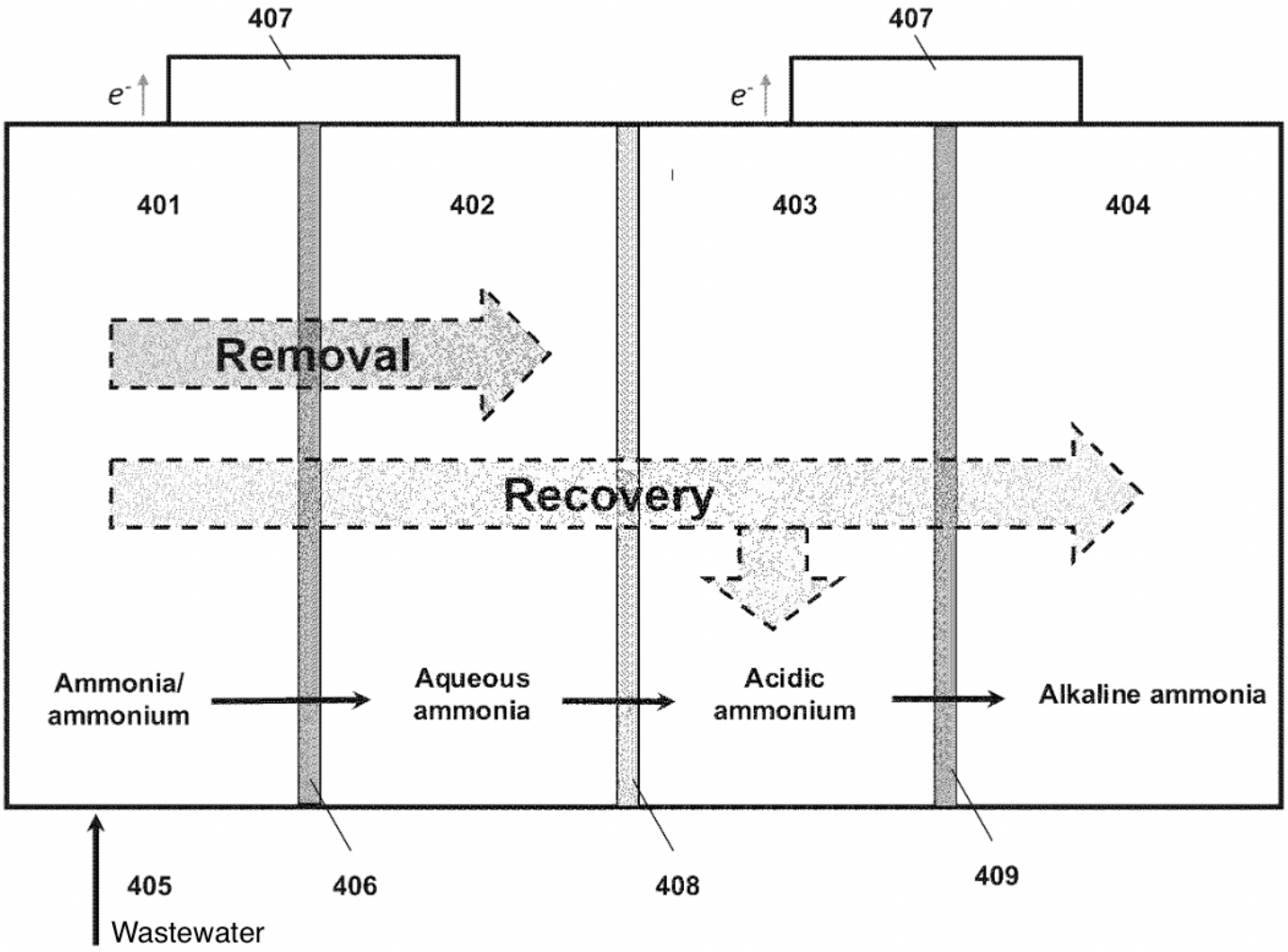
**Docket #:** S20-349

# Flexible electrochemical stripping to recover alkaline and acidic ammonia from wastewaters

Stanford researchers developed an electrochemical reactor process that combines electrodialysis and membrane stripping, reduces the chemical inputs needed and expands recovered product portfolio to alkaline ammonia (for cleaning products) in ratios customized to a user's specific needs. Currently, few scaled-up nitrogen recovery technologies are available that can generate revenue from wastewater-derived products. The Tarpeh Lab's four-chambered electrochemical reactor is part of a portfolio of related inventions (S19-331, S20-348, S20-349, S23-336) that extract value from wastewater by reclaiming ammonia from contaminated wastewater streams.




**Process schematic of a four-chamber flexible electrochemical stripping (FECS) reactor for recovery of ammonium in wastewater as acidic ammonium and alkaline ammonia.**
(Image courtesy the Tarpeh Lab)

**Stage of Development – Proof of Concept**

# Applications

- Wastewater treatment and environmental protection
- Industrial ammonia recovery and resource recycling
- (Decentralized) fertilizer production

## Advantages

- **Versatile Ammonia Recovery**: ammonia recovered as acidic product (fertilizer) or alkaline ammonia (cleaning product), expanding the range of usable ammonia-based chemicals derived from wastewater.
- **Integrated Process**: Combining electrodialysis and membrane stripping within a multi-chamber reactor enhances the efficiency of ammonia extraction and reduces the need for separate treatment processes and chemical inputs needed during nitrogen recovery (less acid is needed if less acidic ammonium fertilizer is generated).
- **Sustainable** reuse of wastewater by converting nitrogenous compounds into valuable agricultural products.

## Publications


- Kogler, Anna, et al. Flexible Electrochemical Stripping for Wastewater Ammonia Recovery with On-Demand Product Tunability." *Environmental Science & Technology Letters 2024.*
- Tarpeh, W. A., Kogler, A., Clark, B. D., Liu, M. J., & Chow, W. (2024). *U.S. Patent Application No. 18/041,678*.
- Roberts, T. (2024). William Tarpeh taps the potential of polluted water. *Stanford News*. https://news.stanford.edu/stories/2024/10/william-tarpeh-creativity-leads-innovative-wastewater-transformations
- Tarpeh, W. A., Senesky, D. G., Lalwani, A. V., Holliday, M., Mu, L., Clark, B. D., Liu, M.J., Dong, H., & Guo, J. (2022). *U.S. Patent Application No. 17/642,902*.
- Guo, J., Liu, M. J., Laguna, C., Miller, D. M., Williams, K. S., Clark, B. D., B.D., Muñoz, C., Blair, S.J., Nielander, A.C., Jaramillo, T.F., & Tarpeh, W. A. (2024). Electrodialysis and nitrate reduction (EDNR) to enable distributed ammonia manufacturing from wastewaters. *Energy & Environmental Science, 17*(22), 8787-8800. DOI: 10.1039/D4EE03002H
- Tarpeh, W. A., Liu, M. J., & Clark, B. D. (2023). *U.S. Patent Application No. 18/041,769*.
- Miller, D. M., Liu, M. J., Abels, K., Kogler, A., Williams, K. S., & Tarpeh, W. A. (2024). Engineering a molecular electrocatalytic system for energy-efficient ammonia production from wastewater nitrate. *Energy & Environmental Science,*

*17*(15), 5691-5705. DOI: 10.1039/D4EE01727G
- Tarpeh, W. A., Liu, M. J., & Clark, B. D. (2023). U.S. Patent Application No. 18/041,769.
- Roberts, T. (2024). William Tarpeh taps the potential of polluted water. *Stanford News.*

## Patents

- Published Application: WO2022036326
- Published Application: 20240025776
- Issued: 12,709,560 (USA)

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