



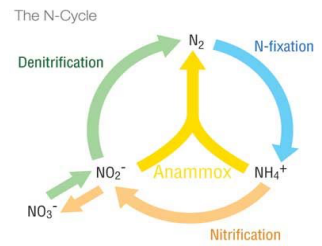
# Application of Zeolites with Anammox for Nitrogen Removal

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## Introduction

The beginning of the twentieth century sparked an increase in the amount of excess nitrogen in water bodies. Major sources of inorganic nitrogen pollution include wastewater, agriculture, and fossil fuels. Eutrophication has resulted, leading to fish kills and dead zones in aquatic ecosystems, as well as a reduction of biodiversity.



In order to enhance nitrogen removal, anaerobic ammonium oxidation (anammox), an energy-efficient biological wastewater treatment process, has been used. In comparison to conventional nitrification/denitrification processes, anammox has a lower aeration requirement and no carbon supplement. However, due to the anammox bacteria's low growth rates, the addition of zeolites are meant to improve the biomass retention in the anammox process.

## Objectives

- Identify the impact of zeolites on start up time for the anammox process
- Track the amount it takes for full scale anammox reactors to reach nitrogen removal rate (NRR) of 1 g/L/ per day

## Methods

- Monitor performance in anammox-only and zeolite-anammox upflow anaerobic sludge blanket (UASB) reactors
- Measure ammonia (NH<sub>3</sub>), nitrite (NO<sub>2</sub><sup>-</sup>), & nitrate (NO<sub>3</sub><sup>-</sup>) effluent concentrations to calculate NRR
- Utilize ion chromatography (IC) to create sorption curves for detecting changes in zeolite sorption capacity under different ammonium concentrations



## Results

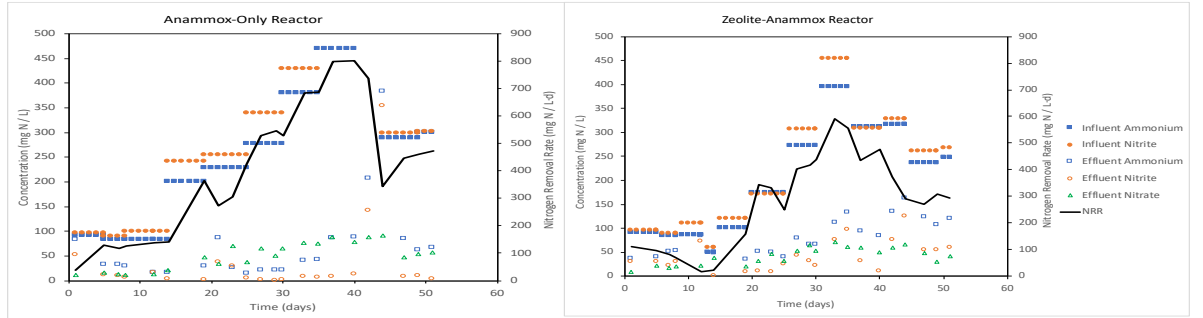


Figure 1: Comparison of NRR performance between anammox reactors in a 50-day period

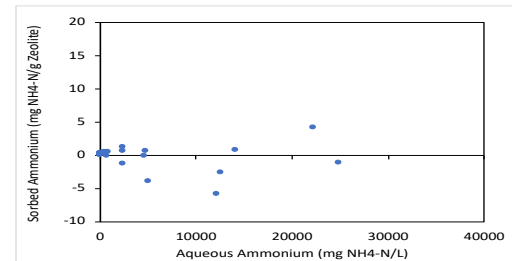


Figure 2: Changes in zeolite sorption capacity with ammonium

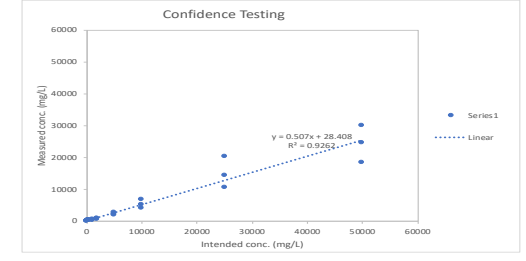


Figure 3: Confidence testing for relationship between intended and measured ammonium values

## Conclusion

The addition of zeolites may improve the start up phase for nitrogen removal, but more research is needed. Furthermore, the amount of time that it took for these full scale reactors to reach a 1 g/L/day NRR is about 50 days under these experimental conditions. The results indicate that zeolites may enhance the retention of the biomass within anammox reactors, but future research will be conducted to conclude this.

## References

Boran, K. et al. (2013). How to make a living from anaerobic ammonium oxidation. *Federation of European*.37:428-461  
Hu, Z. et al. (2013) Nitrogen Removal with the anaerobic ammonium oxidation process. *Biotechnology*. 35(8):1145-1154