RENEWABLE NUTRIENTS

Innovative Nutrient Recovery Technologies

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- Renewable Nutrients is a privately owned US company currently commercializing exclusive, proprietary & patented nutrient recovery technologies in the municipal, industrial, and agricultural markets.

- Renewable Nutrients is a full service technology company with the capacity to license, sell, design, and build nutrient recovery technologies for full scale implementation

- Renewable Nutrients owns exclusive licenses for multiple USDA patents for **Phosphorus & Nitrogen** recovery technologies commercially known as Quick Wash®

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- Renewable Nutrients has redefined nutrient recovery with Quick Wash, a proprietary patented system that draws on exclusive patented technology to extract and recover **Phosphorus & Nitrogen** from municipal, agricultural, and industrial markets

- Renewable Nutrients has completed numerous Quick Wash pilots and trials in municipal, agricultural, and industrial applications and has effectively proven the performance of Quick Wash

- Quick Wash technologies are cost effective and completely customizable based on the costumers needs for nutrient extraction and recovery with the ability to focus on **Phosphorus & Nitrogen individually or as a combined recovery technology.**

- Quick Wash is poised to be the solution for treatment, recovery & recycling of high strength **Phosphorus & Nitrogen** waste streams in any food waste digestate, municipal sludge or centrate, agricultural applications, and other high strength waste streams

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IP Portfolio Summary

Patent	Description	Transformative Invention	Market Applicability
Phosphorus	Phosphorus extraction & recovery	**Yes** - moves facilities from simply sequestering P to biosolids to P extraction & recovery. Yields a recovered commodity (calcium phosphate)	Municipal Industrial Agriculture
Ammonia Liquid	Passive ammonia recovery from liquid waste streams	**Yes** – drives efficiency and reduces cost of nitrification/ de-nitrification operations. Yields a recovered commodity (ammonium sulfate)	Municipal Industrial Agriculture
Ammonia Gaseous	Passive ambient ammonia recovery from a gaseous ammonia-rich environment	**Yes** – potential to competley transform current costly ventilation practices in confined animal agriculature	Agriculture
Combined **Phosphorus & Ammonia**	Protects the IP when combining both phosphorus and ammonia recovery	**Yes** – aids in the operational efficiency of phosphorus recovery and yields two commodities (calcium phosphate & ammonium sulfate)	Municipal Industrial Agriculture

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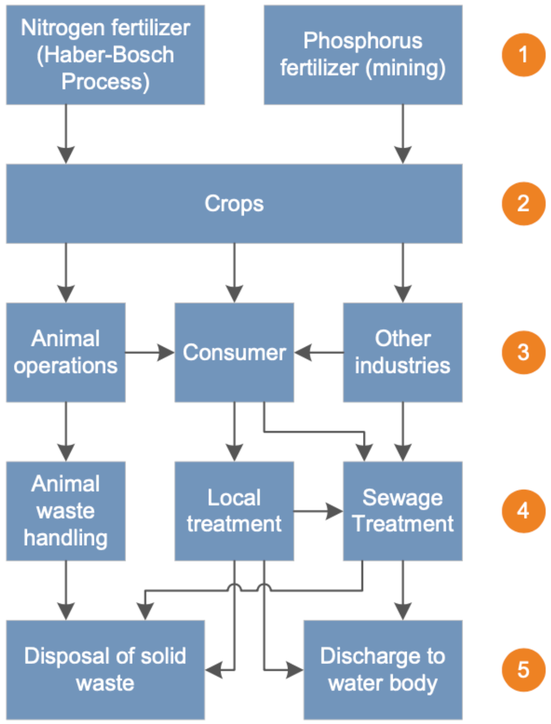
Opportunity for Market Driven Solutions

- More than 16,000 municipal waste treatment plants in US
- Animal production is a major component of the US economy
- Existing solutions to water treatment and disposal of animal waste are costly and ineffective
- Concern for public health risks and treatment costs of contaminated water supplies
- Increasing demand for fertilizer and nutrients and limited world phosphorus reserves
- Major environmental risks around important bodies of water like the Chesapeake Bay, Susquehanna River, Lake Michigan and the Gulf of Mexico etc.
- Current “old” technology does not produce usable and marketable co-products



General scheme of nutrient pathways

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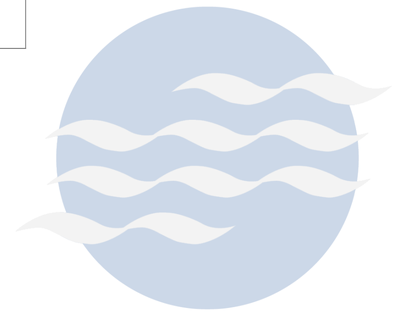
Competitive Technology Comparison

Nutrient Removal/Recovery Technologies

Characteristics	Chemical	EBPR	Algea	Struvite	Renewable Nutrients
	Alum, Ferric Chloride, Cerium Chloride	A2/), 4-5 Stage Bardenpho, Biological/ Chemical, SBR	Clearas, ABNR. Algae Wheel, Lagoon Settling Systems	Ostara, Multi-Form Harvest, CNP-Airprex, Phospaq, Crystalactor, NuReSys	QUICK WASH®
Side Stream vs Main Stream	Both	Side Stream	Mainstream	Side Stream	Both
Solids Stream Application	No	No	No	No	Yes
Phosphorus Removal	Yes	Yes	Yes	Yes	Yes
Phosphorus Recovery	No	No	Yes	Yes	Yes
Nitrogen Removal	No	No	No	No	Yes
Ammonia Recovery	No	No	No	No	Yes
Sludge Bulkin	Yes	Yes	No	No	No
Byproduct Recovered	N/A	N/A	Algae Biomass	Struvite Fertilizer	Calcium Phosphate - Hydroxylapatite / Ammonia Sulphate
% Efficiency of Recovery	N/A	N/A	>95%	45-90%	>95%
Scalability	Small to Large Facilities	Typically Larger Facilities >10MGD	Scales from small to large facilities	Large facilities - only economical when sidestream contributes large % of total P	Scales from small to large

"The EPA will actively promote those Municipal Biosolids management practices that provide for the beneficial use of Biosolids while maintaining or improving environmental quality and protecting public health" -- Federal Register Vol. 49, p 24358

Environmental Issue	Scope
Hazards of Disposing of Nutrient rich Waste Biosolids from Wastewater Treatment Plants	• (WWTPs) in U.S. generate approximately 7 million dry tons of sludge each year • Causes more pollution per acre than other "fertilizer" and 4x more phosphorous
Contamination from animal waste	• Over 10.2 million tons of poultry litter alone are generated in the US
Public Health Risks and Treatment Costs from Contaminated Drinking Water Supplies	• Current disposal methods result in contamination of surface waters • Problems compounded by population growth through increased storm water runoff, municipal wastewater discharges, and air carried pollutants
Limited World Phosphorus Reserves	• World will reach peak Phosphorus mining production in 50 to 100 years • Necessity to sustain life • No synthetically reproducible alternative for phosphorus; technology to extract and reuse phosphorus is appealing



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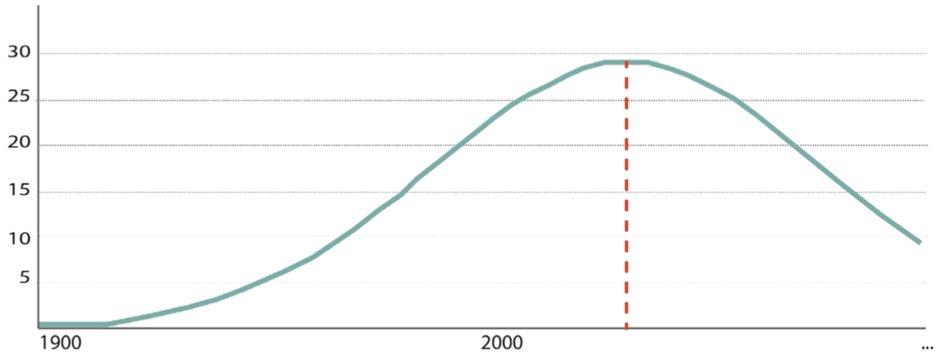
The Environmental Crisis

WORLD PHOSPHATE ROCK PRODUCTION (TONS)

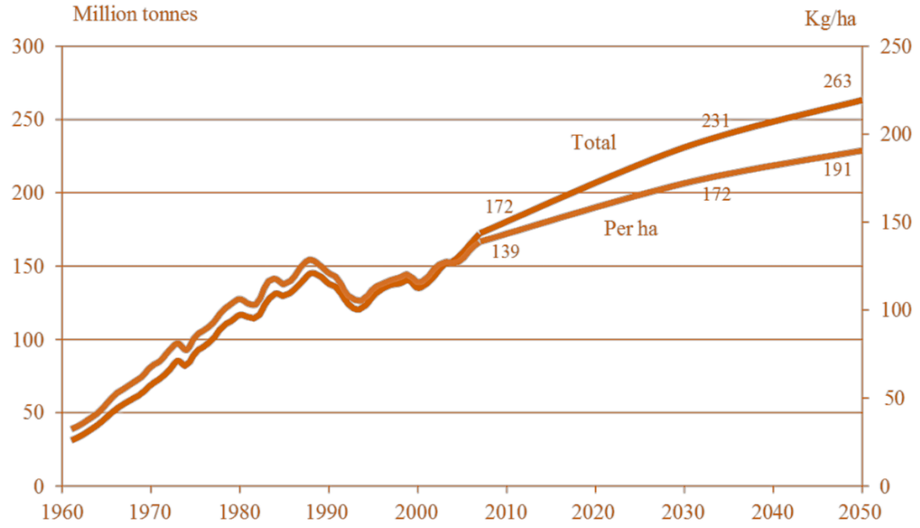
*Source: USGS

Demand for phosphorus has greatly expanded since 1960 and appears to be continuing on this trend



WORLD PHOSPHATE ROCK PRODUCTION (TONS)

Peak Phosphorus refers to a time when production reaches a maxcimum, and high quality, highly accesible reserves have been depleted



World fertilizer use: past and projected (nitrogen, phosphorus and potassium aggregated). Source: FAO, World

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Key Drivers for Adoption of Nutrient Recovery

Environmental	Regulatory	Operational
•Eutrophication of waterways •Drinking water concerns •Growth of toxic algae •Depletion of phosphorus reserves •Impact to fisheries, aquatic species, and food supply	•Facility operational permitting based on nutrient effluent management •Reduction of phosphorus effluent limits to < 1ppm and some will be required to reach “ultra-low” levels for discharge under 0.04 mg/l •Facilities operating near impaired waterways to see phosphorus effluent limits < 0.5ppm •Reduction in permitted “free ammonia” (NH_3) effluent levels •Farmers forced to store or dispose of animal manure vs land application	•Reducing the level of phosphorus in biosolids allows facilities and farmers to land apply vs dispose biosolids •Drives greater efficiency of biological nutrient removal by reducing overall phosphorus and nitrogen load in the facility •Eliminates costly struvite scaling •Reduced biosolids production •Incremental revenue gain through sale of recovered coproducts

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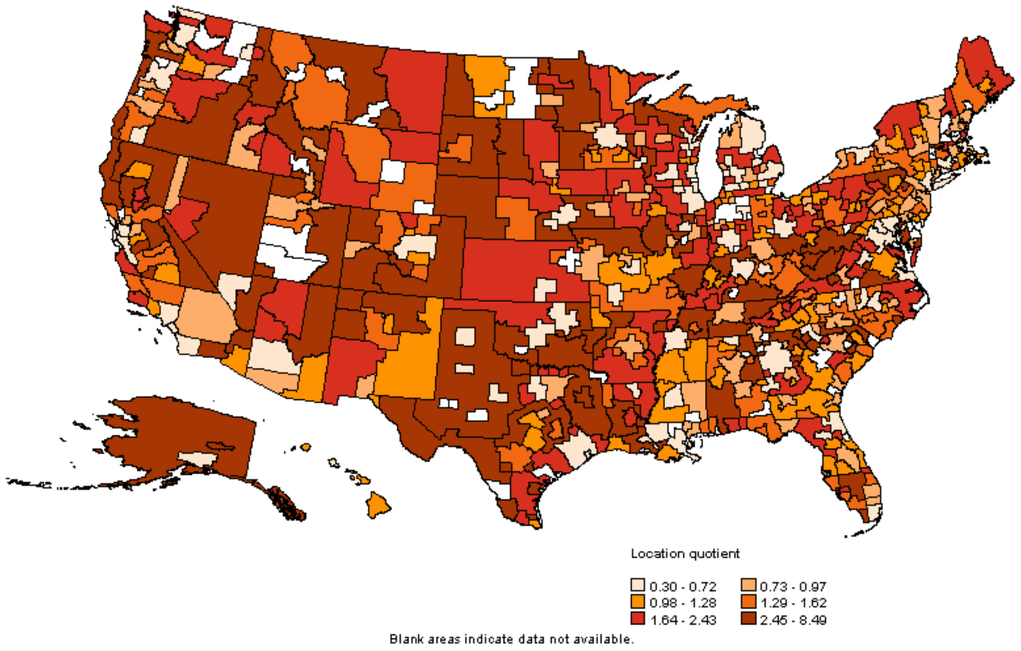
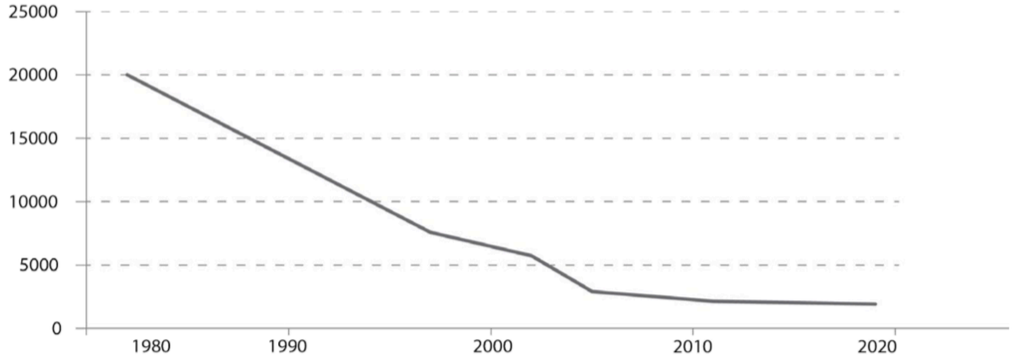
Key Drivers for Adoption of Nutrient Recovery

Municipal System Operators (16,000 +) are located across the entire United States, creating a market and customer base for Renewable Nutrients with regards to waste treatment.

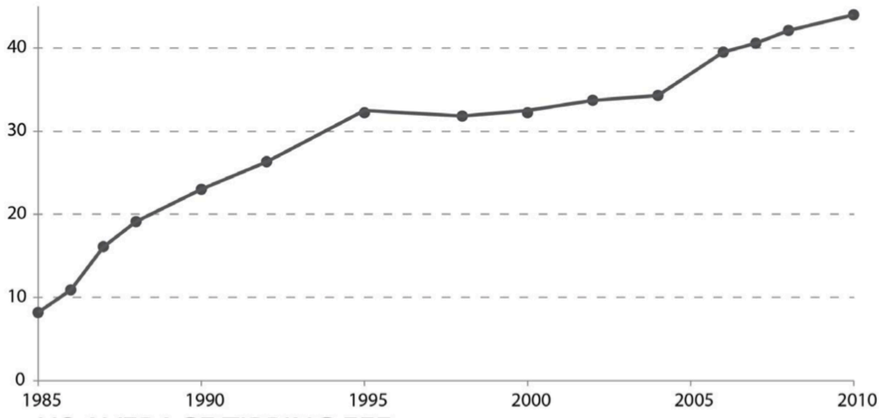




US LANDFILL DECLINE

*Source: Waste & Recycling News

The number of US landfill has been declining since the late 1970s,



US AVERAGE TIPPING FEE

*Source: Waste & Recycling News

The decreasing number of landfills has led to increases in tipping fees at an average of $1.24 per ton across the US each year. In the future, landfill may not be the least expensive biosolid management alternative

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Technology Summary

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Nutrient Extraction & Recovery

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USDA

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- A combined application of both **Phosphorus & Nitrogen** extraction and recovery technologies to solve the total nutrient issue for high strength streams without additional treatment steps
- The use of existing tankage, piping, and pumping is highly possible and recommended
- We anticipate that regulatory agencies will enforce more stringent discharge requirements for both **Phosphorus & Nitrogen**
- Economy of scale can be achieved by implementing both exclusive **Phosphorus & Nitrogen** technologies
- Renewable Nutrients is the only company with a combined IP protected **Phosphorus & Nitrogen** recovery offering in addition to individual **Phosphorus & Nitrogen** recovery solutions
- Utilizing Quick Wash technologies will enable the extraction, recovery, and reuse of valuable nutrients in an efficient and cost effective offering.

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- Side Stream from dewatering (aerobic or anaerobic)
- Solids Prior to dewatering
- Prior to thickening & anaerobic digestion
- Pre-treat a high **Phosphorus & Nitrogen** industrial discharge
- Animal agriculture applications
- Other custom configurations
- Renewable Nutrients has designed multiple process flow diagrams for different applications of the Quick Wash process

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Phosphorus Extraction Benefits

- Removes and recovers more than 95% of **Phosphorus**
- Reduce phosphorus concentration in high strength recycle streams such as digester supernatant liquid waste
- Reduce polymer & metal salts
- Reduce disposal costs
- Eliminate struvite scaling
- Increase revenue from sales of phosphorus by-product
- Meet EPA nutrient TMDL requirements

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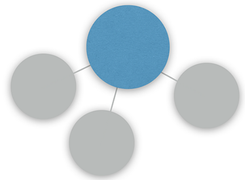
Nitrogen / Ammonia Extraction Benefits



- Removes and recovers more than 95% of **Nitrogen**
- Reduce inputs of energy, carbon, alkalinity
- Recover rather than destroy a valuable resource
- Produce a high quality, marketable ammonium compound product ie ammonium sulfate or ammonium citrate
- Improve the quality of the effluent by enhancing exiting nutrient removal processes
- Allow the reduction of ammonia alkalinity
- Potentially free existing capacity and allow the re-rating of treatment plants in lieu of additional capital investment
- Provide a solution for additional capacity in plants with limited footprint for expansion

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A Multitude of Intangible Benefits

Description	Discussion	Value
Ability to treat high-strength side stream digestate, centrate, filtrate without complex or expensive equipment	Depends on application. Compared to other technologies, the RN technology can serve as an enabling technology, solving the problems that are generated from anaerobic digestion	Possibly worth millions depending on specific project application and compared to alternative technologies
Production of beneficial use byproducts	Our standard design produces calcium phosphate and ammonium sulfate. Both are valuable and popular in the agronomics/agriculture sector for fertilizer and other uses.	We recognize the byproducts do not generate significant revenue. But they generate revenue rather than a byproduct that requires further cost for disposal. Value in tens of thousands to hundreds of thousands annually depending on system size
Elimination of struvite formation	Many agencies are struggling with the effects of scaling and struvite formation in piping, pumps, and equipment. By recovering the P, and not allowing it back into the plant to form struvite scaling.	Many agencies are spending hundreds of thousands, even millions, annually to mitigate struvite issues. The value of elimination of struvite is significant.
Small footprint	Unlike some technologies, the RN technologies do not require a great deal of space	Many other technologies are disqualified due to space requirements. Having a technology with a small footprint requirement may save significant project dollars.
Low cost of operations	The input chemicals are relatively inexpensive and the power costs are low. Depending on the hydraulic grade considerations for a specific site, much of the process can flow via gravity	Sulfuric acid is a low cost chemical in comparison to many, as is lime or caustic. Because this is a chemical solution, there are chemical costs, but they are simple, affordable chemicals.
Fast process	Compared to other technologies, the RN technologies are fast acting, therefore not requiring large tankage for long HRT's. This reduces CapEX and OpEx.	Compared to many, the RN technologies are fast. Speed is related to cost. The value in treatment costs is significant.
Major opportunity to reuse existing facilities	Existing tankage, pumps, and other facilities can be reused with ease to reduce costs	The equipment required for the technology is simple and is not proprietary. Therefore, existing tanks, mixers, pumps, piping and other facilities can be repurposed reducing project costs and saving money.
Flexibility in targets for performance	Adjustments in stoichiometric can allow for flexibility in performance and results and costs	Facilities can be sized and operated to achieve specific targets. The flexibility is valuable and allows for a system to follow changing conditions. The value of this flexibility is significant.
Technology is more robust than biological process - chemistry vs biology	With biology, a rogue contaminant, or rapid changes in conditions, can upset the active organism causing treatment failure. Chemistry is more predictable and reliable.	Other technologies that rely on bacteria, algae, microorganisms, or other biological presence have struggled to treat nutrient rich water (particularly) high strength due to the sensitive nature of the organisms. Having a reliable process that is more robust is priceless.
Processes will be more familiar to operations staff	Most operations staff are familiar with the use of pH modifications to manipulate treatment processes. Not much new to learn with RN tech.	Reduction in training and an acceleration in process acceptance has significant value.
Site specific Benefits	Depending on conditions and finanical opportunities ie. Insurance & nutrients trading	Potential to be game changing for a privately owned facility

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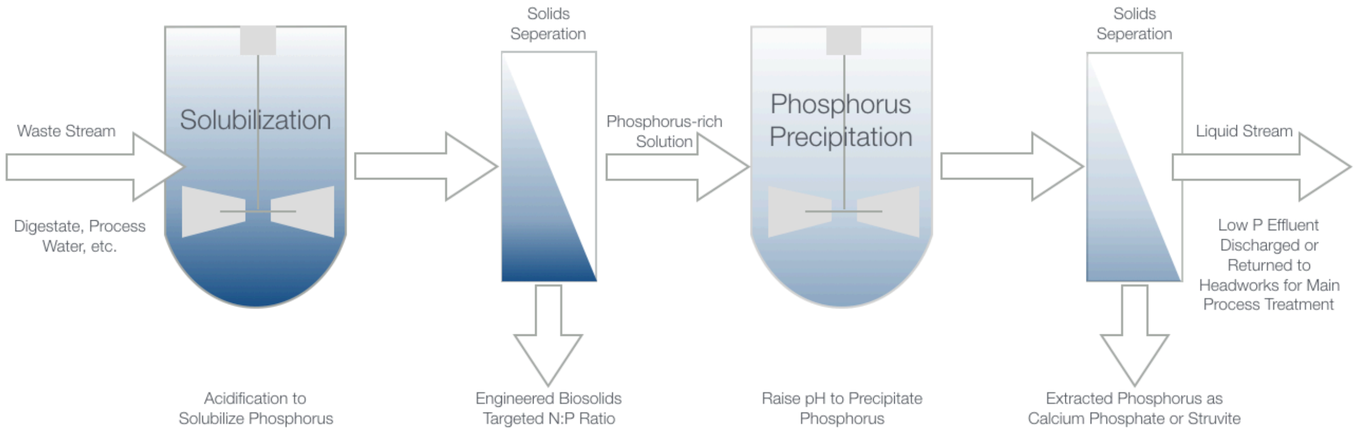
Quick Wash Phosphorus Extraction and Recovery extracts phosphorus from municipal, agricultural, or industrial waste streams in solids or liquids (effluent) and recovers the phosphorus in the form of Calcium Phosphate or Struvite.



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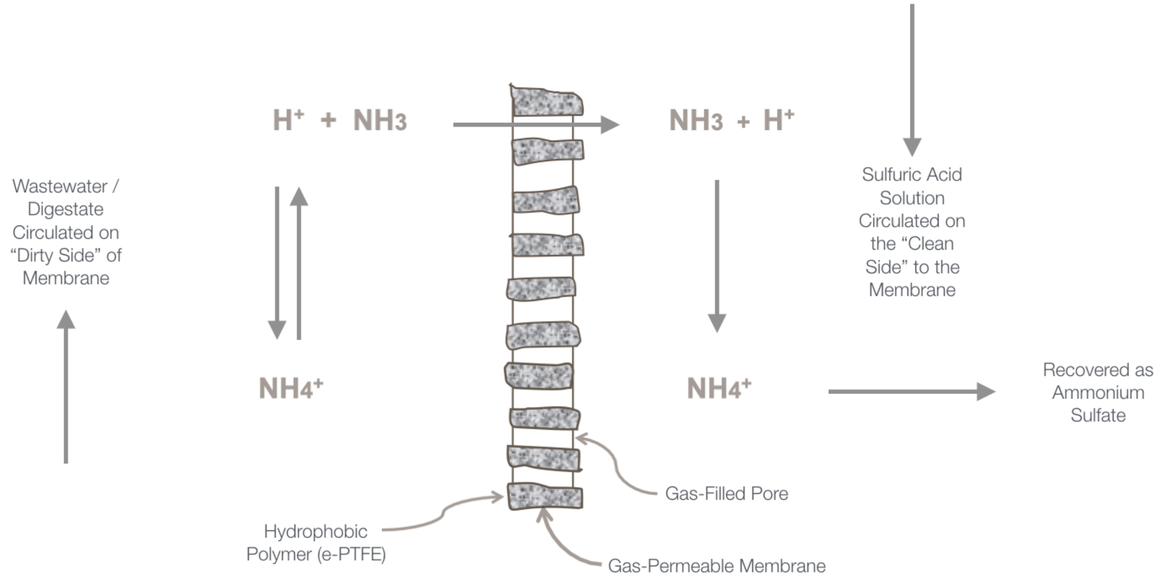
Nitrogen / Ammonia Introduction
Liquid & Gaseous

- Ammonia **LIQUID** technology relates to a system and methods for the removal, recovery and use of ammonia from ammonia-containing liquid effluents such as animal and municipal wastewater.

- Ammonia **GASEOUS** technology relates to a system and method for the removal of gaseous nitrogen to reduce emissions from systems that produce gaseous nitrogen.



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Pilot/Trial & Data Summary

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Pilot/Trial Large Scale Locations

Facility	Size	Type	Treatment
Ephrata, PA	2 MGD	Municipal	Solid Stream - Feed to BFP
Westminster, MD	5 MGD	Municipal	Solid Stream - Feed to Dewatering
Raleigh, NC	60 MGD	Municipal	Side Stream - Filtrate from BFP
Greenville, NC	14 MGD	Municipal	Side Stream Filtrate from BFP & Solid Stream - Feed to BFP
Chapel Hill, NC	8 MGD	Municipal	Side Stream - Filtrate from Rotary Press & Solid Stream - Feed to Rotary Press
Walk Stock Farm, IL	Pit	Agrigultural	Raw Swine Manure - Pit
Fertilizer Manufacturer, PA	Industrial	Industrial	Byproduct of Manufacturing Process
Smithfield Foods, NC	Lagoon	Agricultural	Raw Swine Manure - Lagoons
Waste to Energy Project, OH	40 KGD	Industrial	Animal Waste Digestate
Perrysburg, OH	8 MGD	Municipal	Side Stream - Filtrate from BFP
Mercer County, OH	Pit	Agricultural	Raw Swine Manure - Pit

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Pilot/Trial Sample Bench Locations

Facility	Type	Treatment
Big Ox Energy	Industrial	Animal Waste Digestate
CleanBay	Industrial	Animal Waste Digestate
Abtech	Industrial	Digestate
Feed Energy Corp	Industrial	Animal Waste Digestate
Chicago (MWRD), IL	Municipal	Side Stream - Filtrate from BFP
Denver, CO	Municipal	Side Stream - Filtrate from BFP
Canton, OH	Municipal	Side Stream - Filtrate from BFP
Algonquin, IL	Municipal	Side Stream - Filtrate from BFP
Canton, OH	Municipal	Side Stream - Filtrate from BFP
West Goshen, PA	Municipal	Side Stream - Filtrate from BFP
Charlotte, NC	Municipal	Side Stream - Filtrate from BFP

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Sample Municipal Performance QWP

Facility	P Extraction %	P Recovery %	Stream Characteristics
Raleigh, NC	98%	>99%	Side Stream - Filtrate from BFP
Greenville, NC	98%	>99%	Side Stream Filtrate from BFP & Solid Stream - Feed to BFP
MWRD	95%	>99%	Post Centrate Stream
Chapel Hill, NC	99%	>99%	Solid Stream BFP

SUBURBAN TESTING LABS

Select 3rd Party Laboratory Analytical Results
Select On-Board Pilot Analytical Results
Quick Wash Pilot Operations

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Sample Agricultural / Industrial Performance QWP

Facility	P Extraction %	P Recovery %	Stream Characteristics	Situation
Walk Stock Farm, IL	89%	>99%	Raw swine manure in sow and finisher pits	Desire to expand and operation, but limited by land availability to apply manure due to P restrictions
Fertilizer Manufacturer, PA	56%	>99%	Dewatered poultry litter	Recover P to mix into custom liquid fertilizer blends for specific markets
Smithfield Foods, NC	81%	>99%	Raw swine manure in lagoon	Beneficial reuse of P for applications beyond fertilizer
Waste to Energy Project, OH	88%	>99%	Swine Manure digestate	Remove P at Waste to Energy Facility prior to effluent discharge

SUBURBAN TESTING LABS

Select 3rd Party Laboratory Analytical Results
Select On-Board Pilot Analytical Results
Quick Wash Pilot Operations

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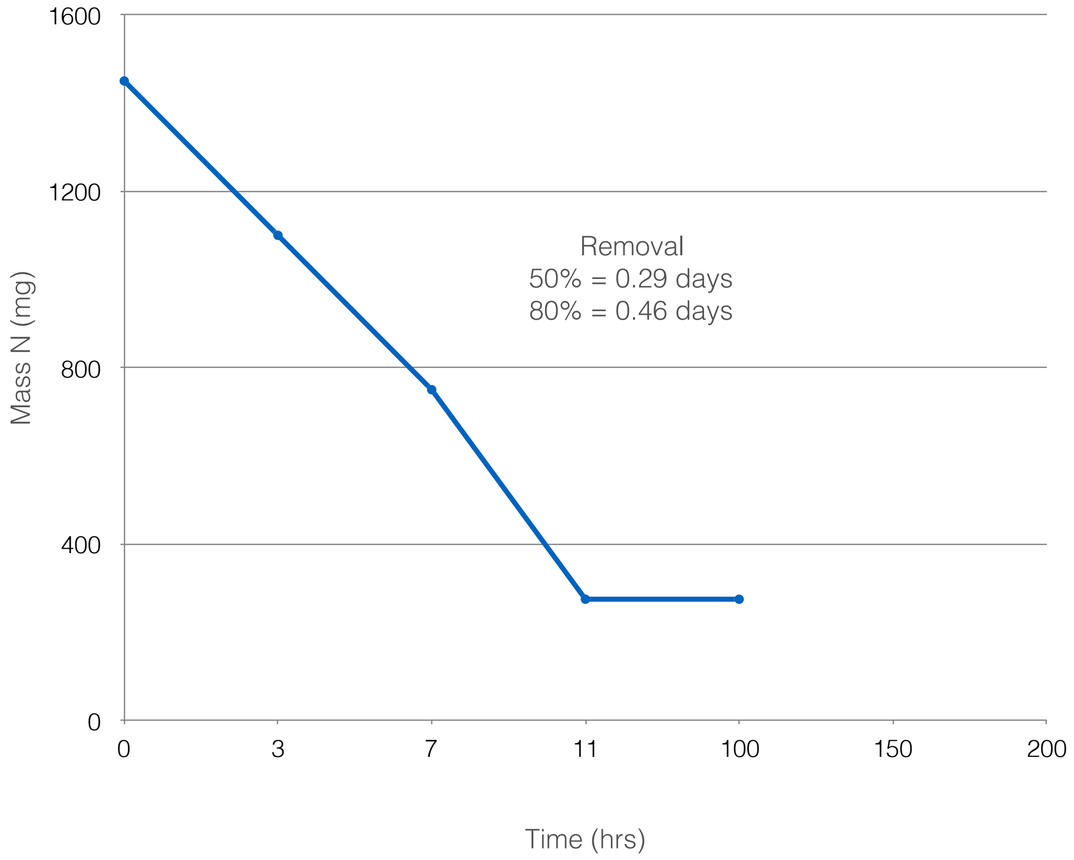
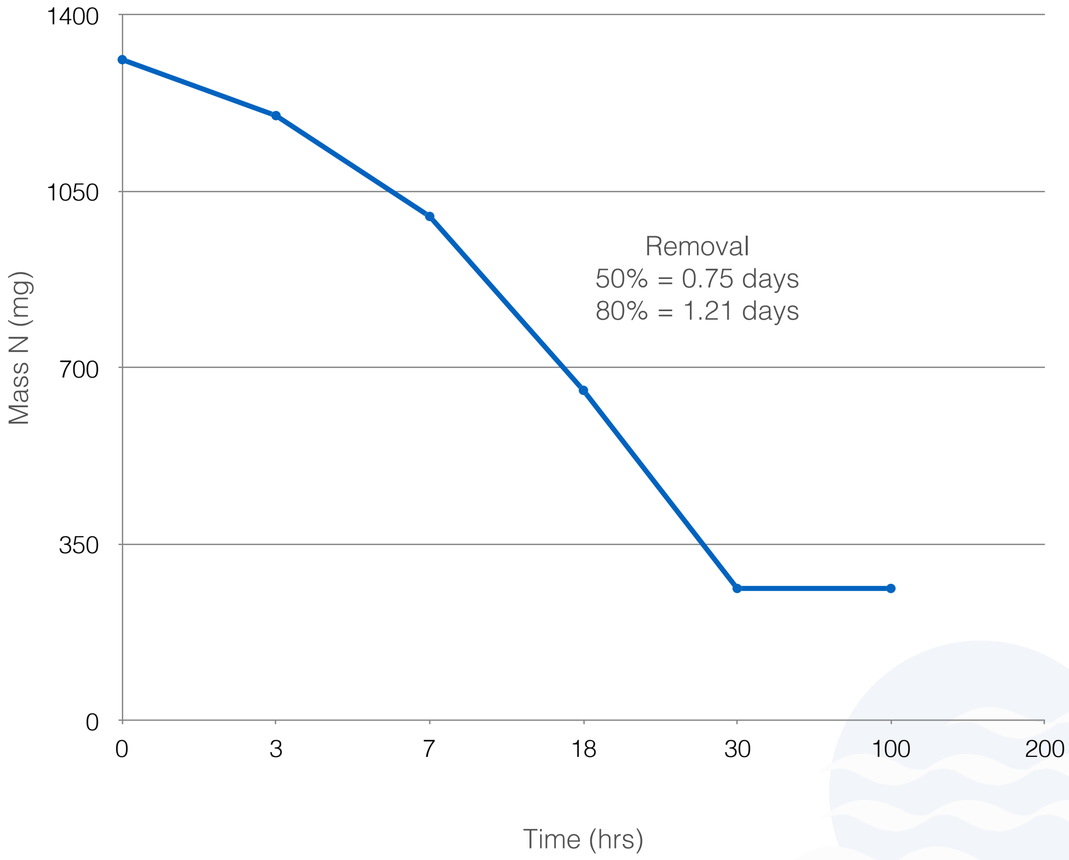
Sample Municipal Performance - Side Stream QWN





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"Leading the way in nutrient recovery"