

## CASE STUDY: Ammonia Wastewater Treatment

### At a Glance

#### Industry:

Industrial wastewater & municipal WWTP

#### Wastewater:

Landfill leachate and WWTP centrate

#### Treatment

##### Requirements:

Ammonia removal prior to downstream treatment systems or discharge to sewer

#### Product:

Ammonia Splitter

#### Results:

Reliable ammonia removal and destruction, ammonia discharge limits met

#### Economics:

Dependent on water chemistry, plant capacity, and site conditions. Contact Saltworks for an economic assessment of your ammonia treatment project.

### Challenge

Industry contacted Saltworks seeking a reliable, fully controllable ammonia treatment system that can meet any outlet requirements, is resilient to salinity, does not require addition of methanol or fertilizer products, can be turned ON/OFF and instantaneously ramped to change capacity with ammonia load. In response, Saltworks developed the Ammonia Splitter: a reliable electrochemical means to remove and destroy ammonia without the reliability challenges of biological treatment.

Ammonia in wastewater is a growing concern due to its detrimental impact on aquatic ecosystems. When discharged to receiving bodies of water, ammonia causes algal blooms that deplete dissolved oxygen and release toxins, destroying aquatic life. Regulatory agencies are requiring industry to treat ammonia in their effluents to meet stringent requirements. Some existing wastewater treatment plants (WWTP) are unable to comply with these regulations as their service load increases. Removing ammonia from their concentrated centrate circuit could free as much as 20% additional ammonia processing capacity. Industry and landfills are also experiencing increased regulations on their wastewaters, and are being cut-off from sewer discharge. Industrial ammonia treatment is often more challenging for biological treatments.

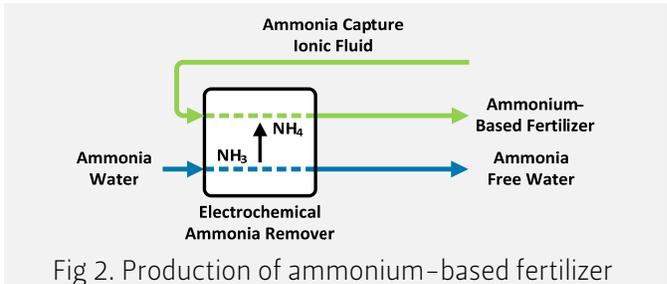
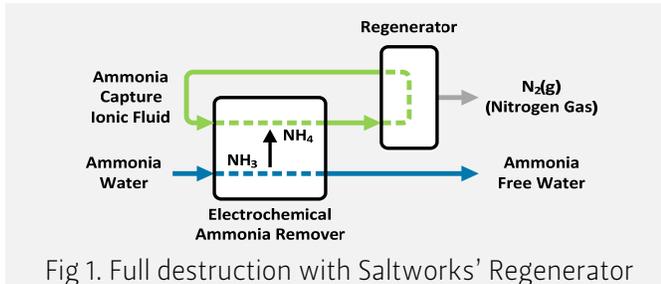
To treat to low ammonia discharge limits, biological plants require expansion with large aeration tanks and clarifiers, which is challenging in areas with limited or expensive real estate. Moreover, biological systems are susceptible to damage if feedstock is changed or too saline, require addition of methanol and phosphorus (addition of pollutants), are difficult to control due to sensitivities to temperature and feed water chemistry, and have little flexibility to adjust to changing ammonia load. Other ammonia treatment systems (e.g., breakpoint dechlorination and air stripping) are chemical intensive and produce harmful emissions or by-products.

### Solution

Saltworks' Ammonia Splitter is a fully controllable, electrochemical system for reliable ammonia treatment that can either permanently destroy ammonia producing benign nitrogen gas or produce a valued fertilizer by-product. The Ammonia Splitter is a flexible system to treat any concentration of ammonia to meet any outlet requirement. It operates without sensitivity to temperature or salinity, making it widely applicable. Unlike biological processes, the Ammonia Splitter does not require addition of methanol and phosphorous that could also impact aquatic systems. Ammonia Splitter builds off of Saltworks' ElectroChem advanced electro dialysis platform with membranes tuned for ammonia removal and proprietary processing and controls. Ammonia Splitter is a compact and modular system that bolts on to existing plants and starts working immediately.

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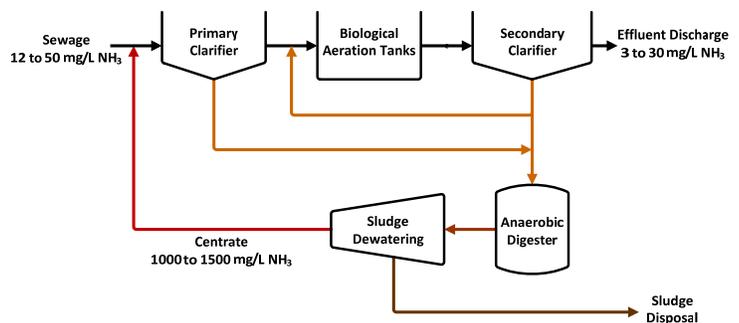
Through an ion exchange membrane process, Ammonia Splitter pulls ammonia out from wastewaters and concentrates it into the Ammonia Capture Ionic Fluid ( $\text{NH}_3\text{-CIF}$ ). The  $\text{NH}_3\text{-CIF}$  may be treated by a Regenerator unit to destroy ammonia completely to nitrogen gas or used to produce ammonia-based fertilizer, such as ammonium sulfate. The Ammonia Splitter Regenerator can be direct DC solar powered, using low cost photovoltaics to offset the energy requirements.



There are two main applications for Ammonia Splitter:

- Remove Ammonia Mass: Reduce ammonia loads circulating in a system, freeing valuable process capacity or helping to meet final discharge limits. Example applications include treating the highly concentrated side stream centrate in municipal WWTPs or reducing ammonia loads in industrial wastewaters, such as landfill leachate, to meet discharge limits.
- Polish: Treat ammonia to very low levels to meet regulatory surface discharge limits.

For most municipal WWTPs, there is a highly concentrated centrate nutrient stream, accounting for roughly 1% of the plant flow but 20% of the ammonia load, which is produced during biological sludge de-watering and is recycled back to the front end of the plant. Ammonia Splitter can treat the centrate as a sidestream process, reducing the ammonia load on the WWTP and enabling it to meet discharge limits and effectively increase plant processing capacity. On industrial wastewaters, such as landfill leachate, Ammonia Splitter provides the advantage of being resistant to organic foulants and is not impacted by salinity at any concentration. Moreover, the automated self-cleaning systems maintain reliable operation.



## Results

Ammonia Splitter pilot projects were completed demonstrating both ammonia mass removal and ammonia polishing. Water samples from industry partners were tested over a six month period. Key results are summarized below:

- 24/7 reliable operation of the Ammonia Splitter pilot on WWTP centrate. The plant operated for 6 months continuously (Figure 9).
- Ammonia mass reduction in WWTP centrate and landfill leachate:
  - WWTP Centrate: 95% reduction (1300 mg/L reduced to 64 mg/L N)

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- Landfill Leachate: 85% reduction (5280 mg/L reduced to 772 mg/L N)
- It is noted that the final concentrations of ammonia met the requirements of the project. Ammonia Splitter can reduce the concentration further if required.
- Ammonia polishing to low concentrations
  - WWTP effluent: 98% reduction (39 mg/L reduced to 0.94 mg/L N)
- Destruction of ammonia to N<sub>2</sub> gas with no substantial consumables or waste stream (Figure 7)
- Production of 7.5% ammonium sulfate for the fertilizer output option when polishing landfill leachate evaporator crystallizer product water (Figure 8)

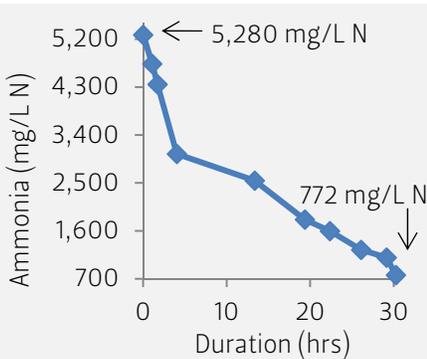


Fig 4. Landfill leachate treatment (ammonia mass removal)

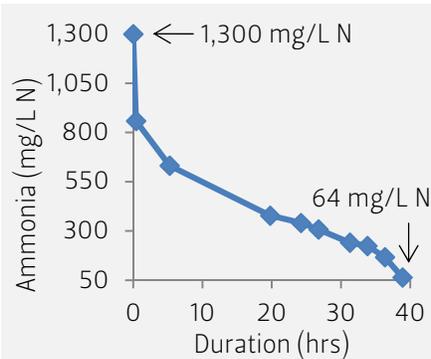


Fig 5. WWTP centrate treatment (ammonia mass removal)

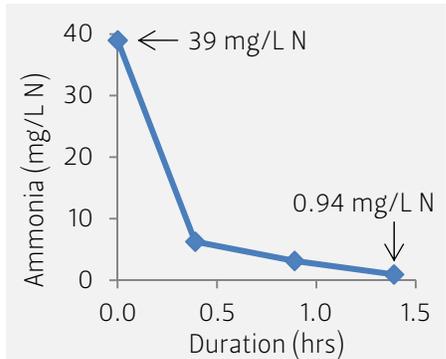


Fig 6. WWTP final effluent treatment (ammonia polishing)

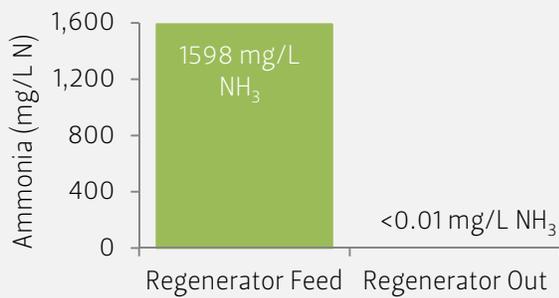


Fig 7. Ammonia in Ammonia Capture Ionic Fluid fully destroyed in the Regenerator

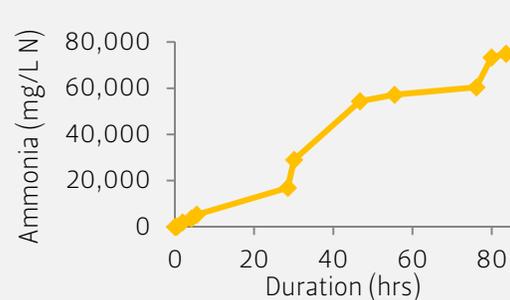


Fig 8. Ammonium sulfate production option. Ammonium sulfate max concentration of 7.5%.

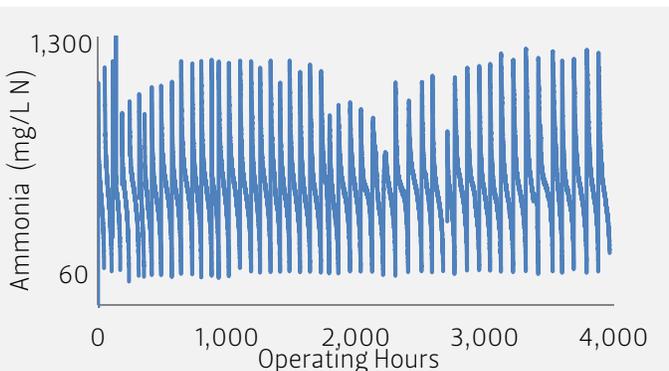


Fig 9. Reliable operation of Ammonia Splitter on centrate



Fig 10. Ammonia Splitter pilot plant

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### Summary

Pilot testing on industry supplied wastewaters confirmed the flexibility of Ammonia Splitter to reliably remove and destroy ammonia from municipal and industrial wastewaters. It can operate reliably at extremely high ammonia levels (>5,000 mg/L), treat ammonia at any inlet concentration and reduce to any discharge concentration. The projects also demonstrated full destruction of ammonia to nitrogen gas or production of a 7.5% ammonium sulfate solution. The pilots operated without sensitivities to temperature or feed water chemistry. Saltworks can complete an Ammonia Splitter performance and economic assessment for your ammonia treatment project. Please contact [projects@saltworkstech.com](mailto:projects@saltworkstech.com).