VALORIZATION OF NUTRIENTS IN THE LIQUID FRACTION OF BIOGAS FROM DIGESTATE

Department of Environmental Engineering, Marmara University
ENVE498 Engineering Project

Beyza BOZKURT[1], Burçin BAHADIR[2], K.Gözde AYTEKİN[3], Merve YEŞİLSANCAK[4]
Supervisor: Prof. Dr. Barış ÇALLI[5]

Contact: [1]beyzabozkrtt@gmail.com [2]burcin.bahadir@hotmail.com, [3]kubragozdea@gmail.com,, [4]merveyesilsancak@hotmail.com, [5]baris.calli@marmara.edu.tr,

OBJECTIVE

The main **purpose** of this project is **nutrient recovery (N and P)** from the liquid fraction of an anaerobic digester effluent (digestate). In order to achieve this, **ammonia stripping** (head space flushing) and **struvite precipitation** experiments were conducted to get valuable fertilizers.

INTRODUCTION

Because of increasing energy demand, the consumption of fossil fuels also increased; this boosts global warming and air pollution. So, nowadays, anaerobic digestion gained importance due to their renewable energy production potential from organic wastes. Beside the obtained biogas, also a biowaste, the digastate is released in high amounts. However, high quantities of valuable nutrients can be recovered from digestate as fertilizer.

- Recovery of ammonia with **ammonia stripping.**
- Recovery of ammonia and phosphate as **struvite precipitation** with external magnesium addition.

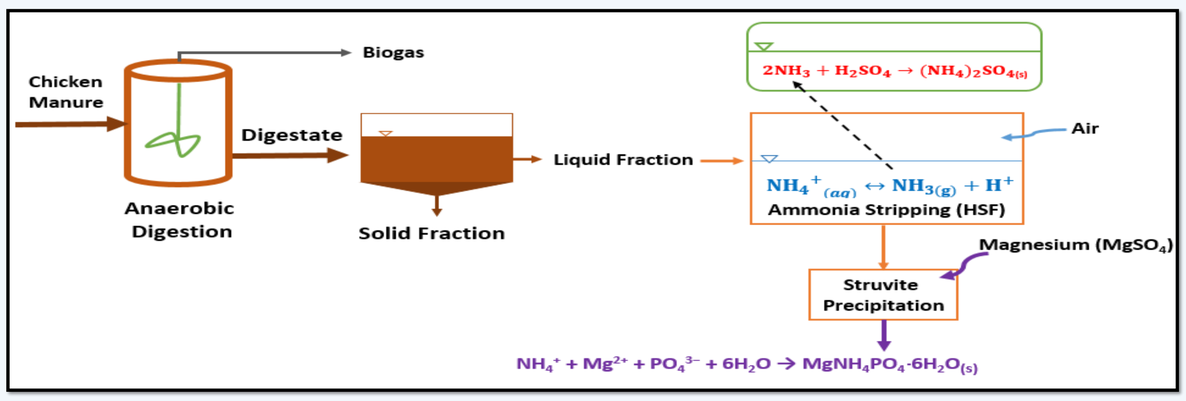


Figure [1]: Flow Diagram of Nutrient Recovery

MATERIAL AND METHODS

Ammonia Stripping (Head Space Flushing)

- **Effect of Air Temperature**

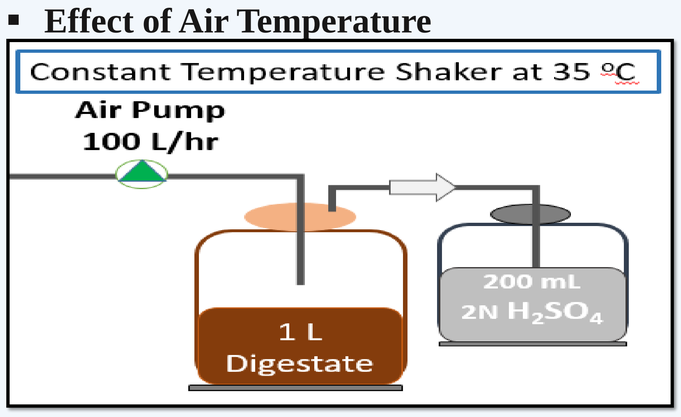
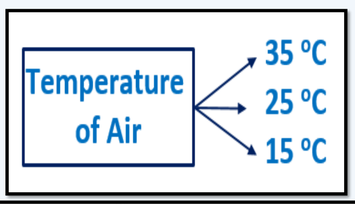
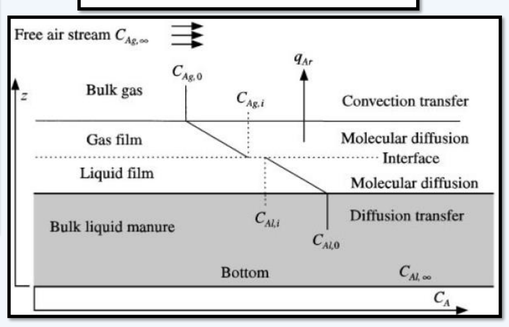


Figure [2]: Experimental set-up of the ammonia stripping





Strutive Precipitation

- **Effect of Molar Ratio**

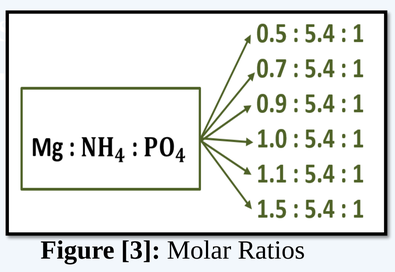


Figure [3]: Molar Ratios

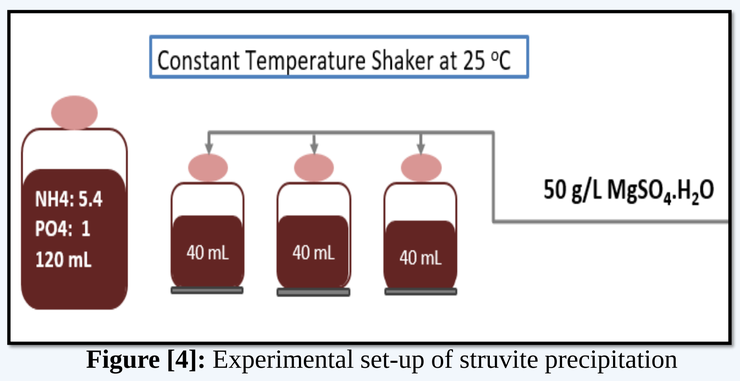


Figure [4]: Experimental set-up of struvite precipitation

- **Effect of pH**

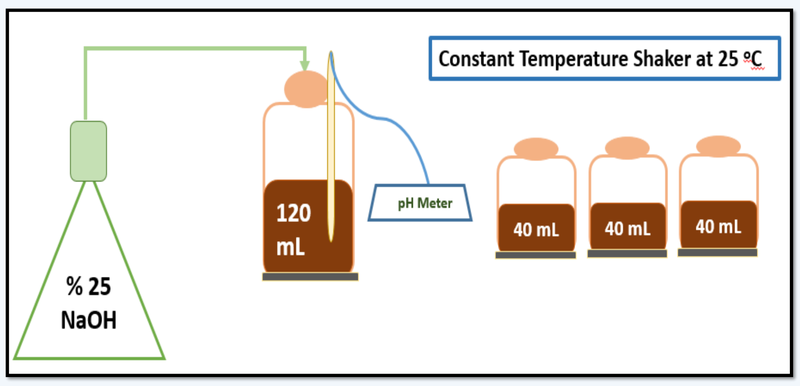


Figure [5]: Experimental set-up of struvite precipitation

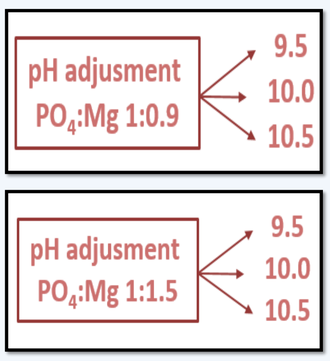
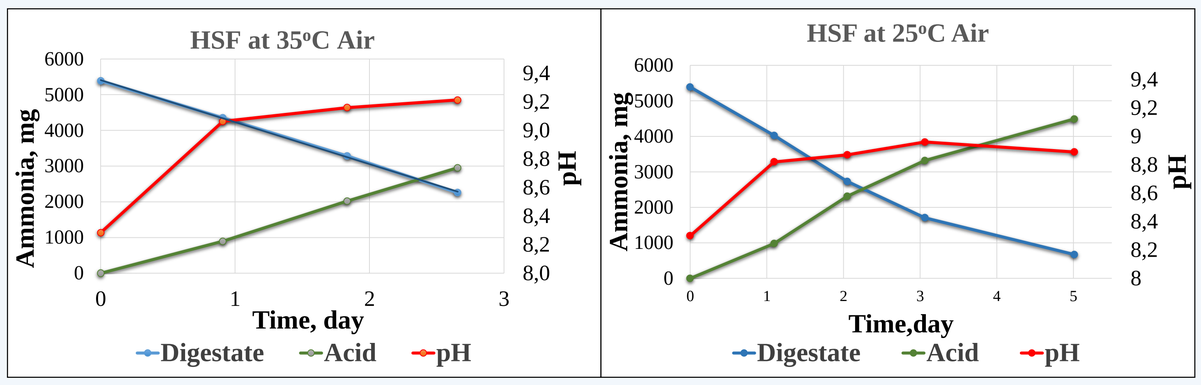


Figure [6]: pH Values

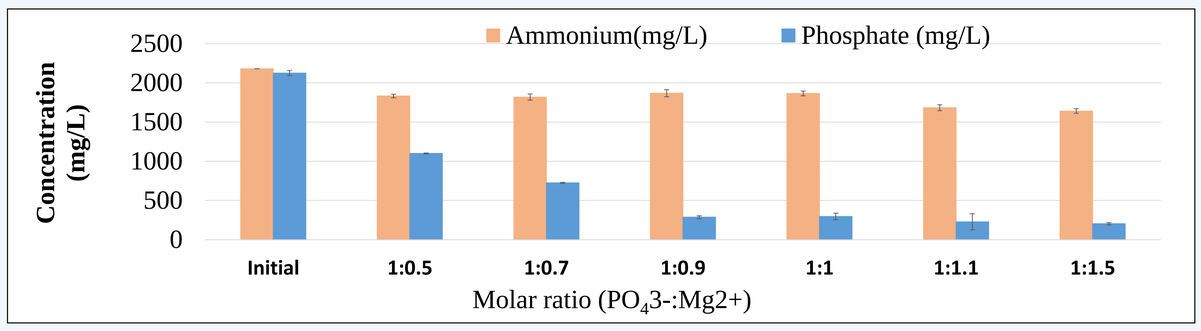
RESULTS AND DISCUSSION

Head space flushing experiments:

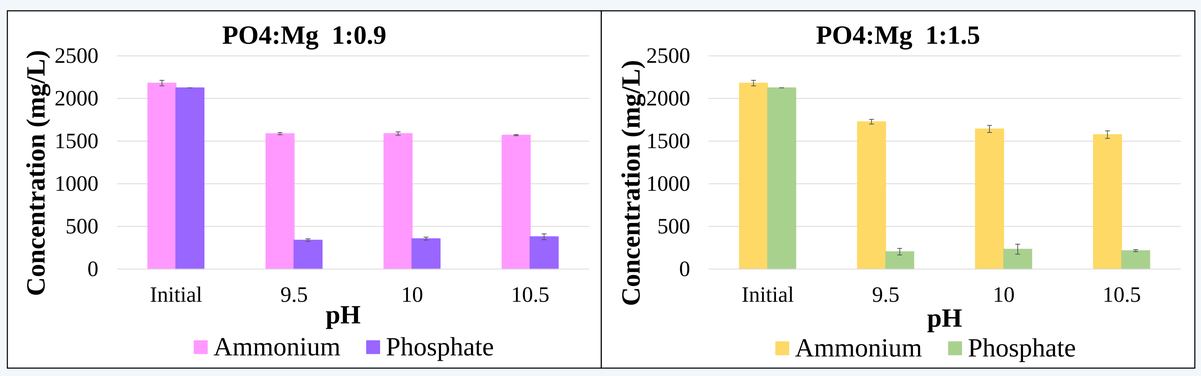


Graph [1]: Ammonia, acid and pH depending on time

- After all, HSF seems an efficient and practical method for ammonia removal & recovery.
- Cold air (25ºC) has a positive effect on ammonia removal.
- However, too much cool air (15ºC) decreased the removal rate with decreasing the NH_3 (free ammonia nitrogen).

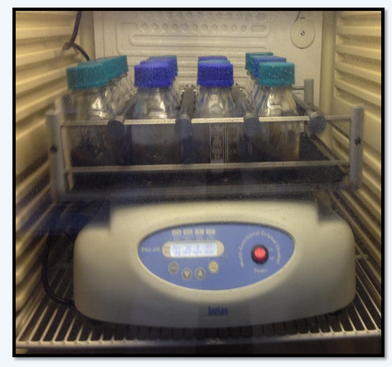


Graph [2]: Effect of different molar ratios on struvite recovery



Graph [3]: Effect of pH on struvite recovery (molar ratio of 1:1.5)

- The most efficient molar ratio for struvite precipitation is 1:1.5 as PO_4:Mg. However there is not significant difference with and above 1:0.9 ratio.
- As the pH change, it was observed that the ammonia and phosphate did not precipitate parallel to pH increase. So there is not an importance with the pH change.



CONCLUSION

In this project, ammonia recovery and struvite precipitation experiments were conducted with chicken manure digestate taken from a lab scale anaerobic digester. Head space flushing experiments were done with different air temperatures to remove and recovery of ammonia (75-85 %) as a pre-treatment before struvite precipitation. The struvite experiments were done with different molar ratios and pH values with the addition of magnesium to recover phosphate and ammonia. As a result, we obtained 90% phosphate with 1.5:1 ($Mg:PO_4$) ratio at pH 10.