A brief description of drinking water contaminants with a focus on nitrate and its current removal approaches

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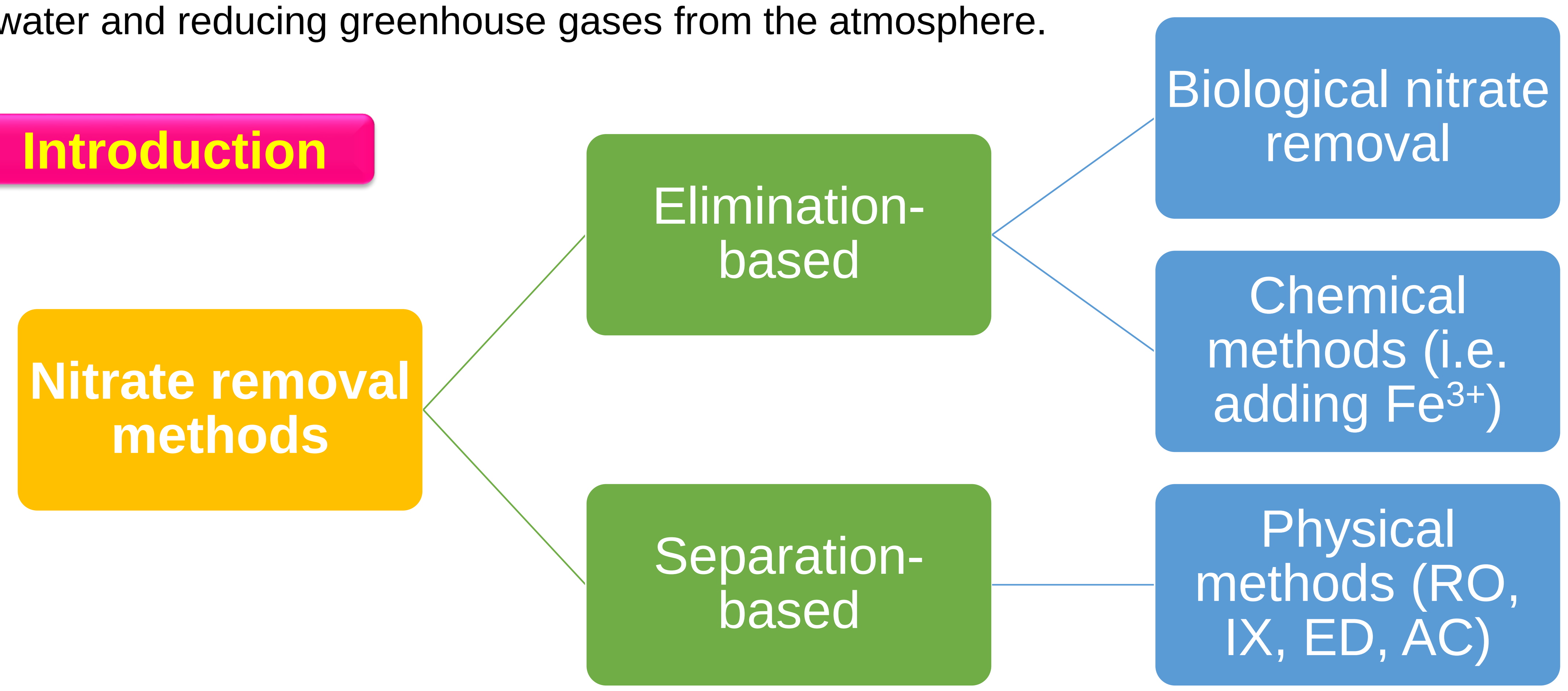
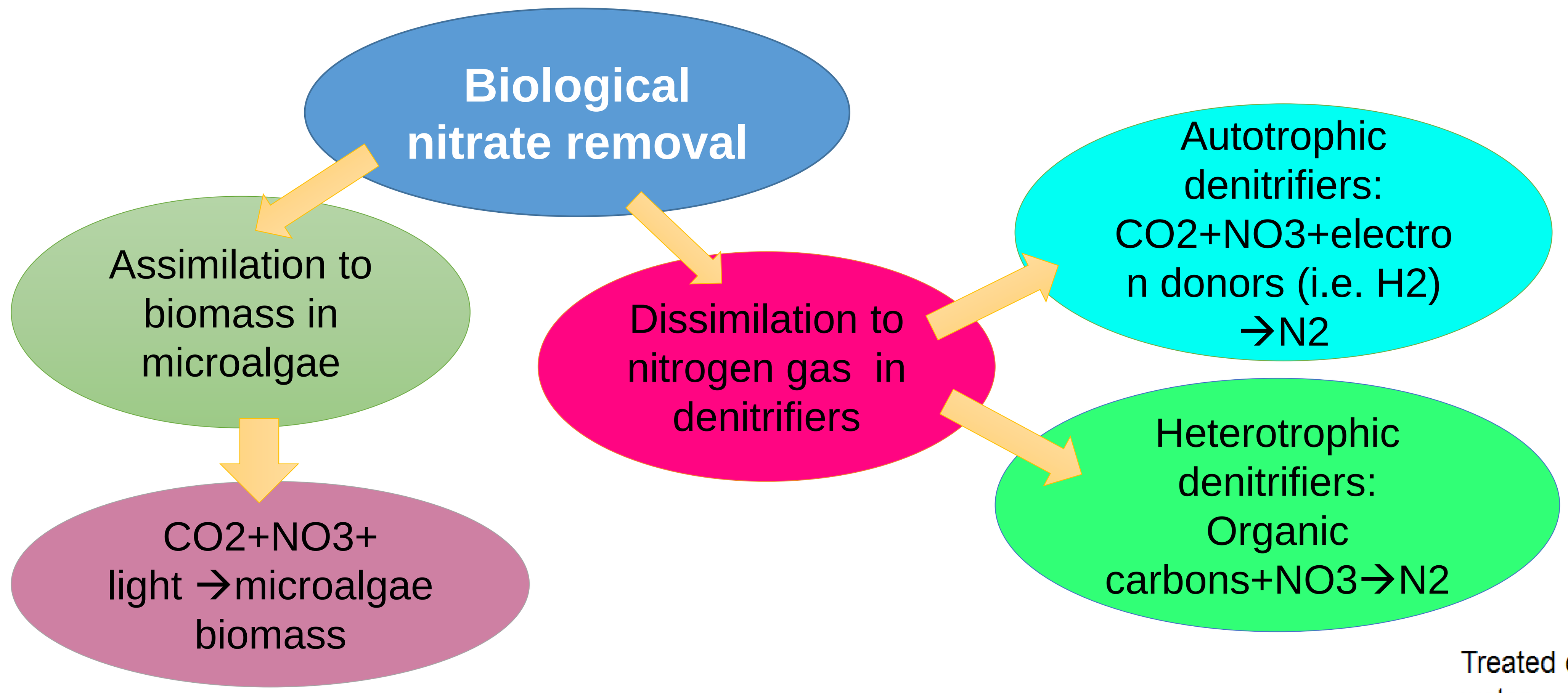
Abstract

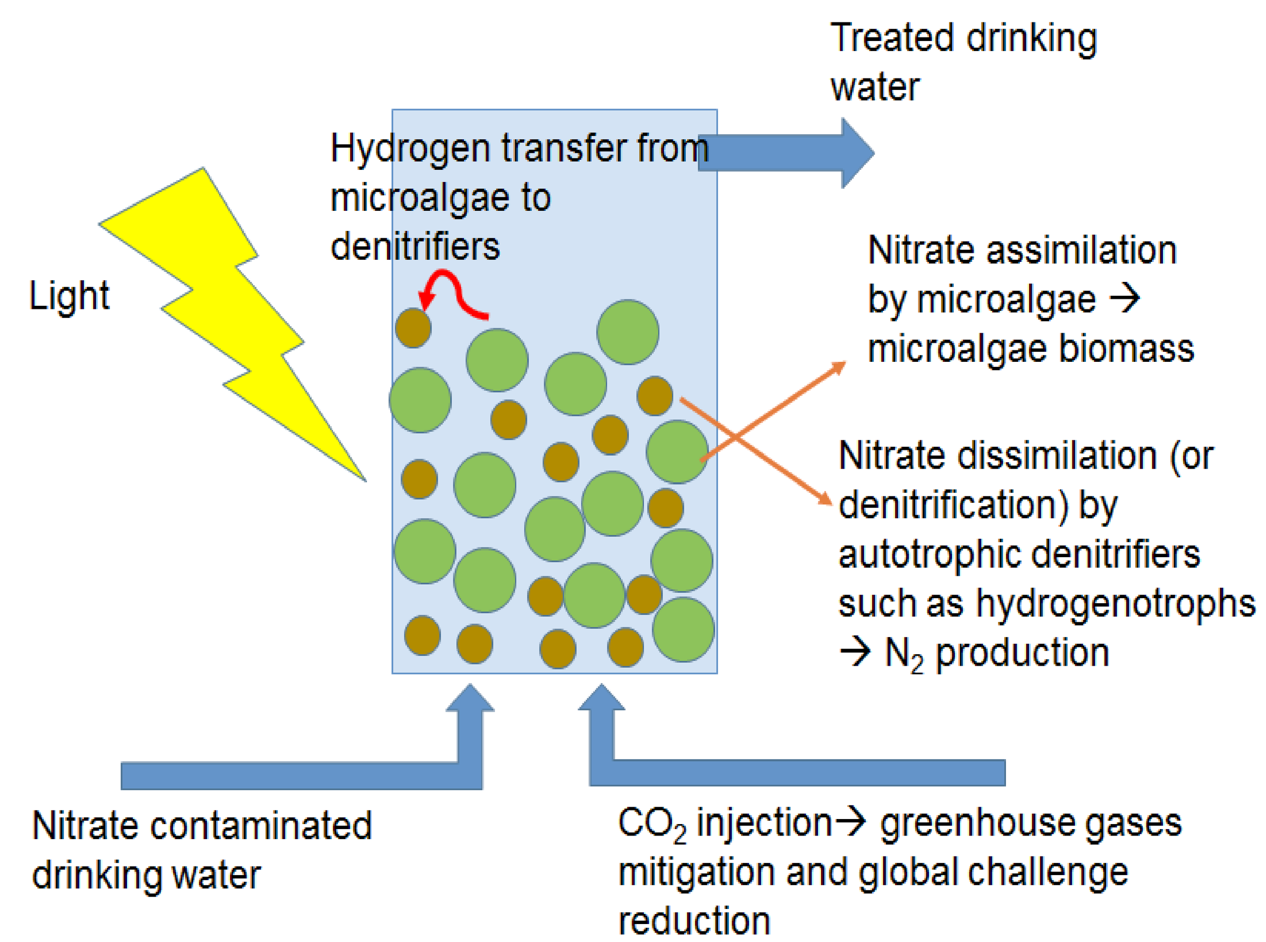
Access to safe drinking-water along with climate change forces each country to invest a water supply infrastructure for water treatment as well as greenhouse reduction. Several types of drinking water contaminants include microorganisms (E. coli, Giardia, noroviruses), inorganic chemicals (fluoride, lead, arsenic, nitrates, nitrites), organic chemicals (atrazine, glyphosate, trichloroethylene, tetrachloroethylene), and disinfection byproducts (chloroform). Although microbial contamination is a major water-related health problem, the presence of chemical contaminants in drinking water may also cause a number of serious health concerns. Nitrates as the most challenging contaminants may arise from the excessive application of fertilizers and leaching of wastewater into groundwater resources, due to high solubility of it in water. Since high levels of nitrates can be harmful especially for children, due to blue baby syndrome, United States Environmental Protection Agency has established a maximum contaminant level of 10 mg nitrate–nitrogen (NO_3^-–N)/L to prevent the exceed of nitrate level in groundwater resources. To remove nitrate, several techniques have been established that are primarily classified into separation-based and elimination-based methods according to the fate of the nitrate in water treatment. Elimination-based methods are generally preferred to separation-based methods as they completely remove nitrate by converting it into nitrogen gas; however, current treatment technologies and the development of emerging technologies for nitrate removal from drinking water require additional optimization. Separation-based processes, including reverse osmosis, ion exchange, electrochemical reduction, electrodialysis, and activated carbon adsorption, which merely separate and transfer nitrate to a waste stream, have expensive operating costs and the subsequent disposal of the generated waste brine presents another problem. In contrast, chemical and biological nitrate removal facilitates the complete removal of nitrate by conversion it to harmless nitrogen gas. However, a full scale system of chemical denitrification has not been reported, owing to the formation of ammonia and the potential health hazards of exposure to chemical compounds, such as electron donors and active catalysts. Hence, biological nitrate removal can be considered as a cost-effective and promising method for eliminating nitrate via assimilation to biomass and dissimilation to N_2. Among the biological nitrate removal carried out by both autotrophic and heterotrophic microorganisms, a consortium of microalgae and autotrophic denitrifiers like hydrogenotrophs is a new approach to reduce both CO_2 via autotrophic cultivation and nitrate as their N-source for microbial growth. This approach can improve previous strategies by addressing both challenges of supplying a safe water and reducing greenhouse gases from the atmosphere.

Introduction





Interaction of microalgae and autotrophic denitrifiers as new approach



Conclusion

1. Microalgae and autotrophic denitrifiers would have a good communication to increase the process efficiency during nitrate removal
2. This method would be comparable with conventional biological nitrate removal and improved the current way for hydrogenotrophic denitrification
3. This approach can be considered as an alternative way for current biological nitrate removal, biomass production, and CO2 mitigation .

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