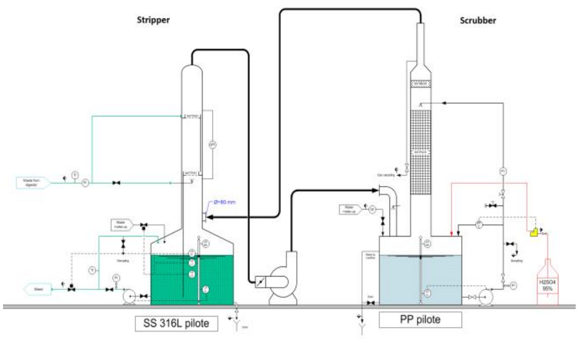
Pilot scale explorations & demonstrations of good practice techniques

Ammonia stripping and scrubbing

A STRIPPER AND SCRUBBER PILOT INSTALLATION TO RECOVER AMMONIA FROM N-RICH WASTESTREAMS WAS OPERATED AT THE WATERLEAU PLANT IN IEPER (BELGIUM). THE MAIN GOAL OF THE STUDY WAS TO DETERMINE THE OPTIMAL PROCESS PARAMETERS OF THE INSTALLATION.

The ammonia removal and recovery is carried out in two steps: first ammonia is removed (stripped) from the waste stream (in this case the liquid fraction of digestate) by blowing air through the liquid stream in a countercurrent tray stripper (WATTRAY®), subsequently the stripping gas charged with ammonia is put into contact with an aqueous sulfuric acid solution in a packed scrubber (WATPACK®), resulting in $(NH_4)_2SO_4$ or ammonium sulfate, which can be used as N-S-fertilizer.



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It is known that temperature and pH are key factors as they influence the equilibrium between NH_3 and NH_4^+. At higher temperatures and pH, it is expected that removal efficiencies increase due to the fact that more NH_3 would be available. For this reason, these parameters were investigated. All other parameters (fan speed and recirculation flow) were kept constant throughout all the performed tests.

The baseline test (no heat and no pH correction) showed that more than four hours were necessary to significantly reduce the amount of NH4 in the digestate fraction. However, batch tests showed that with the addition of heat up to 50 to 60°C the retention time dropped to ± three hours. Application of the maximum attainable temperature of the heat exchanger did not show a higher ammonium recovery rate. The low recovery rate was caused by condensation in the pipeline that connects both units. It is however expected that in an optimal design set-up higher temperatures will increase the removal efficiency.

In case both temperature and pH were increased, the retention time decreased even more to approximately one hour. It is however important to highlight that a large amount of caustic soda was needed to increase the pH from 8 to 10. For industrial applications more research is necessary to investigate if the benefits of a fast NH_3 removal outweigh the costs of the caustic soda.

The semi-continuous tests were carried out to determine the minimal concentrations of NH_4 that could be reached when using the ideal parameters from the previously performed batch tests. Results showed a slight decrease in efficiency, but depending on the wanted N concentration at the end, the values were still acceptable.

An additional evaluation of a temperature increase to about 75 to 80 °C is a potential next step in the pilot testing. At these temperatures nutrient recovery can be combined with hygienization of the fertilizer products and possibly without any pH modifications. However, by increasing the temperature, the solubility of heavier precipitates (such as CaPO4 and MgPO4) increases accordingly. Some of these precipitation reactions will lead to the formation of useful fertilizer products, but these reactions might also contribute to increased fouling of the system.

CONCLUSION

Both pH and temperature play an important role for the stripping of ammonia. Without additional heat, the process is slow and inefficient. A higher removal efficiency can be obtained by increasing the temperature to 50 to 60°C and the pH to 10. However, more research is necessary to investigate the ideal process conditions on industrial scale.

INFORMATION & CONTACT

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