thus semiconductor photocatalysis can be used to oxidize nitrite, sulphite and cyanide anions to form relatively harmless products. Due to the non-selective action of photocatalysis, it finds application beyond the degradation of organic species in water. Semiconductor photocatalysis has also found application in the degradation of toxic inorganic compounds to harmless or less toxic compounds [9].

3. Results and discussion

The photocatalytic degradation method is fast, effective, ecofriendly, economically viable and efficient method in the waste water treatment. Figure 2 shows the schematic representation of

the advantages of photocatalysis in the treatment of organic pollutants in waste water [4].

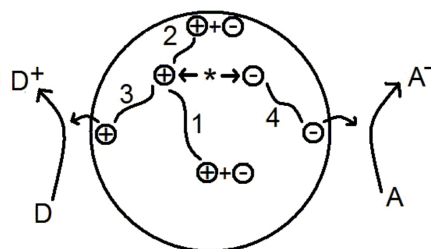


Figure 2. Schematic image showing different pathways for an electron-hole pair created at. (1) Recombination inside the bulk of the particle. (2) Recombination at the surface of the particle. (3) A hole migrates to the surface and reacts with a donor molecule. (4) An electron migrates to the surface and reacts with acceptor molecule, [4].

Semiconductor materials possess a region that is void of energy bands, thereby creating an energy space between the VB and the CB . This energy difference between the VB and the CB is called the bandgap energy. Reactions of photo generated electron hole pairs on the surface the photocatalyst occur in the presence of electron donors or electron acceptors adsorbed on the photocatalyst surface. Thus, if there is an electron acceptor, A , then the photo generated electrons can react with A generating a reduced product A^- . Similarly the photogenerated holes that migrate to the surface can react with an electron donor, D ; to form an oxidized product D^+ [10,11].

We hope that in animal production, the organic pollutant degradation efficiency was over a wide range of pH values, irradiation time and optimum catalyst load. In additional effects like aeration and stirring increase the photodegradation efficiency of organic. Easy recovery and reuse of supported photocatalyst, along with higher degradation efficiency is the major advantages and it reduces the over treatment cost [4].

We know that the problem of nitrate pollution in Colombia, must be improved and animal production will be of better quality. Pesticides and herbicides, intentionally released into the environment, are ubiquitous in aquatic systems; they are often detected at low levels and commonly occur in the form of complex mixtures [4]. Leaching of chemical fertilizers and pesticides, applied to agricultural and forest land, is one of the main reasons for organic pollution in several water streams. Pesticides and herbicides are harmful to life because of their toxicity, carcinogenicity.

Acknowledgements

Authors acknowledge financial support from the Colciencias-Colombia and CNPq-Brazil agencies.

References

- [1] M Palaniappan, P H Gleick, L Allen, M J Cohen, J Christian-Smith, C Smith and N Ross 2010 *Clearing the waters a focus on water quality solutions* (Nairobi: Publishing Services Section)
- [2] M Z Kassae, E Motamedi, A Mikhak, R Rahnemaie 2011 *Chem Eng J* **166** 490
- [3] W Wang, Z Jin, T Li, H Zhang, S Gao 2006 *Chemosphere* **65** 1396
- [4] H P Shivaraju 2011 *Int J Envir Sci Sci Technol* **1** 05
- [5] A O Ibadon, P Fitzpatrick 2013 *Catalysts* **3** 189
- [6] D Beydoun, R Ammal, G Low, S McEvoy 1999 *J Nanop Resech* **1** 439
- [7] S J A Moniz, S A Shevlin, D J Martin, Z X Guob 2015 *J Tang Energy Environ Sci* **8** 731
- [8] M I Litter 1999 *Appl Cataly B Envir* **23** 89
- [9] S K Lee, A Mills 2004 *J Ind Engi Chem* **10** 173
- [10] E E Bamuza-Pemu 2014 *Photocatalytic degradation of phenolic compounds and algal metabolites in water* (South Africa: University of Pretoria)
- [11] R M Nageeb 2013 *Adsorption technique for the removal of organic pollutants from water and wastewater* (Croatia: INTECH Open Access Publisher)
- [12] W Aktar, D Sengupta, Chowdhury 2009 *Inter Toxic* **2** 1